

UBIQUITOUS LEARNING: CREATING A LEARNING ENVIRONMENT FOR ALL FOR NATIONAL DEVELOPMENT

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Abstract

The challenge in an information-rich world is not only to make information available to people at any time, at any place, and in any form, but specifically to say the right thing at the right time in the right way. A ubiquitous computing environment enables people to learn at any time and from any place. A ubiquitous learning environment provides an interoperable, pervasive, and seamless learning architecture to connect, integrate, and share three major dimensions of learning resources: learning collaborators, learning contents, and learning services. Ubiquitous learning is characterized by providing intuitive ways for identifying the right learning collaborators, right learning contents, and the right learning services in the right place at the right time. This paper examines the innovation in Ubiquitous learning and how it can help in enhancing the economy and making higher education available to all.

Keywords: Learning Environment, Ubiquitous learning, ubiquitous computing

Introduction

The country has been classified as an underdeveloped country (UN, 2009) and is unlikely to meet the Millennium Development Goals (MDGs), and one of the criteria for meeting the MDGs is the provision of education for the citizenry. The concept of education (formal learning) as presently practiced in Nigeria is that it should be confined to the four walls of schools, to the point that the National Open University of Nigeria (NOUN) is still regarded as a normal university, rather than a distance learning institute. To reach more people and to make education more accessible to many, particularly the working class, a new approach needs to be applied.

Educational technology is constantly evolving and growing, and, inevitably, this progression will continually offer new and interesting advances in our world. Worldwide, various modes have been adopted to transform learning and make it readily available. Various learning systems have been developed in the past decade; the majority of these systems are implemented either with client-server architecture or are centralized server-based. The client-server and centralized server approaches are metaphors of student-teacher and repository centric which reflect real-world learning scenarios in which teachers act as the content producers while students act as the content consumers. The instigation of ubiquitous media for the delivery of education is another new approach now emerging. The challenge in an information-rich world is not only to make information available to people at any time, at any place, and in any form, but specifically to say the right thing at the right time in the right way (Fischer, 2001).

Computer-based learning-learning and m-learning

Over the last few decades, information and communication technologies have improved greatly, and computers have become more widespread. As a result, educators started to look at ways to use this technology. Computer-based education (CBE) was one of the initial stages, leading to online education and e-learning in the mid-1990s. E-learning offered new ways for students to access many resources. This was a major breakthrough in education, leading to better management of both in-house tertiary education and distance education.

M-learning is often thought of as a form of e-learning, but Georgiev et. al (2004) believe it would be more correctly defined as a part, or sub-level, of e-learning. They believe m-learning is a new stage in the progress of e-learning and that it resides within its boundaries. M-learning is not only wireless or Internet-based e-learning, but should include the anytime/any place concept without a permanent connection to physical networks. The advantages of m-learning compared to e-learning include flexibility, cost, size, ease of use, and timely application. The devices used include PDAs, mobile phones, portable computers, and Tablet PCs.

The ubiquitous learning environment provides an interoperable, pervasive, and seamless learning architecture to connect, integrate, and share three major dimensions of learning resources: learning collaborators, learning contents, and learning services (Chang & Sheu, 2002; Cheng et. al., 2005). Ubiquitous learning is characterized by providing intuitive ways for identifying right collaborators, right contents and right services in the right place at the right time based on learners surrounding context such as where and when the learners are (time and space), what the learning resources and services available for the learners, and who are the learning collaborators that match the learners' needs (Ogata, & Yano, 2004; Zhang, Jin, & Lin, 2005; Takahata, et. al., 2004).

As a result, the effectiveness and efficiency of ubiquitous learning heavily rely on the surrounding context of learners. "Context" can be defined from two perspectives: one is for the learners, and the other is from the learning services. From the learners' perspective, context is defined as the surrounding environment affecting learners' Web services discovery and access, such as learners' profiles and preferences, the network channels and devices learners are using to connect to the Web, etc. From the services perspective, context is defined as the surrounding environment affecting learning services delivery and execution, such as service profiles, networks, and protocols for service binding, devices and platforms for the service execution, etc. Typical learning services for ubiquitous learning are device and network detection services; location tracking services; calendar and social activities services; and content access services.

