

Prospects of Implementing E-Learning Systems based on Learning Objects and XML in Nigeria's Educational Sector.

ARTHUR U. UME (PhD)

*International Development Consultant & Solutions Expert, School of Computing and Information Technology,
Baze University- Abuja, Nigeria*

ABSTRACT: *This paper started with highlighting the forms of e-learning and pointing out the key difference between Synchronous and Asynchronous e-learning. It described the popular e-learning systems that gained ground and recognition in Higher Institutions in countries like Nigeria, and went on to point out the need for resident application developers and computer interaction designers to study the existing conventional e-learning systems out there with the aim of finding possible ways to extend/improve the interactivity, accessibility and compatibility of such disparate systems through the use of XML (Extensible Markup Language) and learning objects such as Avatars and Embodied Conversational Agents (ECAs).*

KEYWORDS: *E-learning, e-learning systems, Synchronous e-learning, asynchronous e-learning, XML, Learning objects, Avatars, Embodied Conversational Agents (ECAs), Artificial Intelligence (AI), Virtual characters, Anthropomorphism.*

I. INTRODUCTION

E-learning is not a new phenomenon in promoting education in the developed parts of the world. Presently, with the tremendous boom in Information technology in Nigeria many educational institutions are increasingly using e-learning capabilities to promote distance education (DE) and lifelong learning. Much literature abound regarding e-learning and e-learning management systems.

According to Abbaszadi et al., (2010) with accelerating developments in educational technologies in Nigeria, distance learning is becoming more convenient than it was some decades; Abbaszadi et al., also state that e-learning offers great opportunity to those individuals who have little time to spare because of their jobs, to earn their living while studying.

E-learning according to Timothy O.A et al (2008), is the use of electronic technology to deliver education and training applications, monitor learner's performance and report learner's progress. Hedge and Hayward (2004), also defined e-learning as an innovative approach for delivering electronically mediated, well-designed, learner-centered and interactive learning environments to anyone, anyplace, anytime by utilizing the internet and digital technologies in concern with instructional design principles. In other words, e-learning involves the use of the computer or any other electronic device (mobile, handheld or wearables) to acquire knowledge through the internet or through offline electronic data storage (CD-ROM, flash drives etc.). It should be noted that the online aspect involves the use of browsers. Thus, e-learning is all about learning with the use of ICTs.

Islam (1997) writes that the convergence of the internet and learning, or Internet enabled learning is called e-learning. The applications and process of e-learning include computer-based learning, web-based learning, virtual classroom and digital collaboration where contents is delivered via the internet, intranet/extranet, audio and or video tapes, satellite TV and CD-ROM.

Higher educational institutions are increasingly moving towards the use of the Internet as a blended capability for delivery of courses, both on campus and at a distance (Ally, 2004, Kim & Bonk, 2006). The Internet provides significantly different and interesting possibilities for computer-mediated communication and learning from other forms of educational technologies (Weller, 2002, p. 34). There are, therefore, ways in which e-learning environments may be utilized based upon pedagogical needs. The development of instructionally effective online learning environments that meet the pedagogical needs require the application of appropriate instructional design principles. The literature suggests that there are gaps between the bodies of knowledge relating to learning theories, instructional design principles and student learning in higher education, (Siragusa & Dixon, 2005a).

In a recent PhD study (Siragusa, 2005) developed a theoretical framework and research methodology aimed at putting forward instructional design principles that effectively promote the use of online learning to meet the varying pedagogical needs in higher education.

(Ozkul, 2003), records that the use of internet brought lots of opportunities to different fields and especially to Instructional Technologies. This author went further to note that based on these new technologies, learning environments are able to provide a wide range of educational alternatives for learners. Distance learning he says is one of these alternatives which became attractive where students and instructors are physically in different locations and time. By using distance learning tools, education can be more flexible with respect to place and time constraints. Thus, students can access information anytime and anyplace, such as either in libraries or during lectures.

(Dutta et al., 2011) Broadly speaking, e-learning is the delivery of educational content through electronic media, including Internet, intranet, extranet, satellite broadcast, audio and video tapes, interactive TV, interactive CDs and computer-based system. However, the strength of recent e-learning systems lies in the emergence of Web 2.0 tools which according to Awodele et al. (2009) is a concept that has developed some new initiatives in education identified as e-learning 2.0. Web 2.0 tools have influenced e-learning systems in terms of pedagogy and delivery as a result of a high degree of user involvement and social networking (Anderson, 2007). The Web has therefore been established as a major platform for applications in learning.

