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Cloud-Based E-Learning Platform: From the Perspective of 'Structure' and 'Interaction'

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***Abstract* – Cloud computing is the use of computing resources (hardware and software) that are delivered as a service over a network (typically the Internet) while E-Learning is the currently fashionable term used to describe the diverse use of information and communications technologies to support and enhance learning, teaching and assessment from resource based learning. E-learning system is a welcome idea in this modern day life, because the massive proliferation of affordable computers, Internet broadband connectivity and rich education content has created a global phenomenon in which information and communication technology (ICT) is being used to transform education. This paper merge cloud-computing and e-learning to presents the design and implementation of cloud-based e-learning platform for scientific subjects. We use the three core science subjects (physics, chemistry and biology) as test bed for this research work. The choice of programming language is PHP (Hypertext pre-processor) for server-side scripting, Action script and Macromedia-Flash for media content authoring and MySQL as the back-end database.**

***Keywords* – E-learning System, Cloud Computing, ICT, Science Subjects, Education, PHP.**

I. INTRODUCTION

The massive proliferation of affordable computers, Internet broadband connectivity and rich education content has created a global phenomenon in which information and communication technology (ICT) is being used to transform education. One of the major areas of application of ICT in modern day educational system is e-learning. E-Learning is convenient and portable and does not need physical attendance. Learning is self-spaced. One can study at home, work or on the road, one can read materials online or download them for reading later [12].

E-Learning is the currently fashionable term used to describe the diverse use of information and communications technologies to support and enhance learning, teaching and assessment from resource based learning (in which students carry out face-to-face tasks supplemented by a range of online resources) to fully online courses [6].

E-learning platform could be used as a tool to decongest student's population in schools, and therefore eliminate all forms of problem associated with overpopulation of students in our institutions of learning [12]. Among the learning technologies, e-learning offers several benefits over conventional classroom-based learning. Its biggest advantages are the reduced cost since a physical environment is no longer required and therefore it can be used at any time and place for the convenience of the student. Additionally, the learning material is easy to keep updated and the teacher may also incorporate multimedia content to provide a friendly framework and to ease the understanding of the concepts. Finally, it can be viewed as a learner-centered approach which can address the differences among teachers, so that all of them may check the confidence of their material to evaluate and re-utilize common areas of knowledge [8].

The cloud computing term was derived from the way the Internet is often represented in network diagrams. Due to the fact it involves the existence of data centre's that are able to provide services; the cloud can be seen as a unique access point for all the requests coming from the world wide spread clients. Cloud computing comprises of three layers infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (SaaS). The customers are renting or simply accessing the needed processing capacity from the data centre using any of the services mentioned. The quality of the service becomes a crucial factor of the cloud computing success [11].

At present, most of the conventional education forms are becoming not being suitable for requirements of social progress and educational development and not being able to catch up with the changes of learning demand in time, thus e-learning via computer networks have brought opportunities for meeting the modern needs of students and educational administrator.

This research work aim at designing and implementation of e-Learning platform that uses cloud computing layers through which students or learners could study offline (study without the cloud owners or his/her representative) and online (study with life interaction with owners of the cloud/representative).

When this work is completed, the cloud could be rented, by individual instructor, institutions of learning or individual learners in area of science-based subjects.

Purpose of Study

Many education institutions do not have the resources and infrastructure needed to run top e-learning solution. E-learning is widely used today on different educational levels: continuous education, company trainings, academic courses, etc. The purpose of this research work is to design and implement a form of cloud-based learning platform that will be readily available to the researchers, institutions of learning in area of sciences.

Objective of Study

- Providing access to a range of resources and materials in science subjects.
- It allows students to study at their own pace.
- It provides a student centered learning environment which can be tailored to meet the learning needs of individual students; creating an environment that promotes an active approach to learning.

- Support increased communications between stakeholders in education

Scope of the Study

The scope and area of study is limited to design and implementation of cloud-based learning system for science subjects that will be using audio-visual technique which allows clients; students to learn in both offline and online fashion, instructors to upload their lessons for learner to access etc. It is specifically targeted at high school students, teachers and administrators.