Ubiquitous Learning

Ubiquitous learning is an offshoot of Ubiquitous Computing. Mark Weiser coined the phrase "ubiquitous computing" around 1988, during his tenure as Chief Technologist of the Xerox

Palo Alto Research Center (PARC). Both alone and with PARC Director and Chief Scientist John Seely Brown, Weiser wrote some of the earliest papers on the subject, largely defining it and sketching out its major concerns. Recognizing that the extension of processing power into everyday scenarios would necessitate understandings of social, cultural, and psychological phenomena beyond its proper ambit, Weiser was influenced by many fields outside computer science, including "philosophy, phenomenology, anthropology, psychology, post-Modernism, sociology of science, and feminist criticism." Weiser's third wave in computing describes a one-to-one relationship between computers and humans (Weiser, 1993). This relationship is common in the evolving ubiquitous computing era. This also correlates with the u-learning concept currently emerging. Each student interacts with many embedded devices. In the ubiquitous classroom, students move around Ubiquitous Space (u-space) and interact with various devices.

Massachusetts Institute of Technology MIT has also contributed significant research in this field, notably Hiroshi Ishii's *Things That Think* consortium at the Media Lab and the CSAIL effort known as Project Oxygen. Other major contributors include Georgia Tech's College of Computing, NYU's Interactive Telecommunications Program, UC Irvine's Department of Informatics, Microsoft Research, Intel Research, and Equator.

Ubiquitous computing names the third wave in computing, just now beginning. First were mainframes, which were shared by lots of people. Now we are in the personal computing era, person and machine staring uneasily at each other across the desktop. Next comes ubiquitous computing, or the age of calm *technology*, when technology recedes into the background of our lives. Alan Kay of Apple calls this "Third Paradigm" computing.

Features of Ubiquitous Learning

The main characteristics of ubiquitous learning are shown as follows (Chen et al., 2002; Curtis et al., 2002):

- **Permanency:** Learners can never lose their work unless it is purposefully deleted. In addition, all the learning processes are recorded continuously every day.
- **Accessibility:** Learners have access to their documents, data, or videos from anywhere. That information is provided based on their requests. Therefore, the learning involved is self-directed.
- **Immediacy:** Wherever learners are, they can get any information immediately. Therefore, learners can solve problems quickly. Otherwise, the learner may record the questions and look for the answer later.

- Interactivity: Learners can interact with experts, teachers, or peers in the form of synchronous or asynchronous communication. Hence, the experts are more reachable, and the knowledge is more available.
- Situating instructional activities: learning could be embedded in our daily lives. The problems encountered, as well as the knowledge required, are all presented in the natural and authentic forms. It helps learners notice the features of problem situations that make particular actions relevant.
- Adaptability: Learners can get the right information at the right place in the right way.

Moreover, ubiquitous learning can be Computer Supported Collaborative Learning (CSCL) environments that focus on the socio-cognitive process of social knowledge building and sharing.

Ubiquitous Learning Environment (ULE)

According to Vicki Jones and Jun H. Jo (2006), an ubiquitous learning environment is any setting in which students can become totally immersed in the learning process. To define:

- Ubiquitous = pervasive, omnipresent, ever present, everywhere
- Learning = educational, instructive, didactic, pedagogical
- Environment = surroundings, setting, situation, atmosphere

So, a ubiquitous learning environment (ULE) is a situation or setting of pervasive (or omnipresent) education (or learning). Education is happening all around the student, but the student may not even be conscious of the learning process. Source data is present in the embedded objects, and students do not have to DO anything in order to learn. They just have to be there.

The development of a ubiquitous learning environment combines the advantages of an adaptive learning environment with the benefits of ubiquitous computing and the flexibility of mobile devices. Students have the freedom to learn within a learning environment that offers adaptability to their individual needs and learning styles, as well as the flexibility of pervasive and unobtrusive computer systems.