According to Friesen, N. (2009), e-learning is an educational system for providing learning through electronic technologies especially the Internet. This researcher writes that e-learning brings a community of learners together and unrestricted by the time and place where students are able to discuss with other fellows and teachers via online and gather different types of knowledge from the different discussion forums. Holmberg, B. (2005). Also writing about e-learning noted that e-learning is a relatively new phenomenon and can be defined as delivering education to students who are not physically present; rather than being in lecture halls in person, students and teachers can communicate with each other using the Internet.

Concerning the design and implementation of e-learning systems, according to Observatory on Borderless Higher Education (2002), some higher educational institutions continue to develop in-house systems or buy into open source alternatives, but it is being reported that an ever-larger majority is purchasing licenses for proprietary platforms. In another study that supports the results of Observatory on Borderless Higher Education. (Paulsen 2003) shows that, usually many institutions find it quite easy to start with a commercial-of-the-Shelf Learning Management Systems (LMS), but they face many problems such as; Linguistic, assessment tools, suitability to target groups and pricing. It is therefore no wonder that, open source LMS is having a great impact on the future of the LMS market with its cost effectiveness and advanced features. Due to the advantages of distance learning, schools and companies are increasingly adopting these new learning technologies and increasing their investments in it. However, along with the advantages that accompany these innovations, installation and support costs appear to be big disadvantages compared to a traditional learning environment. There is also the problem of incompatibilities of platforms if modules of the e-learning systems do not come from the same software developer or vendor. This is actually the case with many Nigerian universities that implemented massive and robust e-learning systems, and are presently stuck with its perceived "incompatibilities" with surround instructional technologies.

It is worth noting that in order for different e-learning systems to communicate and interoperate with each other, it is important to have a common language among the systems. Nowadays, the common language adopted by most learning organizations is the Extensible Markup Language (XML), since XML can facilitate significant features in the e-Learning framework, such as personalization, interoperability, reusability and flexibility [XML 2000]. The XML was actually originally developed to facilitate the description and exchange of data with the aim to enhance interoperability on the Web by the World Wide Web Consortium.

Regarding the mode communication of e-learning systems, Andersen A., Hristov, E. & Karimi, H. (2008), noted that e-learning could be either synchronous or asynchronous or both.

II. SYNCHRONOUS E-LEARNING

This is when teachers and students communicate in real time by using webcams and microphones for instance. The communication is done live and thus it leaves some room for interaction in the form of students asking questions and getting answers to their questions shortly after. It is interesting to note that since synchronous e-learning is done in real time, it requires a relatively fast Internet connection, something that was not available ten years ago.

Examples of synchronous online technology types include videoconferencing, webcasts, interactive learning models, and telephone conferences (Er et al., 2009; eLearners.com, 2012). The advantages of synchronous e-learning include the following: instructional pacing, improved student engagement, synchronous real-time collaboration.

ASYNCHRONOUS E-LEARNING

Asynchronous e-learning on the other hand is when students can download or stream pre-recorded materials (lectures or written documents for instance). Asynchronous e-learning has its limitations when it comes to interaction between teacher and student

However, it possess a great advantage in that it offers students more flexibility as students can download lectures and watch them at any point they wish.

For synchronous as well as asynchronous e-learning, the platform that is generally used is an intranet—where lectures and documents can be uploaded and made accessible for everyone within the intranet. However, due to technological development in recent years, new platforms for online learning have been made available.

Regarding the design, creation and development of e-learning systems, Hall (2003) wrote that all Learning Management Systems (LMS) are built in a way to “manage the log-in of registered users, manage course catalogs, record data from learners, and provide reports to management.”

III. STATEMENT OF PROBLEM

Just like in the other parts of the world, with the current penetration of ICTs in Nigeria, e-learning educational technology is becoming more prevalent in the country. Consequently gradually teaching and learning is no longer being restricted just to face – to – face instruction by teachers in traditional classroom enclosures. In the formal educational institutions, the combination of e-learning technology and face - to –face teaching and learning is continuing to increase accessibility, flexibility and choices for student – instructor interactivity. This is causing a leap in instructional productivity. Traditional instructional activities such as information presentation, managing course materials, collection, tracking and evaluation of students’ work are all now being complemented using e-learning systems.

