
Mobile and Ubiquitous Learning Contents: The Meta-analysis

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Abstract

The literature based studies conducted earlier provide very important insights into m-learning. Due to rapid growth in technology, there is still a need to re-examine the m-learning to find the recent research trends. A meta-analysis approach has been adopted to review the literature (Palvia, 2006), thus a detailed content analysis of the articles has been made published during 2010 to 2015, which have been selected from the leading educational and technology related journals. This study tries to aggregate the subject taxonomy which includes development, management, context, and delivery of m-learning contents to mobile users. The findings of this research study provide recent and future research trends in mobile and ubiquitous contents in m-learning to young researchers

Key words:

M-learning, Ubiquitous Learning, Learning Object, Learning Context, U-learning

Introduction

Learning is the process of acquiring new knowledge or modifying or re-defining the existing knowledge. Computing technologies provide tremendous support in learning (Naidu , 2006). With the emergence of web technology, a new educational medium has emerged, called electronic learning (MUP, 2013). Researchers from various fields intersected e-learning domain with knowledge management (shown in Figure-1). The hand held and wearable devices with appropriate learning tools and resources give birth to a new era of learning supported by user friendly interfaces and high speed communication networks (Sharples, Corlett & Westmancott, 2002).

Due to rapid growth of mobile and wireless technology, mobile devices have become the part and parcel of the society. The recent advances in both capacity and speed of mobile devices support the new mobile applications and makes mobile computing possible. Mobile computing refers to the ability of mobile devices to retrieve and publish information with the use of wireless network without predefined location (Imielinski & Badrinath, 1994). The use of mobile devices introduces a new term in e-learning that is m-learning. Mobile computing and e-learning are the two separate scientific fields which are combined into mobile learning (Trifonova, 2003).

A learning technique which uses mobile technology and wireless communication in the learning process is called mobile learning (Chang, Sheu & Chan, 2003; Hoppe, Joiner, Milrad & Sharples, 2003; Elmorshidy, 2012). M-learning carries many components of e-learning, but has some distinct features also. The three key features of mobile devices i.e. portability, anywhere and anytime connectivity irrespective of the context differentiates m-learning from e-learning (Sharples, 2002). These distinctive aspects of mobile devices give unique learning experience to m-learners which includes individual learning, situated learning, collaborative learning, and informal learning.

Taxonomy

It is very difficult to define and categorize mobile learning clearly; however, it can be viewed as e-learning with mobile devices and wireless transmission (Chang, Sheu, & Chan, 2003; Hoppe, Joiner, Milrad, & Sharples, 2003), as explained in Figure-2. Mobility and ubiquity are the main characteristics which differentiate m-learning from e-learning (Penga, Sua, Choua & Tsaib, 2009). The wide variety of applications and learning

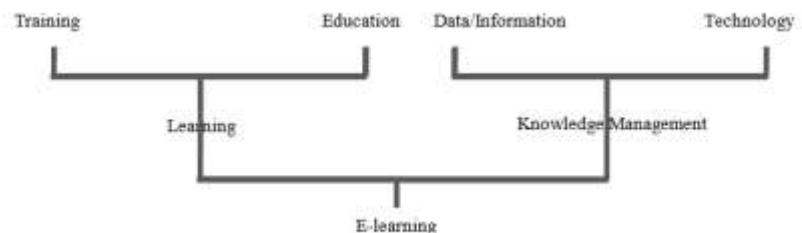


Figure-1: E-learning

techniques are included in the mobile learning domain.

M-learning mainly depends on the development of learning resources which includes software and human resources. The software resource development relies on three basic components that are: mobile learning, knowledge resource design & development and application software that facilitate knowledge resource development

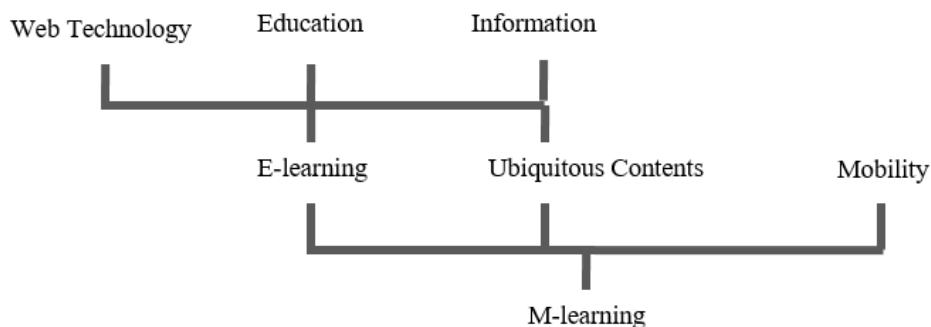


Figure-2: m-learning

Research Methodology

The papers published in the major ISI/SSCI indexed journals have been analyzed. Following is the list of journals:

Table-1:

Scope of the Research Study

Sr. No	Journal Name	Frequency
01	IEEE Transactions on Learning Technologies	7.89%
02	British Educational Research Journal	00%
03	IEEE Transactions on Education	13.16%
04	Computers and Education Journal	5.26%
05	Innovation in Education and Teaching International journal	18.42%
06	Journal of Information Processing Systems	1.32%
07	Journal of Computer Assisted Learning	30.26%
08	Journal of Personal and Ubiquitous Computing	1.32%
09	Electronic Journal on e-Learning	19.74%
10	World Wide Web Journal	2.63%

From the above-mentioned journal list, published articles have been filtered out on mobile and ubiquitous learning on the basis of the following criteria:

1. Article published between January, 2010 to December, 2015
2. Learning must be for education sector at any level
3. Technology device must be mobile

In the initial search with words “mobile learning or ubiquitous learning” about 223 articles were searched. Out of 223 articles, 81 fulfilled the defined criteria and constituted the sample for content analysis. To track the research direction about the m-learning, content analysis of the selected research articles was made. Table-2 also showed the frequency of the selected articles from different journals. The content analysis of each article was conducted as described in (Palvia, 2006), according to which the text was systematically examined to identify the themes and develop categories of the subject.

Major Areas of Discussion

The majority of researchers, who are working on m-learning, presented the vision of this field as anywhere, anytime and with any device learning (Wagner, 2005). M-learning is spontaneous, networked, situated and informal. Broadly speaking, the areas of investigation in m-learning are: Learning Content/Resource Development, Learning Content Management, Learning Content Delivery and Learning Context (Location Awareness). On the basis of the reviewed literature, taxonomy of mobile learning contents has also been developed.

Learning Content/ Resource Development

Mobile learning resources refer to the resources that facilitate mobile learning. Learning content is the part of software resources and the most important entity in mobile learning. Learning content does not only mean learning material, it includes authoring, aggregation and delivery of the contents also (Juang et al.,2004).

The internet and intranet accessibility has been extended to anywhere and anytime due to mobile technology. This extension encourages the development of mobile learning contents. The mobile learning content development framework considers three dimensions: time, space and scale, to make content development efficient (Juang et al.,2004). The contents can be authored with any commercial authoring tool and stored in database. Later, delivery of the developed contents is made according to user’s hardware requirements.

The developed m-learning contents may be reusable, shareable and interoperable, developed on the basis of object oriented paradigm (Ying & Qunli, 2011). To cater the intricacies of mobility and to better facilitate learning in mobile environment, a design for the development of learning contents/material is required to be developed (Bai, 2010).

Learning Content Management

The evolution in technology offers various software, protocols and standards for learners and learning content developers to manage the learning contents. Learning objects and tagged meta data standards not only improve the efficiency of learning resource management system but also

enable the developers to design and manage granular, reusable, interoperable and aggregated contents (IMS, 2003 & SCORM, 2003).

