

Evolution of Learning Environment: A Review of Ubiquitous Learning Paradigm Characteristics

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ABSTRACT

This paper performed literature analysis for evolution of learning environment focusing on a new learning paradigm which is known as ubiquitous learning environment. This paper also intend at providing specific information about ubiquitous learning concepts and the criteria that needed in the future research. It begins by briefly describing the evolution of learning environment with the comparison for each of the learning paradigms. Finally, the definition of ubiquitous learning and the comparison of characteristics in ubiquitous learning paradigm are also compared and discussed to further enhance the understanding of ubiquitous learning concept. As a conclusion these paper providing a basis foundation for novice researcher that interested in exploring ubiquitous learning environment area.

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1. INTRODUCTION

Learning is the process in gaining information or knowledge by studying, experience, being taught or synthesizing the information. Definition of the learning is much deeper than memorization of the knowledge content. The statement has been agreed by the educational researchers that classified learning as the ability to generate critical thinking and transfer the new knowledge to different context, understanding the knowledge content, relating the main ideas in the knowledge retrieved and making connections between prior and new knowledge [1]. Figure 1 show that for the last few years, the rapid developments in information computer technology (ICT) have been gradually transferred from traditional learning to electronic learning (e-learning) to blended learning, then move to mobile learning (m-learning) and now we are moving towards to ubiquitous learning (u-learning).

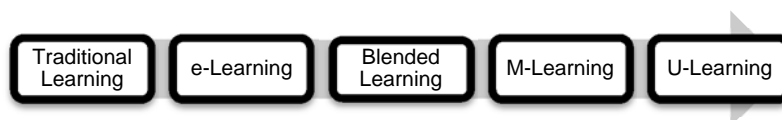


Figure 1. Evolution of Learning Environment

A traditional learning is a learning environment with an educator in front and the learners at the desks. Different learners have different types of ability in retrieving the knowledge but the educator does not

focus and teaching at individual but as generalized. Traditional learning is known as passive, formal and direct learning environment whereby the educators is the only source of the knowledge delivery. The knowledge delivery content is usually delivered in writing or orally process. The interaction process between educator and learners happen in one-way communications. The knowledge transfer process is seen as “one to many” which the educators is the authority in the learning process and act as the main communicator [1].

Electronic learning (e-Learning) is a learning that enhances traditional learning to online learning environment that use web-based and can support distance learning [2]. The interaction process between educator and learners happen in two-way communications. The knowledge delivery process seem to be “many to many” whereas learners can communicate and giving personal feedback according to their field of study needs. In e-Learning, educators interact and give instructions to the learners in web-based using computer network and the learners give feedback using the similar platform [3]. The foundation of technology in e-Learning is the internet and it is associated with communication technology whereby learners need to be more active and participate in the learning process [4]. There are two-way communication happens and they can communicate better in defining the appropriate learning content. However, in e-Learning learners are not interested in accessing knowledge materials regarding of the differences of their learning styles that depending with their behavior [5].

Blended learning is focusing on integration of traditional classroom learning with e-Learning and consider as extension of e-Learning environment. It is also represents an opportunity to integrate advances technology that offering by online learning [6]. The interaction process between educator and learners happen in two-way reciprocal communications whereby the educator will receive feedback from more than one learner at the same time. In addition, the learners are able in giving the feedback and accessing the knowledge content and repeating the same topic for several times through the web-based and if they have any questions regarding the subject matter, they can communicate in face to face interaction and reducing the possibility to misinterpret the delivery of knowledge content.

Mobile learning (M-Learning) is the extension of e-Learning applications [7]. In M-Learning, the learners use handheld devices such as mobile phones to access the learning content using wireless connectivity. In interaction aspects, M-Learning enhances two-way communication where it supports the communication between learners to the educators directly which through mobility of the devices, learners can perform their learning in anytime and at anyplace [8]. The interaction process between educator and learners happen in two-way reciprocal communications. Learning in M-Learning is a supplementary for face to face interaction by enhancing learning activities and learning experiences of the learners [9].