Significance of the Study

This research work when completed and implemented, it will add values to scientific education in many ways;

- It will help to decongest the population of students in school. Therefore eliminate or reduces all problems associated with students population congestions in our schools
- It will enable students to prepare for any scientific related exams within the scope of the research work.
- It will reduce the cost of learning of scientific subjects in schools.
- It will make learning material in area of sciences easily accessible to the science students and instructors

II. LITERATURE SURVEY

A. E-learning Technologies

E-Learning provides a range of technologies including: Generic software applications, which includes word-processing, databases, and Spreadsheets, as well as statistical and qualitative data analysis tools. Students can use these to develop their skills and understanding, develop ideas and hypotheses, and present their results and findings. Presentation technologies, which are widely available, include software such as Microsoft PowerPoint, digital projectors, and interactive whiteboards. The World Wide Web (or the Web), which provides access to a range of digital resources including online libraries, journals, databases, and datasets. The Web can form the basis of many types of learning such as resource, enquiry, or problem based learning [9].

Computer Mediated Conferencing (CMC), which includes e-mail, discussion boards, bulletin boards, and chat tools. CMC can be used to support many types of discursive or collaborative activities. Multimedia materials, which include graphics, pictures, photographs, animations, film, video, and sound. Multimedia can support a variety of student learning styles - some students prefer to read, some to watch, some to listen and some to experience [10].

Computer Assisted Assessment (CAA) is automated, online objective testing. This can be automatically marked and can provide immediate and individual feedback to students. Computer Assisted Learning (CAL) or Computer Based Learning (CBL) simply means any use of a computer to support learning. The most common use is for online tutorials, which can combine text, animations, sound, video, quizzes, and feedback, in a structured framework. Students usually navigate CAL tutorials in small, guided steps to develop their knowledge and understanding of a topic [1].

Audio conferencing and Videoconferencing involve the use of audio and visual communication, via phone lines or the Web. These can be used with applications, such as Microsoft NetMeeting, which allow you to simultaneously conference, edit documents, communicate via chat, and design a product on the shared online whiteboard.

B. Cloud Computing Technologies

Cloud computing is the use of computing resources (hardware and software) that are delivered as a service over a network (typically the Internet). The name comes from the use of a cloud-shaped symbol as an abstraction for the complex infrastructure it contains in system diagrams. Cloud computing entrusts remote services with a user's data, software and computation [17].

C. Cloud Based Learning

Essentially, the Cloud is a notion of a group of computers acting as one - and all connected to a network (and usually, the World Wide Web). Further, the Cloud is a model of computing that allows for scaling of resources based upon real-time needs. So, if there are many users utilizing the system, a larger number of resources will be called upon to help distribute the load [4].

Cloud based learning takes the notion of a perpetual, universally accessible, scalable network of computers and applies it to electronic learning - everything from online classrooms at accredited universities, to smaller training modules to be used within companies or other private enterprises. With this technology, learners can access their tools from any computer, regardless of platform, as long as the computer is able to connect to the cloud. Further, as there are spikes in traffic or as the amount of resources available to the users of the system grow, the system automatically adjusts to the need, ensuring that the overall user experience remains relatively the same [2].

D. E-Learning Using Social Network

Social networking sites have become a vital platform to connect people not only to digital knowledge repositories but also to other people. Currently it is estimated that over 300 million people use social software, and that number is still growing. Social software is an element of Web 2.0 technologies that enables the formation of networks between people in order to share and create new forms of social knowledge. These networks offer a way for people around the world to communicate and collaborate with each other. These people usually share a common interest, or simply seek to meet new people. There are also social networks that are formed around content such as YouTube and Flickr where videos and images are the objects of interests [13].

Furthermore, social sites such as Facebook and MySpace have become extremely popular with Internet users, in part because of the simplified interfaces they provide to desired capabilities. Simple yet powerful interfaces are extremely valuable as they make the power of IT accessible to almost everyone, with little or no training required [3].

In addition to social networking, currently several social software provide a platform that enables users to build social applications. In May 2007, Facebook was the first to release an application development platform which

provides an API that allows third party applications to be integrated into Facebook. Users are easily able to access and share a large variety of applications. Users like choice of applications as it enables them to personalize their experience, without requiring application providers to do extra work. As an indication of the perceived value of the application development platform, many other social networking sites have followed suit. Friendster, MySpace and hi5 have recently launched their application development platforms. Applications developed using the Open Social API, which is expected to have a widespread deployment on all of the sites that support the API, this is in contrast to the proprietary platform being used by Facebook [14].