There are four characteristics in ubiquitous learning environment (1) context-aware, the learners' learning performances and the learning environment information can be known by the ubiquitous learning system; (2) personalization, the learning resources learners might need can be provided according to learners' profiles and learning status; (3) seamless, learners' learning activities will not be stopped in ubiquitous learning though they move to another place; and, (4) calm, the learning materials will be delivered to learners automatically to avoid interrupting learners with different devices.

The ULE resides within the physical environment. Microprocessors are embedded in objects or devices. The use of wireless and mobile technology makes them easily accessible and contributes to educational functionality. The wireless and mobile devices include mobile phones and PDAs. A ULE can provide the props and stimuli needed to encourage student involvement easily, but without needing the active attention of the student. The benefits of the many-to-one relationship found in U-learning include the potential for one ULE (of many devices) to service an unlimited number of individuals at once. Essentially, the many-to-one relationship exists for every one of the students within the environment.

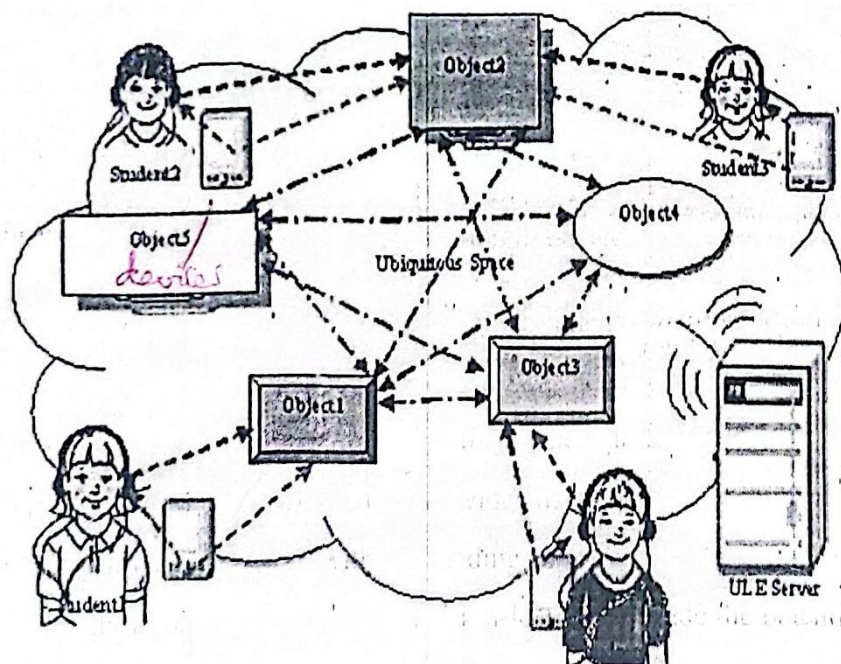


Figure 1. The Ubiquitous Environment

In designing the ULE, the application of learning theories is an important consideration. Jacobs (1999) states that using learning theories in educational design helps to create a relationship between the information, the learner, and the environment. Gersten and Baker (1998) explain that when this relationship does occur, there is a greater chance that the student will retain the information within their own knowledge base. For example, if a student can understand why *and how* something happens in nature, such as why and how a seed will sprout in soil and not in rocks, rather than just being told that it is true, the information has more relevance and therefore more meaning. Put simply, once an individual understands a concept, they are more likely to remember it. There are, of course, a number of learning theories that have been presented over the years. However, for this ULE model, the theory of constructivism is applied.

Components of the ULE include:

1. **Microprocessors** with memory will be embedded in every object/device. The information each microprocessor will hold will be about the object. When a student approaches, the sensor detects their presence and will start relaying information to the student's PDA.