Ubiquitous learning (U-Learning) is a new learning environment that integrates the benefit of e-Learning and M-Learning [10-11]. In general, a widely accepted definition of ubiquitous learning is learning can happen in anytime and at anywhere using the ubiquitous technology devices. Ubiquitous learning environment, relying on ubiquitous technological devices, meaning that technology is the medium that ubiquitous learning depended on. Interaction in U-Learning consider as a social collaboration, whereby the interaction process between educator and learners happen in multi-directional communication [12]. Based on those explanations above, we identified a comparison between learning paradigms as given in Table 1 below:

Table 1. Comparison of Learning Paradigms

Characteristic	Traditional Learning	E-learning	Blended learning	M-learning	U-learning
Physical setting	- Classroom in the schools.	- Specified place	- Specified place	- Anywhere and anytime	- Anytime, anywhere using any types of devices
Role of teacher	- Authority	- Tutor - Presenter - Information provider	- Coach - Presenter - Assessor	- Expert - Moderator - Adviser	- Expert - Planner - Adviser - Academic guide
Learners Concept	- Teacher-guided	- Teachers-directed	- Self-directed	- Self-directed	- Self-directed - Self-determined
Types of interaction	- One-way communication	- Two-way communication	- Two-way reciprocal communication	- Two-way reciprocal communication	- Multi-directional communication
Technology embedded	- None	- Computer network	- Computer network	- Mobile Technology - Wireless	- Sensor technology - Mobile technology - Wireless
Mode of Learning Education Sector	- Passive - Child education	- Passive - Adult education	- Active - Adult education	- Active - Adult education	- Active - Adult education

2. LITERATURE BACKGROUND

2.1. Definition of Ubiquitous Learning

Ubiquitous learning is a new learning paradigm after the existence of e-Learning, blended learning and M-Learning. Basically, the definitions of ubiquitous learning have been discussed in many literatures [13-19]. However, it still has no any definitions that being accepted regarding the transformation in academic learning paradigms that changed so fast. In this study, several definitions have been chosen to prove that definition of ubiquitous learning is changed quickly over the time. Lyytinen & Yoo [13] have been classified four learning environments with reference of ubiquitous computing.

Figure 2 represents the four learning environments. From there, it was classified that the first learning environment will be *Desktop-Computer Assisted Learning* that provides low level embeddedness and low of mobility and the environment of this learning is limited. The second learning environment will be *Mobile Learning* that provides low level embeddedness and high level of mobility and the learners will increase their capability by accessing the knowledge information at anytime and anywhere. Meanwhile, the third learning environment will be *Pervasive Computing* that provides high level embeddedness and low of mobility and learners will obtain the information through the embedded devices in the environment itself. The fourth learning environment will be *Ubiquitous Learning* that becomes a new type of learning paradigm that offering high level of embeddedness and high level of mobility in which the learners can access the knowledge information anytime, anywhere using any types of devices with their own convenience. Of the four types of learning environment that has been discussed earlier, it is obvious that the level of embeddedness and level of mobility has a relationship with learners learning activities in their daily life.