The other elements of Web 2.0 technologies such as blogs, wikis, RSS feeds, instant messaging, and virtual office applications, provide Internet users with easier mechanisms to produce Web content and to interact with each other. These technologies enhance interactive communication and collaboration among participants who either possess related learning resources, or can help to discover and obtain the resources, or are willing to exchange and share the resources with others. Social interaction within an online framework can help university students share experiences and collaborate in relevant topics. As such, social networks can act as a pedagogical agent, for example, with problem-based learning. It would likely also appeal to the new generation of students, who are very well familiar with Web 2.0 technologies.

E. E-LEARNING Platforms

A number of organizations and educational institutions use learning platforms to deliver and manage their learning processes [16].

A learning platform is a set of interactive online services that provide learners with access to information, tools and resources to support educational delivery and management through the Internet. There are a variety of learning platforms with different levels of complexity, but their most important features include:

Learning content management - creation, storage, access to resources.

Curriculum mapping and planning - lesson planning, personalized learning experience, assessment.

Learner engagement and management - learner information, progress tracking Tools and services - forums, messaging system, blogs, group discussions [18].

Learning platforms are usually referred to as virtual learning environments (VLEs) or learning management systems (LMSs). These terms are often used interchangeably, and despite differences between these platforms, they have many features in common. Virtual learning environments, or VLEs, are used to simulate traditional face-to-face classroom activities and facilitate teaching and learning with a strong collaborative component. Examples of VLEs are Moodle and Blackboard.

A learning management system, or LMS, solution facilitates delivery and management of all learning offerings, including online, virtual classroom and instructor-led courses. It automates the learning course and easily delivers training, manages learners and keeps track of their progress and performance across training activities, which reduces administrative overhead [7].

F. E-Learning Tools

E-learning sometimes termed computer-based training (CBT) includes all forms of electronically or technologically supported learning and teaching, including educational technology. The information and communication systems, whether networked learning or not, serve as specific media to implement the learning process.

E-learning often involves both out-of-classroom and in-classroom educational experiences via technology applications and processes such as Web-based learning, computer-based learning, virtual education opportunities and digital collaboration. Content is delivered via the Internet, intranet/extranet, audio or video tape, satellite TV, and CD-ROM. It can be self-paced or instructor-led and includes media in the form of text, image, animation, streaming video and audio. It is commonly thought that new technologies can make a big difference in education process [15].

III. RESEARCH METHODOLOGY AND FRAMEWORK

A. Data Collection Method

The form of data collection method used was an in-depth interview with local education authority and the office of the registrar of West African Examination Council.

B. Data Collected

During the course of this research, we were able to gather information about the core science subject (physics, chemistry and Biology) for senior secondary schools in Nigeria. The curriculum was tailored to meet the requirement for student to excel in the final examinations as well as the entrance examinations into the tertiary institutions.

C. Analysis and Design of the Proposed System Description of its Components

The e-learning system cannot completely replace teachers; it is only an updating for technology, concepts and tools, giving new content, concepts and methods for education, so the roles of teachers cannot be replaced. The proposed e- learning cloud architecture can be divided into the following layers:

1) Infrastructure layer is composed of information infrastructure and teaching resources. Information infrastructure contains Internet/Intranet, system software, information management system and some common software and hardware; teaching resources is accumulated mainly in traditional teaching model and distributed in different departments and domain. This layer is located in the lowest level of cloud service middleware, the basic computing power like physical memory, CPU, memory is provided by the layer. Through the use of virtualization technology, physical server, storage and network form virtualization group for being called by upper software platform. The

physical host pool is dynamic and scalable, new physical host can be added in order to enhance physical computing power for cloud middleware services.

2) Software resource layer mainly is composed by operating system and middleware. Through middleware technology, a variety of software resources are integrated to provide a unified interface for software developers, so they can easily develop a lot of applications based on software resources and embed them in the cloud, making them available for cloud computing users.
3) Resource management layer is the key to achieve loose coupling of software resources and hardware resources. Through integration of virtualization and cloud computing scheduling strategy, on-demand free flow and distribution of software over various hardware resources can be achieved.
4) Service Layer has three levels of services namely, SaaS (Software as a service), Paas (Platform as a service), IaaS (Infrastructure as a service). In SaaS, cloud computing service is provided to customers. As is different from traditional software, users use software via the Internet, not to need a one-time purchase for software and hardware, and not to need to maintain and upgrade, simply paying a monthly fee.

