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A COMPARATIVE STUDY ABOUT ECOSYSTEM IN E-LEARNING BASED ON CLOUD COMPUTING: A THEORETICAL APPROACH

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A Comparative Study about Ecosystem in E-Learning Based On Cloud Computing: A Theoretical Approach

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Abstract – Cloud computing is all about implementing processes online instead in our local gadgets. Data and process could be done online without the need of any local software or client. It refers to application delivered as a service over the internet (SaaS), the hardware and system software in the data centers that provide those services (PaaS) and Infrastructure as a service (IaaS). This paper discusses on what cloud computing is all about, itsvarious delivery models, its advantages and disadvantages. The heart of the paper contains the idea which is been proposed with the motive of promoting e-Learing to the student community in a much easier way (Community cloud computing). In short, the introduction of e-learning through Cloud Computing. This is then further made hardware simplex using wireless technology. In the above application SaaS delivery model is used. Many companies and educational institutes abroad are just beginning to realize the benefits of cloud computing applications that have traditionally required concurrent site licensing which is a type of software license that allows the user to install a software package in several computers at a particular site or facility. Depending on the amount of price paid, the license may be unlimited or may limit simultaneous access to a certain number of users, installation and subsistence.

Research community has believed that an e-learning ecosystem is the next generation e-learning but has faced challenges in optimizing resource allocations, dealing with dynamic demands on getting information and knowledge anywhere and anytime, handling rapid storage growth requirements, cost controlling and greater flexibility. Additionally, e-learning ecosystems need to improve its infrastructure, which can devote the required computation and storage resources for elearning ecosystems. Cloud computing technologies although in their early stages, have managed to change the way applications are going to be developed and accessed. These technologies are aimed at running applications as services over the internet on a flexible infrastructure.

Cloud computing provides a low cost solution to academic institutions for their researchers, faculty and students. This setup provides an additional benefit because all browsers based applications can also be accessed through mobile devices in addition to being available to a variety of laptop and desk top computers, provided internet access is available. In this paper we combined various technologies to achieve this goal. We present an interactive tool that can be used for science education; integration between cloud computing as a platform and web 2.0 are presented as a solution for building effective e-learning ecosystem.

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INTRODUCTION

In this competitive era, education has become equally demanding and competitive. Due to innovation, it create a new ways of learning. E-learning is playing more and more important role in our learning. E-learning is basically computer-based learning and Web-based learning. Actually in traditional learning we have short supply of resources, but at that same time they also provides a lot of benefits to students like monitoring and examination of students, face-to-face, static time and static location.

To overcome these problems of scarcity of resources used in learning process, E-learning came into existence. Students can study at any time and at dynamic location. They can also use various services like chat, e-libraries, message box, and web-links. E-earning is the way through we which can share information, gain knowledge in a easy way through computer and technology resources. By using the internet technology we can improve our performance, enhance our quality in every aspect. The students and learners can enjoy give and take process of learning. In traditional learning process we have so

many benefits like static time, location for studying and face to face communication .The teacher can easily supervise the students and understand their behaviour. But as the technology grow there are lot of benefits are offer to learning process like studying at any time, cost benefits, abundance learning material and problem of location not any more. The user can gain the knowledge in a better way. E-learning provides them various tools like discussion forums, chat message box, list of courses offered, multiple choices, glossary references, web links, e-library, different students from different location can easily communicate with each other. Every interaction is carried out in friendly and interactive way. This is absolutely web based collaborative system. So there are different tools for administration, teacher and students for handling communication and scattered the knowledge to each other in a better way.

Cloud computing is a new way of referring to the use of shared computing resources. In IT world, we always talk about cloud computing. Cloud computing provides a lot of solutions to the problems of various companies and institutions in variegated ways. Cloud computing is portray by internet-driven economics. It totally provides the user's high level of abstraction to the users without knowing the underlying structure. It is an emerging delivery model.

The marked feature of cloud computing are that it totally reduces cost of entry, so capital investment is totally zero for the user, users can enjoy the services in run time and minimum response time. Moreover, they have to pay according to their usage. They pay only for the resources which they acquire and use. They provide greater efficiency, productive, improve quality, improve service delivery and control. They have the capability of storing the data in giga bytes.

Cloud computing is totally increasing innovation, lowering cost; it can be used to assemble the application in a minimal time, including server, technology and network.