Learning Content Delivery

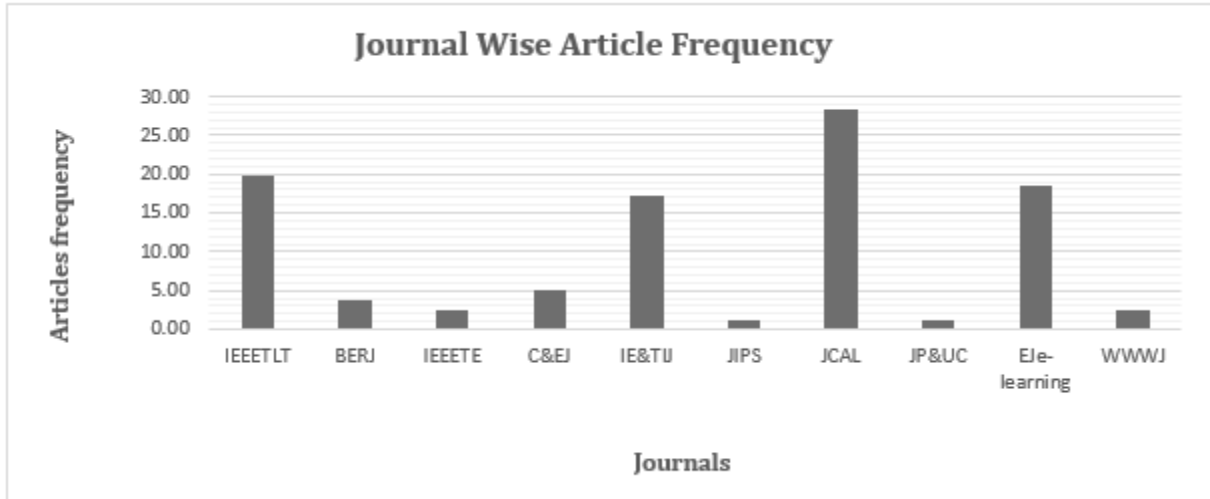
Mobile learning mainly depends on the wireless technology to access the learning contents. 3G and Wifi supported networks have better data rates as compared to the 2G, and 3G supported mobile learning (Miao, 2012).

Learning Context (Location Awareness)

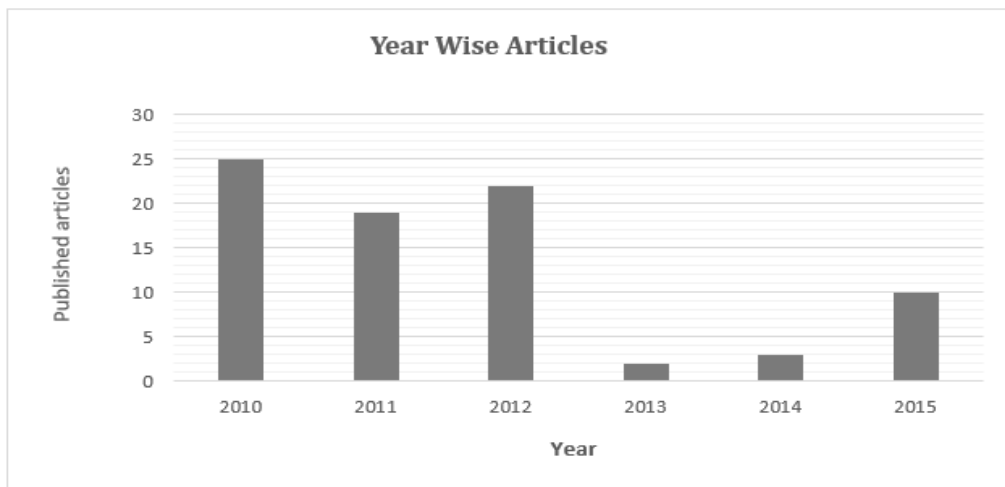
Location is an important context in mobile learning, both in terms of learner's where about and opportunities for learning (Brown et al., 2010). Time, location, learner's trajectory, goals, motivation, surrounding learning resources and co-learners are the important contexts which mediate mobile learning. The mobile learning knowledge resources are developed and adjusted according to the context (Sharples et al.,2002). The 5R adaptive learning content generation platform for mobile learning is used for content generation, not for content creation/development (Ako-Nai et al.,2012). This study also provides following taxonomy of the mobile contents research areas.

- 1 Learning Content Development
- 2 Learning Content Delivery
- 3 Learning Content Placement/Management
- 4 Learning Context (Location Awareness)

Graph-1 shows the frequency of the selected articles from different indexed journals. The graph-1 shows that the journal of computer assisted learning (JCAL) and electronic journal of e-learning (EJe-learning) ranked higher. The JCAL is expected to be the major platform to publish m-learning research and it may provide new trends in this area. The graph-2 shows that there is no continuous growth in m-learning research.



Graph-1: Journal Wise Articles Frequency



Graph-2: Year Wise Articles Frequency

Discussion

Mobile learning aims at facilitating anywhere and anytime learning regardless of location and time (Abowd & Mynatt, 2000). M-learning customized the learning contents according to the learner environment (Chung & Lee, 2012). The theoretical frame work for mobile learning has yet not been defined (Penga et al., 2009). Learning contents include learning activity and appropriate learning material used for learning ([Juang, Chen](#), Chen & Chan, 2004).