Nevertheless, there is still need to design e-learning systems in such a way to increase compatibility, accessibility, and interactivity between instructors and the students. The incorporation of Avatars and ECAs (Embodied Conversational Agents) in the design of e-learning systems would further enhance the effectiveness in delivering instructional contents to remote areas, where distance learning is expected or anticipated and few teachers are on ground to provide face-to-face teaching. This possibility and penetration can as well be extended to improve the teeming informal education sector in developing countries like Nigeria.

IV. OBJECTIVES OF PAPER

The key objectives of this paper are:

- i. To discuss the forms of e-learning systems.
- ii. To spur Information Technology designers and developers to improve and extend e-learning systems’ compatibility use of XML and learning objects such as Avatars and Embodied Conversational Agents (ECAs).
- iii. To discuss the limitation of outright purchase and installation of off-the-shelf disparate e-learning systems.

V. THE CONVENTIONAL E-LEARNING MANAGEMENT SYSTEMS

In an educational context, e-learning platforms are also known as Learning Management Systems (LMSs) which are Internet based software. The Learning Management Systems allow instructors to manage materials distribution, assignments, communications and other aspects of instructions for their courses Abu, S.B. (2009). Today, LMSs have become an integral component of the educational systems in most universities and interest is increasing in hybrid approaches that blend in class and online activities as stated by Pishva, D. et al. A LMS is not intended to replace the traditional classroom setting, but its main role is to supplement the traditional lecture with course content that can be accessed from campus or the Internet Landry, B. Griffeth, R. & Hartman, S. (2006).

The most popular LMS are out there in most Universities in countries like Nigeria are the following: Modular Object-Oriented Dynamic Learning Environment (MOODLE), Online Learning and Training (OLAT), Claroline, eFront, Blackboard, Share Point LMS Faxen, T. (2011).

- **THE MODULAR OBJECT-ORIENTED DYNAMIC LEARNING ENVIRONMENT (MOODLE)**

The Moodle is an Open Source Learning Management System, which is known as one of the most widespread and famous Learning Management Systems. Moodle has been translated to 30 languages and found in 1026 sites from 75 countries over the world (Itmazi&Megías, 2005). Moodle gives the educators the best tools to manage and promote learning (Raadt, 2013; Jin, 2012). However, some of the disadvantages and missing features are as follows, Working Offline: Occasionally, students download their course contents and they access the content on a CD-ROM to work offline. In this regard, the course placeholder automatically returns to the location in their course where they were working the last time they logged off. A big issue with Moodle is the fact that it is not fully developed to cope with big projects. While it may be useful for colleges or universities of small to medium size, the system might not work efficiently with larger schools or serve as a great way to conduct all classes in a city. In addition to the lack of complete development, Moodle users frequently complain about the troubles they experience with customizations.

- **THE ONLINE LEARNING AND TRAINING (OLAT)**

OLAT (Online Learning and Training) is an Open Source LMS (Learning Management System) tailored to the needs of Universities and Higher Education institutions. The development of OLAT was driven by the University of Zurich where it is presently extensively used. There are approximately 70,000 users and nearly 50 institutions in Switzerland using OLAT (with up to 5,000 courses and millions of resources), and the numbers keep on growing. OLAT is available in several languages and can provide diverse functionality for all e-learning needs in web-based learning and training

- **CLAROLINE**

Claroline is a collaborative e-Learning and eWorking platform (Learning Management System) released under the GPL Open Source license. Created in 2000 at the Catholic University of Louvain (UCL), Claroline is the second most commonly used online learning application in Europe. It is easy to use, owing in part to its lesser functional depth in comparison to Moodle

- **eFRONT**

The core of eFront is distributed as an open-source project and custom software solution for your training needs. eFront is designed to assist with the creation of online learning communities while offering various opportunities for collaboration and interaction through an icon-based user interface. eFront comes in a number of editions, from an open-source edition to the latest eFrontPro edition.

- **SHAREPOINT LMS**

The SharePoint LMS is an award-winning learning management system for the internal SharePoint platform. SharePoint LMS lets instructors intuitively combine new and existing training elements, documentation, materials, media, communication channels, and learning methods to deliver a media-rich training experience learners find valuable, and enables the following Webinars, Blended classroom training, Instructor-led and self-study workflows, Embedded procedures, manuals, and other compliance documents.