We can rent a server, load a software on it use it and turn off. Cloud computing is the next generation of network. It totally increases efficiency and free owner from the risk of investment in physical infrastructure. It increases the speed and ability with which services are deployed on demand, open source software. Cloud computing has changed the things by updating deploy, scale, maintain and pay for applications and the infrastructure for their use. By using cloud computing, we can enhance our working, create more flexibility and give numerous qualities in e- learning.

During the last years, the nature of the Internet was constantly changing from static environment to a highly dynamic environment that allows end users to run software applications collaborate, share information, and creates new services online. There is no doubt that the future belongs to the cloud computing. This new environment supports the creation of new generation of e-learning ecosystem that is able to run on a wide range of hardware devices, while storing data inside the cloud.

The need for e-learning is increasing constantly and the development and the improvement of the e-learning solutions is necessary. Also, the e-learning systems need to keep the pace with the technology, so recently research community has believed that e-learning ecosystem is the next generation of e-learning and the new direction is building and hosting e-educational system into the cloud. Also, there are several tools that offer support for e-learning ecosystem among this tools web 2.0.

Web 2.0 has changed the World Wide Web from the original traditional publishing model of information into a collaborative information creation model. The great diffusion of Web 2.0 as new instrument is having strong effect and change on the way people search, find, collaboratively develop and consume information and knowledge.

Today people are extensively using some of the Web 2.0 applications such as Wikipedia, YouTube and Twitter to create and share information. Cloud Computing presents a new way of deploying applications. Today we can get Infrastructure as a Service (IaaS), Platform as a Service (PaaS) or Software as a Service (SaaS). There are elastic clouds where memory and processing power get allocated based on computing resources required at the time.

AN E-LEARNING ECOSYSTEM BASED ON CLOUD COMPUTING INFRASTRUCTURE

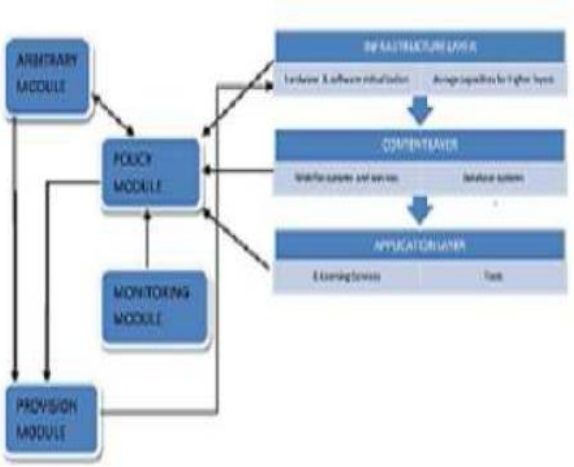

Fig.1 E-Learning Architecture.

An e-learning ecosystem based on Cloud computing infrastructure is composed of three layers: Infrastructure layer, Content layer, and Application layer. It is also with four ad hoc modules: monitoring module, policy module, arbitration module, and provision module. **Infrastructure layer** is the resource pool of an e-learning ecosystem. The infrastructure is managed by Cloud computing

platform. Hardware and software virtualization technologies are used to ensure the stability and reliability of the infrastructure. Supplying computation and storage capacities for higher layers, it is the energy source of an e-learning ecosystem. **Content layer** mainly consists of e-learning contents, such as Web file systems, database systems, Web Services, and so on. Except for content storage and maintenance, this layer exposes the standard interfaces and APIs of contents for higher layers. **Application layer** consists of e-learning services, systems, tools, and so on. It also provides functions and interaction interfaces for users or other programs. **Monitoring module** is keeping track of the executions of requests, the real-time configuration information and resource utilization levels of species, including the health of CPU, memory, I/O, and so on. **Policy module** establishes and maintains the teaching and learning strategies, the run-time and resource scheduling strategies. According to the data from monitoring module and the strategies of its own, policy module establishes specific solutions, and then triggers provision module. Policy module also decides which species to get higher priorities on resource scheduling according to some e-learning policies in order to safeguard the running of critical businesses. Policy module is the core of an elearning ecosystem. In the **arbitration module**, some policies are made by experts manually; requests from users are completed; and some disputes among species within the e-learning ecosystem are solved. Arbitration module amends, adjusts, and improves the resource allocation and management. It also establishes usage modes for different kinds of users based on the learning styles, learning preferences, and cognitive levels. Arbitration module is an efficient complement to the policy module, while the privilege of its policy is higher than the one in the policy module. **Provision module** starts the execution of resource allocation solutions set by the policy module and arbitration module, and deploys resources referred to users or species automatically in a short time. If the request comes from a user, some related information such as IP, user name and password will be supplied.