The importance of m-learning can be viewed from the statistics given by Taylor (2001). Almost 95% of the population in Japan between the age of 15-24 have web enabled mobile phones while 100% university students owned mobile phones, out of which 99% use it for sending emails

(Thornton & Houser, 2004). The formal method of teaching has its own importance but m-learning can facilitate the formal learning in higher education (Campanella, 2012)

Mobile devices are available with different computational and storage capacity. Due to the heterogeneous nature of mobile devices, there is a dire need of developing learning resources which can be accessed and viewed on any kind of mobile devices without affecting the learning process. The developed mobile contents may be universal and ubiquitous in nature. Presently the construction of effective, reasonable and universally accessible resource development for mobile devices is the need of m-learning. The developed resources facilitate students and teachers in higher education.

Development of mobile learning contents, technical issues in mobile learning service and mobile learning system need to be studied in order to enhance mobile learning service and system (Chung et al., 2012). The service stability in mobile learning can be achieved by using high speed downlink packet access (HSDPA) instead of wide-band code division multiple access (WCDMA) (Chung et al., 2012).

Furthermore, in case of mobile learning, user location can also be considered to improve contents delivery. The contents may be provided from the nearby location. Researchers around the world predicted that a mobile and wireless technology played a key role in bringing revolution in education (Liu & Hwang, 2010).

Another research area which requires exploration is the m-readiness assessment which can be defined as organizations' infrastructure availability and capacity or ability of faculty, staff, tutors and learners involved in m-learning. The m-readiness assessment is the evaluation of organizations' available infrastructure and ability of other stakeholders to accept m-learning. M-readiness assessment also considers the issues like cellular bandwidth issues, high cellular bandwidth cost, cellular infrastructure, management policies etc. The assessment process leads to a strong base for planning the development of m-learning system environment and it can act as a take off point for devising m-learning strategy.

Learners' readiness assessment is a highly vital factor in mobile learning environment. The student's readiness towards m-learning has been explored in many studies. At higher educational institutions, students' readiness by using technology acceptance model (TAM) was assessed with encouraging results (Iqbal and Bhatti, 2015). Student assessment was also made by using TAM and theory of planned behavior (TPB) where students showed acceptance of computer and mobile devices as learning tools (Horzum, Öztürk, Bektaş, Canan Güngören & Çakır, 2014). Students' readiness at Open University of Malaysia was investigated for mobile alerts, tips and audio files

reception on mobile and 63.71% showed their interest (Abas, Peng & Mansor, 2009). Students' readiness was analysed on the basis of their skills, psychology and budget, which showed positive results (Hussain, Manap, Amir, & Krish, 2011). Readiness of students was assessed on the basis of various factors i.e mobile phone availability, its features, internet service availability, affordability and willingness. Mostly authors used TPB and TAM to assess m-learning readiness among students (Iqbal et.al, 2015; Horzum et.al, 2014). These theories were mostly based on ease of technology use, usefulness, attitude, behavior and intention. However, the situation is a little different in the developing countries where other factors like availability of mobile phones, accessibility of internet, cellular data cost, infrastructure in institutions, cellular network coverage, faculty and staff competencies and learner ability play an important role in the assessment. Therefore, there is a need to develop an assessment model to assess m-readiness level in learning institutes of the developing countries by considering the basic local influential factors.

Conclusion

The findings of the study reveal that development and management of mobile learning contents, technical issues in mobile learning service and mobile learning system need to be studied in order to enhance mobile learning service and system. To improve content delivery, service stability in mobile learning can be achieved by using high speed downlink packet access (HSDPA) instead of wide-band code division multiple access (WCDMA). The findings also reveal that user location can also be considered to improve contents delivery to m-learners. However, due to the varied range of mobile devices, there is a need of developing learning resources which can be accessed and viewed on any kind of mobile devices without affecting the learning process. Moreover, an assessment model to assess m-readiness level need to be developed in the developing countries considering the factors such as availability of mobile phones, accessibility of internet, cellular data cost, infrastructure in institutions, cellular network coverage, faculty and staff competencies and learner ability.

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