2. The **ULE Server Module** will include the Server, the Educational Strategies Unit, and a Database: The *ULE server* manages the network resources. The *Educational Strategies* Unit allows for the application of strategies to reinforce and aid student understanding through interaction and feedback. It analyses student responses to short quiz questions and returns more information or information in a different form when needed; *Database* - stores all the data about the 'objects/devices', the users, and the interactions that occur.
3. **Wireless technology-this** will be in the form of Bluetooth and WiFi: *Bluetooth* has weak signal strength, uses little power, and covers a relatively short distance. Its low power consumption and ability to communicate with many devices are extremely beneficial when using handheld devices. WiFi, based on the IEEE 802.11 specification, has range and speed, which surpasses that of Bluetooth. It is compatible with any brand of access Point and client hardware built to the WiFi standard (Brevard User's Group, 2002)
4. **Sensors** will be used to detect any changes in the surroundings. These will be placed adjacent to the objects/devices and will be used to recognise the presence of students. The sensors used will include proximity, movement, and light to detect changes in light intensity.

Challenges of m-learning and e-learning in Nigeria

Basically, the main challenges are power, infrastructure, and capacity building. From the findings by David Hollow and ICWE in May 2009, on a survey of 147 eLearning practitioners from 34 countries in Africa. "They consider practitioner perspective regarding current challenges, priorities for action, and the role of donors within the eLearning arena. The priority area, highlighted as most significant by 35% of respondents, was the issue of training. Many pointed to the simple fact that very few teachers and lecturers are currently able to use eLearning because of the limited opportunities available for learning how to do so. It was suggested that the knowledge regarding eLearning leads to an increase in motivation, an appreciation of issues surrounding integration, and a subsequent increase in appropriate and innovative usage. This in turn, was believed to lead to capacity building for people to begin developing their own content for effective teaching and learning. There was a strong linkage between training and limited funding, that, due to a lack of money, the initiatives both planned and already operational were unable to function at their most effective. The third most common response, from 18% of respondents, was that of bandwidth as the top priority for improving eLearning. Responses focused on the prohibitive cost of bandwidth and identified it as the primary barrier for using eLearning, with one respondent stating that 'the high cost of bandwidth in Africa just defeats the whole purpose of eLearning'. Associated with the cost of bandwidth is the difficulty of accessing required content due to the slow connection speed. When respondents were questioned regarding the highest priority for Africa as a whole, rather than for their programme specifically, the answers given prioritized training with 24%, bandwidth with 23%, and donor funding with 15% responses. In addition to this, 12% considered the lack of electricity supply to be the most significant priority.

To itemize the challenges, we have: Capacity building - training, Infrastructure - computers, bandwidth, Power cost of running alternative energy. With ubiquitous learning, most of these challenges would be taken care of.

Adapting Ubiquitous learning in Nigeria

Between 1999 and 2009, the tele-density of the nation has greatly increased from less than 400,000 users to over 60,000,000, which means virtually every literate adult has access to GSM, which is the main core for the learner and a network of systems by each institution.

According to Mark Weiser (1999), the technology required for ubiquitous computing comes in three parts: cheap, low-power computers that include equally convenient displays, a network that ties them all together, and software systems implementing ubiquitous applications. Current trends suggest that the first requirement will easily be met. Flat-panel displays containing 640x480 black-and-white pixels are now common. This is the standard size for PC's and is also about right for television. As long as laptop, palmtop, and notebook computers continue to grow in popularity, display prices will fall, and resolution and quality will rise.

The institution packages its programmes and makes them suitable for carriage by any GSM network provider, and these will be accessed by the learner via his/her own smartphone anywhere, anytime, and at their convenience for the learner. The learner chooses what to learn, where to learn, and when to learn. The main constraints in e-learning and m-learning are not concerns in u-learning.

Conclusion

Ubiquitous learning will simplify learning and make it readily available to all. In this paper, we have shown the present state of ICT-based learning and its prevailing challenges, and the new wave in ubiquitous learning. Since GSM is virtually in every community in the country, using it as a medium of learning will make education readily available, and this will enhance the economy, as it will translate to the larger society. Finally, we appreciate Mark Weiser's leadership in the pursuit of the Ubiquitous Computing Vision.

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