E-LEARNING ECOSYSTEM

The aim of this section is to summarize the complex situation for learning in environments of the 21st century by applying the ecosystem concept and identify high level requirements for our proposed flexible learning environment. Today's educators have access to new technologies such as cloud computing and Web 2.0 and they should capitalize on this advantage to facilitate learning and make learning environment more successful and effective.

In recent years, we have witnessed significant growth and massive changes in the e-learning industry. Dondi and Delrio expressed concerns about first generation e-learning as follows:

- Isolation of learners, lack of educators' feedback, student collaboration and campus social context.
- Uncertainty of costs for institutions and learners.
- Uncertainty about e-learning quality (resources, technology and support services) and e-learning evaluation.
- Shortage of competencies required for e-learning implementation among teaching staff, technical staff, and students.
- Domination of technology and market forces over educational aims and institutional development strategies.

According to Cowley and others, there are set of contextual elements should take into consideration to make e-learning more effective and successful and to facilitate learning in complex and intricate situations:

- Environment: learners need a certain environment (PC, Connection, software).
- Teach skills: learners need to know something about how to use whatever learning system exists.
- Subject matter skills: learners need to have some prerequisite skills to benefit from the course.
- Support: there has to be a mechanism to get support when learners run into problems.
- Content: must be designed for interaction.
- Instructor: aware of learners' needs/concerns and involvement levels, attempts to draw learners into discussion early, organizes schedule, provides resources for learners in need of additional learning.
- Technology: should play effective role.
- Organization: focused on learning, time and resources made available.

These elements belong to e-learning ecology or ecosystems that lead to the emergence of a second generation of e-learning. This model is comprehensive and is capable of adapting new technologies and tools, integrating new learning

approaches, adaptable to a variety of learning styles, and is responsive to the learning conditions.

Ecosystem is defined according to the Encyclopedia Britannica as a “complex of living organisms, their physical environment, and all their interrelationships in a particular unit of space "also, ecosystem is more flexible which can be of any size as long as organism, physical environment and interaction exists. The British ecologist,

A.G.Tansley in 1935, and the American Raymond L. Lindeman define ecosystem “a biotic community or assemblage and its associated physical environment in a specific place.” . Tansley indicated that ecology should appropriately consider the activities and effects of humans in ecosystems. The fact that he recognized new kinds of ecosystems that result at least in part from human actions is important. The definition implicitly shows the interactions between the living (biotic) and non-living (abiotic) components, and intrinsically within highly complex elements.

The ecosystem is classified by biotic and abiotic components and their entire interrelationship in specified physical boundaries and its applicability to various application domains that lead Chang and Gütl to integrate the idea of the ecosystem to the learning domain.

The generic model developed by Chang and Gütl depict learning ecosystem (LES) that “consists of the stakeholders incorporating the whole chain of the collaborative learning processes, the learning utilities and the learning environment, within specific boundaries, called environmental borders” also, show difference between living or biotic and non-living or abiotic components. This difference is to confirm that learning is a simple process between the living and nonliving components but growing awareness of the different styles of potential learners, aware of learners' needs and early adopters' experiences, strategies and the existence of modern utilities, Pursuit of better learning via ICT(Information and communication technologies) for lifelong learning, emergence of adaptive hypermedia and the growth of open source software (OSS), the need to improve quality of eLearning, and systems compounded by internal and external environmental factors create a greater need to offer flexibility to survive in a complex learning environment.