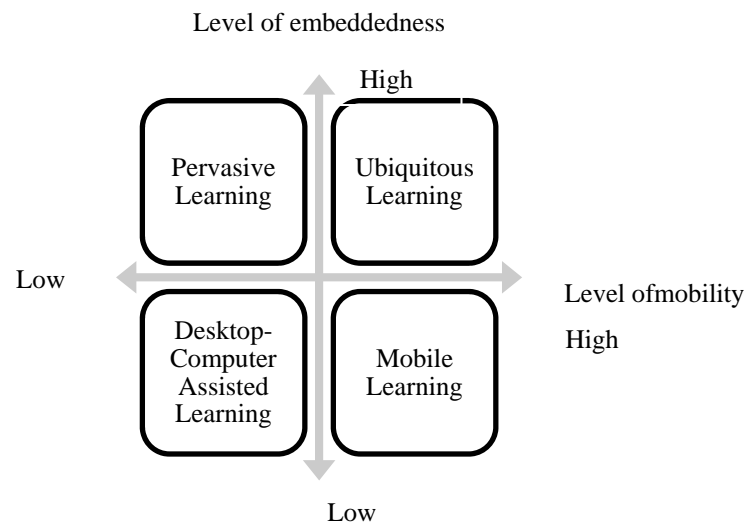


Figure 2. Classification of Learning Environments [13]

The first attempts to introduced the definition of ubiquitous learning is from Ogata & Yano, [14] by combining both of pervasive learning environment and mobile learning environment that been introduced by Lyytinen & Yoo, [13] to get a high level of embeddeness and high level of mobility. In addition, the study by Casey [10] supports the definition that introduced by Ogata & Yano [14] by formulated the definition of ubiquitous learning by combining the integration of e-learning environment with mobile learning environment. However, the term ubiquitous learning environment that's been used in both definitions is confusing because the terms of ubiquitous learning and ubiquitous learning environments convey a different meaning. Ubiquitous learning environment is characterized by ubiquitous learning characteristics [15] meanwhile ubiquitous learning is characterized by the ubiquitous environmentin learners surrounding to get the content from anytime and anywhere [16]. From here, it can be classified that ubiquitous learning should be implemented in the ubiquitous learning environment.

The most accepted definition of ubiquitous learning is “anywhere and anytime”. The definition is trying to represent a learning environment that allows the learners to access the knowledge content using mobile devices via wireless or internet connection in anytime and anywhere. However the definition is quite broad and it might be a confusing term for novice researcher. A more focus definition of ubiquitous learning should focus on utilization of ubiquitous computing technologies into the learning environment which emphasizes the use of sensor technology. Furthermore, with the enhancement of wireless communication

technology together with the advancement of computing technology nowadays helps out to support the expansion in ubiquitous computing that can support ubiquitous learning [16].

Finally, ubiquitous learning can also be defined as a new learning paradigm that promising the learners to learn at anytime and anywhere using the benefit of ubiquitous computing [17-19]. To avoid misconception of researcher in determining the definition of ubiquitous learning that using the terms of “anytime and anywhere” with “learning using ubiquitous computing technology”, a study that conducted by [17] propose a new definition which ubiquitous learning is a learning paradigm which happens through ubiquitous computing environment that enables learning happens in the right thing at the right place and time in the right way. However, as mentioned by Hwang [20], there is no clear definition of ubiquitous learning because of learning environment change quickly over the time. The assumption that can be made is many researchers have different views in defining the definition of ubiquitous learning. Therefore, the ubiquitous learning definition needs to be clarified before applying the terms into the research to avoid any misconception. In the following discussion the definition of ubiquitous learning shall focus on the learning that happens in anytime and anywhere in a right way with a right content using ubiquitous computing technology to distinguish it from the earlier broader definition.

2.2. Characteristics of Ubiquitous Learning

The ubiquitous learning environment is an integrated environment that involved all kinds of resources that consist of physical, virtual, place, devices, people, objects and artifacts. Although u-learning is a new learning environment that attracted the academic scholars, the definition and the characteristics of u-learning remains unclear [20]. There have been multiple attempts from academic scholars to identify the main characteristic of u-learning.

The first attempt to identify ubiquitous learning characteristics was based on handheld computing, Curtis [21] identify three characteristics of ubiquitous learning which are accessibility, immediacy and permanency. However, these characteristics have been acknowledged by other authors in their study [22, 23]. In the same year, Chen et al [24] identifies six characteristics of mobile learning and it has been applied by other scholars to be part of ubiquitous learning characteristics. The characteristics are urgency of learning needs, initiative of knowledge acquisition, mobility of learning setting and integration of instructional content. The most adapted characteristics are interactivity of learning process and situating of instructional activities.