The system design will be based on the proposed model and flowchart in figure 1 and 2:

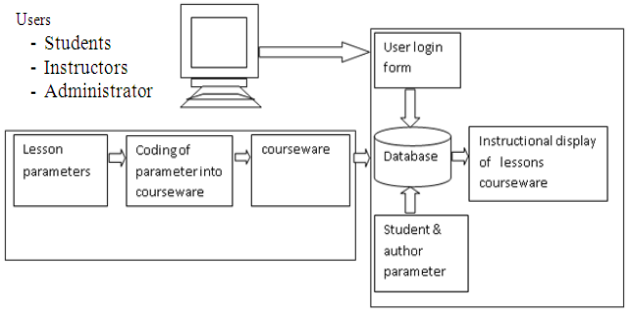

Fig.1. System architecture

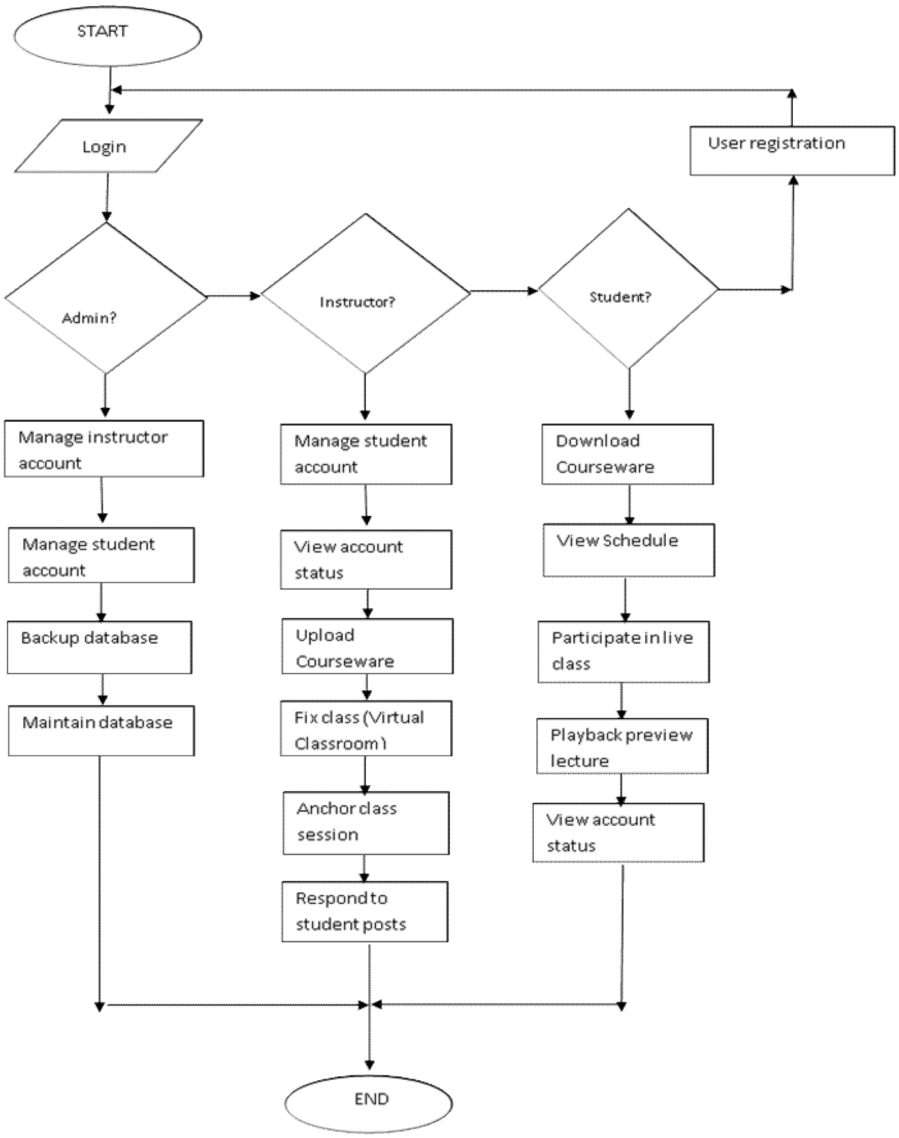

Fig.2. System Flowchart

IV. Design and Implementation

A. Choice of Programming Language

The cloud support learning system needs to effective and efficient. Also it should deliver content at real-time, as such a robust, efficient and easy to use programming language is required to develop the solution. The choice of programming language is PHP (Hypertext pre-processor) for server-side scripting, Actionscript and Micormedia-Flash for media content authoring and Mysql as the back-end database. Also, the above mentioned technologies are open-source technologies and are available for download for free.

B. Input Design

The input design depicts the means in which users in general introduce data to the system for processing. These are initial part of the graphical user-interface which allows the user to interact with the system without necessary following a particular order. The user interaction with the system begins with the login form to collect the user's login credential and validates against the database. The credential are verified and validated by determining the roles each user can play in session. After a successful access to the system the user is greeted with a portal which serves as the dashboard. From here, the user can continue interaction with the system based on the predefined role. New users can find a link to a register and login to the system.

C. Roles Perform by Users

The input stage allows the users (Students, Instructors and System-Administrator) to login. New users can register. Students can download courseware (material such as ebooks, audiobooks, videos, presentations etc), view instructor schedule and participate in live classroom. Students can post questions to the instructors and participate in forum. Instructor can upload courseware, schedule class, initiate a class session and respond to questions from the student.

D. Source of input to the system

The major source of input to the system include the mice-for initiating user initiating commands, the keyboard-for entering data in to the system through the forms provided and the digital camera/microphone for capturing video and audio data. Below are the screen-shot of interface that support user input.

Fig.3. Demo scene login menu

Fig.5. Demo scene of Registration form

E. Output Design

The output defines the way the system responds to users interactions. It shows the various means it uses to present information to the users for decision making. The system presents information to users based on their roles. New users can get a confirmation or error message during the course of registration. The student can view or download courseware or participate in a live virtual classroom anchored by the instructor. The instructor can view report of number of student participating in the class session and also responds to questions or comments. The outputs are presented through monitor/display screen, speakers and printer (i.e hard copy). Below are screen-shot of the output.