- **ILIAS**

This is a Learning Management System (LMS), developed at the University of Cologne/Germany.

ILIAS is a web-based Open Source Learning Management System. ILIAS has been translated to at least 16 languages and found in 115 sites from 18 countries over the world (ILIAS, 2013; Itmazi&Megías, 2005). It was developed using PHP, MySQL and the Apache to work mainly under UNIX/Linux.

VI. IMPROVING E-LEARNING MANagements SYSTEMS BY LEVERAGING XML, VIRTUAL CHARACTERS AND LEARNING OBJECTS

- **XML (EXTENSIBLE MARKUP LANGUAGE) IN E-LEARNING**

Regarding the adoption of XML and learning objects, (Gerber 2001), reports that the great potential of using XML has been predicted by many developers and technology-driven companies. He said that in fact, several learning organizations, including a group newly formed by IEEE, are trying to develop e-Learning standards using XML. XML allows developers to create structured exchangeable learning content which can be manipulated in different ways to achieve educational deliverables among disparate systems. XML tags provide flexibility to create customizable, interoperable and transferable learning content. XML thus is used as data descriptor to make integration between components that render e-learning content easier.

It is worth noting that XML was originally developed to facilitate the description and exchange of data on the Web by the World Wide Web Consortium. It is a means of representing information according to its internal structure. Such a structure makes the information in the XML files meaningful and machine-readable, and therefore achieves interoperability and reusability of information. The great potential of using XML has been predicted by many developers and technology-driven companies. In fact, several learning organizations, including a group newly formed by IEEE, are trying to develop e-Learning standards using XML.

When XML is used to store unstructured or semi-structured data, for which the traditional relational database is not suitable, it gives application designers and developers the ability to manipulate the information easily and quickly. With XML, course developers may put semi-structured information, such as the course content or course structure, into a discrete relational field, and then work with this information as with structured blocks of data, not as with a string of bytes. Therefore, for e-Learning, XML provides a flexible approach to represent and track the content and the structure of a course, and to keep such information separate from the software used for delivery and presentation. Moreover, content stored using XML can be independent of any course, and is in a form ideally suited to re-use in any number of different courseware and other learning-related products. For example, learning content in XML may be transformed into printable PDF to form a part of a book, or into HTML to provide online education.

- **ARTIFICIAL INTELLIGENCE, VIRTUAL CHARACTERS AND AVATARS IN E-LEARNING**

Artificial intelligence (AI) which is an increasingly growing subfield of Computer Science aims at using computers to imitate and simulate human intelligence. AI can be used to make it possible for e-learning systems to use intelligent methods for analysis, evaluation and assessment of user knowledge and skills as well as process control, supervision and optimization. Using AI concept and techniques, new forms of intelligent software can be created to allow the computer to act as an intelligent learner or tutor. Thus, presently, there is an emerging broader perspective among system designers and developers on the various aspects of e-learning which can be extended and augmented with AI technologies; for example, wherever it may not be possible or desirable to incorporate real people or wherever it is possible to complement real teachers, especially in inaccessible remote regions. When incorporated, the ability to hold meaningful dialogues and interaction sessions with humans is a useful characteristic of AIs. This can be utilized while implementing e-learning systems.

Of late, interaction designers are trying to use human-like "virtual characters" on interaction screens to improve interaction in the form of characters in videogames, teaching companions, wizards, newsreaders. It should be noted that a virtual character may be used to provide a persona that is welcoming, and has personality that makes the user feel involved with them. Computer interaction designers classify virtual characters in terms of the degree of the anthropomorphism they possess and exhibit. Based on the degree of anthropomorphism which virtual characters possess and exhibit the types of virtual characters which are presently in use by interaction designers are the following:

- Synthetic characters
- Animated agents
- Emotional agents
- ECAs (Embodied conversational agents)
- Avatars

These are all software agents driven by AI to improve human computer interaction (HCI); these software agents when programmed with the capacity for emotional expression and embedded as extensions can improve the interactivity of e-learning systems.

For example, ECAs are human-centered, personalized and at the same time more engaging speech-based interactive systems. ECAs employ real human gestures, mimics and speech to communicate with the human user. During the last decade research groups as well as a number of commercial software developers have started to deploy embodied conversational characters in the user interface interaction ...especially in application systems where a close emulation of multimodal human-human computer communication is needed. The ECAs may be designed and programmed to actually carry on face-to-face communication that enables pragmatic communication acts such as conversational "turn-taking", synchronous facial expression of emotions. Research has indicated that the use of ECAs results in improved recall of the information presented to the learner.