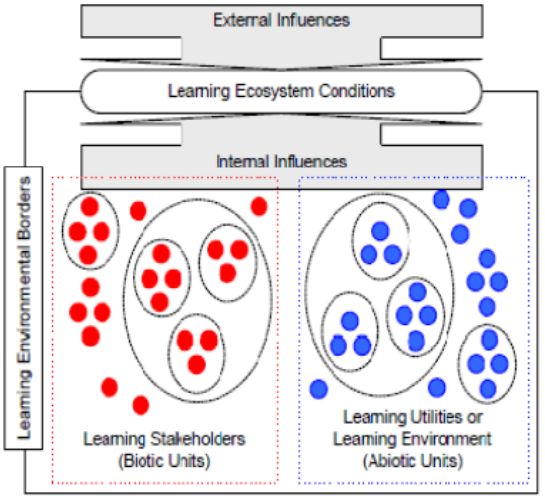

Fig.2 Simplified representation for the learning ecosystem (LES).

The generic model is outlined as follow: The biotic units (living parts) in the learning ecosystem constitute the learning communities and other stakeholders such as teachers, tutors, content providers, instructional designers and pedagogical experts who can interact and collaborate synchronously and asynchronously with one another and play significant roles in teaching and learning .

The learning utilities comparable to the abiotic units represent the non-living parts; include the static and dynamic learning m (content and pedagogical aspects), background knowledge in the form of external sources such as Wikipedia, digital libraries, technology, and tools applied in teaching(Laptops, desktop computers, podcasting, Personal Digital Assistance (PDA)).The technology may consists of the

architecture and infrastructure platform for the management, delivery and tracking of e-learning in the form of learning content management system (LCMS), learning management system (LMS) and content delivery system (CDS).

The learning environmental boundaries, an analogy to the specified physical boundaries of the ecosystem defines the physical and logical borders of the learning system. That is one of the system’s characteristics, which are in common specified as the ecosystem conditions.

The learning ecosystem dynamic conditions are affected by external and internal influences, such as evolution of knowledge, educational goals, learning tasks, cultural and sociological aspects, and expectations by society, private industry and business organizations, the government, public service and not-for-profit organizations. The learning ecosystem conditions have important impact on the “behavior” of the system and its components. To be successful be valuable for the system, each individual and group must adapt to the environmental

conditions to find their niches. In order to fit them all together, proper learning utilities must also be available.

Any learning situation consists of biotic and abiotic components which, their relationships and interactions together with the ecosystems' condition so that, researchers confirm that LES can be used with any learning situation, such as in classroom teaching or e-learning.

The major interests in the learning environment are relationships and interactions related to the information flow as well as knowledge transfer and transformation. Like a biological ecosystem, in a learning ecosystem, individuals can shape groups and can interact other or with learning utilities at the individual or group level. They also can perform, change or adapt specific behaviors in order to contribute to the success of the learning ecosystem. Extending ecosystem to e-learning defines E-learning ecosystem the term used to describe all the components required to implement an e-learning solution".

Fig. 3 E-learning ecosystem components that is consists of Content providers, Consultants, Infrastructure.

By focusing on the learning utilities component (abiotic unit) of ELES, the learning communities (biotic unit) of ELES must be self-organizing. This self-organization is required to avoid a single point of failure. Furthermore, the interaction between learner improvement of the productivity of learning environment must be taken into account to achieve this cloud computing and web 2.0 as platform to develop e-learning ecosystems.

DIGITAL TEACHING AND LEARNING ECOSYSTEM (DTLE)

An analogy can provide a means of building theory, a meaningful way to understand complex situations and scenarios. Analogy can and should be used to inform the analysis of findings in educational research in general, and science education in particular. The merit of analogy in research lies not in any absolute measure of the similarity between the target and the analogue. Rather, the worth of analogical analysis lies in the mental inquiry it promotes, the knowledge produced by this inquiry, the cognitive engagement of researcher and others, and the communication produced. To be productive, the analogy should be contentious enough to provoke and challenge thinking but agreeable enough to resonate with others 'experience of the phenomenon under study.

Biomimicry is a discipline that seeks solutions by emulating nature's designs and processes, where there is considerable opportunity to learn elegant solutions for human-made problems. In this regard, the ecological approach, combined with information technology, can open a new way to understand online learning. The key concept is the idea that teaching and learning can be seen as a process of transformation of information into knowledge. The subject, interface, content (abiotic factors), the teacher, e-learning officer, and the students (biotic factors) are embedded in a content where complex interactions occur and shape the quality of the learning outcomes.