Fig.4. Demo scene of Instructor Portal

F. Implementation

This stage involves the various aspects that would be considered in order to put the new system to proper use and for it to deliver effectively and efficiently. It considers the factors that affect the successful running of the new system which includes: hardware requirement, software requirement, humanwares (users), testing, and documentation.

Fig.6. Demo scene for live class

Hardware Requirement

The infrastructure needed to run this E-learning solution include high computation capability (i.e CPU) due to client request and media processing(ie streaming) , large volume of storage devices in measure of terabyte (TB) to host large media files, large bandwidth due to traffic or high contention. The aforementioned facilities are provided by the cloud at a rent. However, the clients/users (the admin, instructors and students) accessing the solution should have the following minimum requirements

- A multimedia ready personal computer (PC) or Personal Digital Assistant (PDA).
- A small dedicated server (not compulsory)
- Digital Camcoder/Camera to capture video
- Headset/Speaker to play sounds
- A modem/DSL for internet connection
- A microphone to capture audio

Software Requirement

As mention above, the software platform to host the application is provided by the cloud, but the clients/users' needs the following:

- An advanced operating system (windows, linux or mac)
- An updated web browser with flash player
- An updated direct for media processing.

Humanware

These are the various people who can access this new system i.e. the administrator, instructors and students who all need to have the basic knowledge of how to use the system.

V. Conclusion

A cloud-based e-learning system is a welcome idea in this modern day life, because the massive proliferation of affordable computers, Internet broadband connectivity and rich education content has created a global phenomenon in which information and communication technology (ICT) is being used to transform education. This paper presents the design and implementation of cloud-based e-learning platform for scientific subjects. The system is design in such a way that learners can study at their own pace with or without instructor and can also switch from one instructor materials to another when studying offline. Students can also study online directly with the instructor after booking an appointment. This system will enable some busy students to study on their own and also serve as alternative platform for learning after school hours for science-based students.

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