In computing, an avatar is the graphical representation of the user or the user's alter ego or character. It may take either a three-dimensional form, as in games or virtual worlds, or a two-dimensional form as an icon in Internet forums and other online communities. Increasingly avatars are being introduced in e-learning. Speaking Avatars are now increasingly serving roles in delivering online learning in "human" like manner, so that learning has

become widely accessible, interesting, engaging, and memorable. In many instances they are used to give remote learners a campus-like feel, and also enable effective learning for people living with disability. According to the Stanford study, Interactive avatars are increasingly being perceived as real social actors.

Gitika Nagra(2015) writes that Avatarswhen incorporated and embedded into e-learning systems can enhance the quality of learner engagement by grabbing and retaining his/her attention. This designer and author went on to say that “Avatars go a long way in motivating people in the online learning environment. However, if we want to use avatars/characters effectively in e-Learning courses, we must clearly understand what avatars are, why they are useful and how they can be used in e-Learning”.

He concludes by saying that Avatars are powerful learning agents that can transform a boring subject into an interesting one. He maintains that they can be effectively used to guide and motivate learners throughout a course. Because Avatars help learners comprehend the subject-matter of online learning courses effectively, in that they facilitate efficient learner interaction. They serve the same function in a course as an anchor does in a live event, and can be used to personalize learning; form a relationship with learners; retain the knowledge gained; and make learning fun and interesting.

VII. CONCLUSION

This write-up makes a call to improve effectiveness of learning and interaction between students and instructors in Nigeria’s Educational sector. It advocates using XML and programmable software agents to do so; the paper provides basis that spur further discussions among software application developers and designers for a possible incorporation of software agents as learning objects (such as ECAs, Avatars) to complement, enhance and improve the interactivity/effectiveness of the disparate e-Learning systems already out there in use by many institutions of learning in the country. Such enhanced e-learning system will surely improve e-learning and interaction between learners and instructors, and allow improved accessibility to instructional resources even from spatially remote inaccessible locations by diverse learners.

However, it should be noted that several key problems still remain unsolved for developing e-Learning content based on learning objects and XML. Firstly, the exact definition of what a learning object actually is... still remains unclear. Several different definitions exist, and most of them are so broad that they may lose any useful meaning. Secondly, many designers report that though it may be possible to find the appropriate learning objects by their metadata, it is still not clear whether it is possible for computer agents to integrate these learning objects in an appropriate way to form a higher level of course unit that makes instructional sense. Thirdly, there are many e-Learning specifications in XML available now, however each of them has their own emphasis, and none of them provides a complete solution for developing an e-Learning system. Therefore, most online instructional systems are still developed in proprietary ways without adopting the existing specifications. Finally, although XML was introduced several years ago, it is still far from being mature. Many technologies associated with it are still under development or change frequently; so, learning specifications based on XML have to change accordingly. All of these issues make the use of XML in developing a reusable e-Learning system difficult to implement.