The term —Digital Ecosystem‖ has been used to describe a variety of concepts in the area of Information Technology (IT), Information and Communications Technology (ICT) and also in e-learning. In IT the term refers to an existing networking infrastructure on the Internet, while several companies offer a Digital Ecosystem service or solution which involves enabling customers to use existing e-business solutions. In the ICT area it is used for e-business and e-commerce, to create so-called business ecosystems. In e-learning, our major focus, —Digital Ecosystem‖ or —Digital Learning Ecosystem‖ has been cited as an ecological model of learning and teaching, understanding e-learning infrastructure and implementation, and recently has been proposed as an aid when designing new learning tools.

The ecological approach has never been used to describe the complex interactions between student and interface, student and teacher, student and content, and student and student, which shape learning outcomes. Analysis of these interactions is crucial for the in-depth understanding of online learning environments, and to standardise and promote effective e-learning practices.

Digital Teaching and Learning Ecosystem (DTLE) is an analogy with what in ecology is called an —ecosystem‖. An ecosystem consists of all the organisms living in a particular area (biotic component), as well as all the nonliving, physical components of the environment with which the

organisms interact, such as air, soil, water, and sunlight (abiotic component). The entire array of organisms inhabiting a particular ecosystem is called a community. This model will use ecological terms like abiotic and biotic components, niche, populations and communities, biodiversity and environment. The principles to be used will be: symbiotic relationships, balance and adaptation.

The Digital Teaching and Learning Ecosystem (DTLE) model (Figure 4), as an analogy with ‗ecosystem' in ecology, has two major components: the biotic and the abiotic component. The biotic component comprises two subcategories: organisms cohabiting in the Teaching Niche (lecturer, tutor and e-learning officer) and; organisms cohabiting in the Learning Niche, (students enrolled in the unit or course). The abiotic component comprises the physical devices that students use to access content (desktop computers, laptops, netbooks, tablet computers, mobile devices, etc); the internet connection (broadband, Wi-Fi, 3G, etc); the e-learning interface or portal, and ; the content, which can be static or dynamic (communication tools, collaborative tools and assessments). The source of energy which powers the DTLE is Teaching and Learning, which can be seen as a transformative process where information generates knowledge.

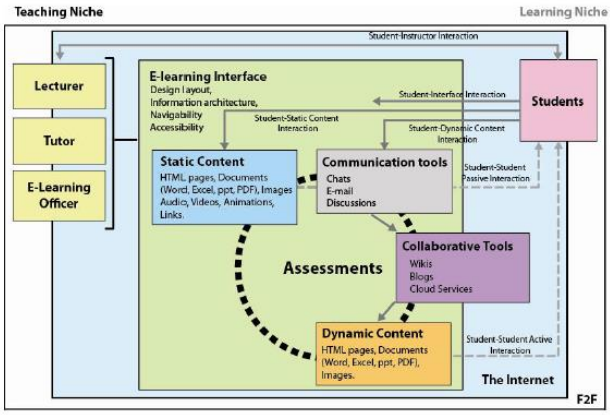

Figure 4: Digital Teaching and Learning Ecosystem (DTLE)

CONCLUSION

The design of e-learning ecosystems is still in its infancy. With the huge growth of users, services education contents and resources, e-learning ecosystem is facing challenges of optimizing resource allocations, dealing with dynamic concurrency demands, handling rapid storage growth requirements and cost controlling. So the best solution for this is using new technologies (integration between cloud computing and web 2.0). In the field of ICT sourcing cloud computing is currently one of the biggest topics. Cloud computing is a delivery model that allows users to rent ICT services and performance on an on-demand or project basis through networks (e.g. the Internet or an intranet) instead of purchasing them. These services can be software (SaaS – Software as a Service), platforms for the development and operation of applications (PaaS – Platform as a Service) or basic infrastructure, e.g. storage space (IaaS – Infrastructure as a Service).

Physical machines in most of the traditional elearning ecosystem are generally simple and exclusively stacked. Most of the resources are deployed and authorized for some specific tasks. Moreover, the utilization of those resources becomes a demanding problem. In this paper, an elearning ecosystem based on Cloud computing infrastructure is presented. Cloud computing realizes an e-learning ecosystem with the infrastructure which is reliable, flexible, cost-efficient, selfregulated, and QoS-guaranteed. It has some mechanisms to guarantee the teaching and learning activities, the quality and the functioning of the ecosystem.

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