On the other hand, Ogata & Yano [22] expanded the characteristics of ubiquitous learning that's been introduced by Curtis by considering the learner's mobility in the new characteristics within the embedded computing environments. The new additional characteristics are interactivity. Therefore, Bomsdorf [23] have again expanded the characteristics by proposing additionally characteristic that considering the function that the learners get the right knowledge at anywhere and anytime with their own convenience. The new characteristic that has been proposed is adaptability.

In previous research, Hwang et al [25] found that the characteristics of ubiquitous learning should focus more on context awareness and adaptation using mobile technologies. The authors proposed the characteristics of ubiquitous learning in reference to the definition of ubiquitous learning. The characteristics of ubiquitous learning that been introduces is context awareness. These context awareness characteristics also supported by Chiu et al [26] when they identified that context awareness need to be utilizing with ubiquitous computing technologies in learning environment so that the learners can increase their motivation and performance in process of retrieving the knowledge.

Finally, Yahya, Ahmad & Jalil [17] proposed new characteristics of ubiquitous learning from the combination of the reference to other researchers' ideas. They found out that situational of instructional activities, adaptability and seamless learning characteristics are part of context awareness characteristic. In analysis that have been made, characteristics that been proposed by them is more comprehensive. It also been agreed by Zolkefley et al., [19] and they also proposed the same characteristics as [17] in their work. The characteristics are accessibility, context awareness, immediacy, interactivity and permanency.

Based on those characteristics of the reference of several authors, a comparison of ubiquitous learning paradigm characteristics is given in Table2.

Table 2. Comparison of Ubiquitous Learning Paradigm Characteristics

Characteristics	Authors							
Accessibility	Curtis et al 2002	-	Ogata & Yano 2004	Bomsdorf 2005	-	-	Yahya, Ahmad & Jalil, 2010	Zolkefley et al 2015
Actively provides personalization	-	-	-	-	-	Chiu et al 2008	-	-
Adaptability	Curtis et al 2002	-	Ogata & Yano 2004	Bomsdorf 2005	Hwang et al 2008	Chiu et al 2008	-	-
Context Awareness	-	-	-	-	Hwang et al 2008	Chiu et al 2008	Yahya, Ahmad & Jalil, 2010	Zolkefley et al 2015
Immediacy	Curtis et al 2002	-	Ogata & Yano 2004	Bomsdorf 2005	-	-	Yahya, Ahmad & Jalil, 2010	Zolkefley et al 2015
Integration of instructional activity	-	Chen et al 2002	-	-	-	-	-	-
Interactivity	-	Chen et al 2002	Ogata & Yano 2004	Bomsdorf 2005	-	Chiu et al 2008	Yahya, Ahmad & Jalil, 2010	Zolkefley et al 2015
Initiative of knowledge acquisition	-	Chen et al 2002	-	-	-	Chiu et al 2008	-	-
Learning community	-	-	-	-	-	Chiu et al 2008	-	-
Mobility of learning settings	-	-	-	-	-	-	-	-
Permanency	Curtis et al 2002	-	Ogata & Yano 2004	-	-	-	Yahya, Ahmad & Jalil, 2010	Zolkefley et al 2015
Seamless learning	-	-	-	-	Hwang et al 2008	Chiu et al 2008	-	-
Self-regulated learning	-	-	-	-	-	Chiu et al 2008	-	-
Situating of instructional activity	-	Chen et al 2002	Ogata & Yano 2004	Bomsdorf 2005	-	Chiu et al 2008	-	-
Urgency of learning needs	-	Chen et al 2002	-	-	-	Chiu et al 2008	-	-