REFERENCES

- [1] **Abu, S.B. (2009)**. Learning Management System and Its Relationship with Knowledge Management. 4th International Conference on Intelligent Computing and Information Systems, Cairo, 19-22 March 2009, 3-5.
- [2] **Ajadi, O. et al., (2008)** Turkish Journal: E-learning and distance Education in Nigeria. The Turkish online journal of educational technology 7(4), 2008, pp. 61-70.
- [3] **Ally, M. (2004)**. Foundations of educational theory for online learning. In T. Anderson & F. Elloumi (Eds.), Theory and practice of online learning. Athabasca, Canada: Creative Commons: Athabasca University.
- [4] **Andersen A., Hristov, E. and Karimi, H. (2008)**. Second Life: New Opportunity for Higher Educational Institutions. Bachelor Thesis within Business Administration, Jönköping International Business School, Jönköping University, Jön- köping, 17.
- [5] **Berteau P. (2009)**. Measuring student’s attitude towards e-learning: A case study. Proceedings of the 5th standing conference on e-learning and software for development held in Bucharest from 09-10 April 2009 Bucharest Romania 1-8.
- [6] **Bosak (1997) Bosak, J: XML, Java, and the future of the Web, 1997.**<http://www.ibiblio.org/pub/sun-info/standards/xml/why/xmlapps.htm> (Retrieved on Dec 5, 2015).
- [7] **Douglas, S. (1993)**. Digital Soup: The ABCs of Distance Learning. EDUCOM Review, 28, 22-30.
- [8] **Gitika Nagra (2015)**. What, Why, and How to Use Avatars in E-learning Courses?, <http://blog.commlabindia.com/elearning-design/how-to-use-avatars-in-elearning-courses>; (Retrieved on Dec 30, 2015).
- [9] **Gustafson, D.A. (2002)**. Theory and Problems Software Engineering. The McGraw-Hill Companies, New York, 14-20. [24]Greer, D. (2010) Software Engineering. Queens University Belfast, Belfast.
- [10] **Hall, B. (2003)**. New Technology Definitions, retrieved August 5, 2015 from <http://www.brandonhall.com/public/glossary/index.htm>.
- [11] **Hedge, N. and Hayward, L. (2004)**. Redefining roles. University e-learning contributing to Life-long learning in a networked world. E-Learning, 1:128 145<http://www.nationmaster.com/country/ni/Internet>.
- [12] **Hedge, N. and Hayward, L. (2004)**. Redefining roles. University e-learning contributing to Life-long learning in a networked world. E-Learning, 1:128 – 145 <http://www.nationmaster.com/country/ni/Internet>.
- [13] **Holmberg, B. (2005)**. The Evolution, Principles and Practices of Distance Education. Open Learning, 21, 273-277.

- [14] **Islam, M.T (1997)**. Educational Technology for 21st century. Observer magazine, Dhaka, May 9, 1997, pp. 3 – 4.
- [15] **Karadag, E. and Caliskan, N. (2009)**. Interaction and Communication in the Process of Education and Shared Common Area in the Classroom. College Student Journal, **43**, 123-128.
- [16] **Landry, B., Griffeth, R. and Hartman, S. (2006)**. Measuring Student Perceptions of Blackboard Using the Technology Acceptance Model. Decision Sciences Journal of Innovative Education, **4**, 87-99. <http://dx.doi.org/10.1111/j.1540-4609.2006.00103.x>.
- [17] **Miller, R. L. (1990)**. Learning Benefits of Interactive Technologies, Multimedia and Videodisc Monitor, February.
- [18] **Miller, S. M., & Miller, K. L. (2000)**. Theoretical and practical considerations in the design of web-based instruction. In B. Abbey (Ed.), Instructional and cognitive impacts of Web-based education (pp. 156-177). Hershey, USA: Idea Group Publishing.
- [19] **Nyiri, J.C. (1997)**. Open and Distance Learning in an Historical Perspective. European Journal of Education, **32**, 347- 357.
- [20] **Olaniyi S. (2006)**. E-learning technology: The Nigeria experience. Shape the change XX111 FIG Congress Munich Germany October 8-13. 1-11.
- [21] **Paulsen, M. F. (2002)**. Online Education Systems in Scandinavian and Australian Universities: A Comparative Study. The International Review of Research in Open and Distance Learning, Volume 3 (2), 152-167.
- [22] **Peters, O. (2001)**. Learning and Teaching in Distance Education—Analyses and Interpretations from an International Perspective. 2nd Edition, London, 4-25.
- [23] **Pishva, D., Nishantha, G.G.D. and Dang, H.A. (2010)**. A Survey on How Blackboard is Assisting Educational Institutions around the World and the Future
- [24] **Reeves, T., & Reeves, P. (1997)**. Effective dimensions of interactive learning on the World Wide Web. In B. H. Khan (Ed.), Web-based instruction (pp. 59-66). Englewood Cliffs, N.J.: Educational Technologies Publications.
- [25] **Siragusa, L., & Dixon, K. C. (2005a)**. Closing the gap between pedagogical theory and online instructional design: a bridge too far? In G. Chiazzese, M. Allegra, A. Chifari & S. Ottaviano (Eds.), Methods and Technologies for Learning. Southampton: WIT Press.
- [26] **Watabe, K., Hamalainen, M. and Whinston, A.B. (1995)**. An Internet Based Collaborative Distance Learning System: Codiless. Computers & Education, **24**, 141-155. [http://dx.doi.org/10.1016/0360-1315\(95\)00013-C](http://dx.doi.org/10.1016/0360-1315(95)00013-C).