After analyzing the table, it is obvious that there have 6 major characteristics (bold text) that are considered as major characteristics of ubiquitous learning. Furthermore, by referring to Table 1, it can be seen that several authors use the same characteristic in their research. The characteristics that successfully identified are accessibility, context awareness, immediacy, interactivity, permanency and situating of instructional activities. However, several researchers agree that situating of instructional activities characteristics is part of context awareness characteristics. The aim of the situating of instructional activities is to sense learner’s physical environment and their behaviors during the learning process which it is shared a same aim as context awareness characteristics. Both of characteristics aim to sense learner’s behavior includes identified learner’s prior knowledge, current location, learning goals, learning style and learner’s interest. Basically, situating of instructional activities and context awareness is related to mobile systems that using ubiquitous computing technology in providing appropriate learning support that will be able to enhance interaction and communication between learners and educators during their teaching and learning process inside and outside the classroom.

Accessibility, context awareness, immediacy, interactivity and permanency are identified as major characteristics of ubiquitous learning paradigm, however, we agree that adaptability should be a major characteristics of ubiquitous learning paradigm that differentiate ubiquitous learning from the previous work. In a ubiquitous learning environment, the major issue is the environment expected to provide the right content, in a right way and at the right time to the learners. Adaptability can be defined as the ability of the system to be change or need to change and filtered according to any circumstances. Being able to adapt multiple contents and change according to devices are the important context for characterising the needs of the system in providing the learners with a right content, in a right way and at the right time [26]. To support our claim above and to focus the definition of ubiquitous learning that shall focus on learning that happens in anytime and anywhere in a right way with a right content using ubiquitous computing technology, a comparison between learning evolution based on the new characteristics is given in Table 3 below:

Table 3. Comparison of learning evolution based on u-learning paradigm characteristics

New Proposed Characteristic	Traditional Learning	e-learning	Blended learning	M-learning	U-learning
Accessibility	Using chalk and board only.	Access uses computer network.	Access uses computer network.	Access uses wireless networks.	Access uses ubiquitous computing technology.
Adaptability	No database or system.	Learners learn at the right time.	Learners learn at the right way.	Learners learn at the right way in a right place.	Learners learn at the right way with a right content in a right place.
Context Awareness	No database or system.	The system cannot sense the learner environment	The system understands the material that learner's want by accessing the database.	By accessing the database, the system understands the learner's situation, but it is cannot sense the learner's location.	By accessing the database, the system can sense the learner location, personal and situation using ubiquitous computing technology.
Immediacy	The information given in the classroom only.	Learners never get the information immediately.	Learners can get the information in anytime.	Learners get the information immediately, but the environment is limited because it is using specific mobile devices.	Learners get the information immediately when they want it.
Interactivity	Interaction only in the classroom.	Learner's interaction is very limited.	Learner's interaction is quite limited.	Learners can interact with anyone in a specified learning environment.	Learners can interact with anyone at anytime and anywhere and not limited to the specified learning environment.
Permanency	No permanency criteria.	Learners can lose their work if something happens to the devices.	Learners can lose their work if something happens to the devices.	Learners may lose their work if something happens towards the mobile devices.	Learners can never lose their work unless it is being deleted.

3. CONCLUSION

The advancement of wireless and sensor technologies brings the rapid progressive evolution of learning environment from traditional learning to ubiquitous learning environment. The ubiquitous learning environment will become a trend in future learning paradigm. It offers easy approach for learners to access learning system using any device at anytime and from everywhere at their own convenience. The definition, characteristics and the evident of ubiquitous learning paradigm that can support learning in a better ways will benefit novice ubiquitous learning advocates by providing a guide to enable the researcher in understanding the concepts and criteria that needed in ubiquitous learning research. In order to success in learning, learners need supportive environment that collaborate them in efficient ways. Therefore, the technology plays an important role in supporting ubiquitous learning and a proper technology configuration to obtain learning information is a must. Further investigations of the ubiquitous learning environment with a possible focus to interaction process in learning and requirements platform of technologies in ubiquitous learning environment are suggested.

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