



Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

A new M-learning system for higher education

Wang Shunye

Department of Computer Science and Technology, Langfang Teachers University, China

ABSTRACT

Now education has been gradually expanded, and each of the components of the education has changed. New portable and electronic devices take place of old text books. Communication and collaboration have been more and more discussed by the education experts. In this paper, an emerging paradigm mobile learning is been discussed. Mobile learning is relatively new, so we research the definition of m-learning, discuss its characters and the difference and connection with e-learning and u-learning, and propose a new m-learning system. It is practical for engineering learners in higher education and intelligent using learning community and personality recommendation. At last, the maturity measure and quality evaluation is introduced to assess the m-learning system.

Key words: mobile learning; m-learning system; quality evaluation

INTRODUCTION

Education is an important component on our life because it equips us with all that is needed to make our dreams come true. Now, more and more conventional education models are not meet with the requirements of the development of the social progress and the education. It is not able to catch up with the changes of learning demand in time. The arising of the network influences the education system. It brings various opportunities to learn knowledge. Education has been gradually expanded [1].

At the same time the increasing processing power, improved accessibility and enhanced applications embedded in emerging mobile technologies has created a challenge for higher education institutions who want to provide students with high quality and sustainable technology-rich environments. Smart mobile technologies, such as tablet computers and smart phones, offer advanced computing abilities as well as access to internet-based resources without the constraints of time or place. The functionality of these devices is continuously enhanced through the inclusion of features from established technologies such as personal digital assistants (PDA), portable media players, GPS navigation, digital cameras and eBook readers [2]. This has resulted in devices that enable the provision of ubiquitous learning environments that combine real-world and digital world resources [3]. And the wireless network also provides enough technical support, for example, the quantity of learning resources and the speed of the wireless network. So the mobile learning (m-learning) appeared.

According to the statistics, the world has six billion people using mobile phone which is three quarters of the total population. That the mobile device is connected to the Internet becomes more and more popular. The mobile devices which are easy to use play the important role in economic and have significant potential applications in the field of education especially in the area that the traditional education resources are relatively deficient [4]. The website of the Ministry of Industry and Information Technology of the China announced the operation of the communications industry. The data displays, the total number of mobile Internet users reached 0.838 billion as of the January 2014. The penetration rate of the mobile phone users reached 67.8%. The mobile traffic Internet accessed 0.133 billion GB, grown 46.9% compared to the same period. The average mobile Internet access flow reached 165.1MB, the mobile phone network traffic accounted for up to 80.8% months, the average mobile phone Internet traffic to 139.3MB in average family [5]. This is not to be ignored in the huge mobile learning groups. It will bring huge potential market

supply and demand. The students in higher education play the important role. The same research result is appeared in Australia [3] and other countries and continents [6, 7].

The structure of the rest of the paper is as follows. Section II properly describes the definition and the character of the m-learning, and the differences and connections with e-learning and u-learning. Many components are introduced and a new m-learning system is proposed in Section III. Section IV analyzes the evaluation of the m-learning system. Finally, the concluding and the next work are given in Section V.

MOBILE LEARNING

Definition

Due to the rapid development of the mobile communication technology, the research of mobile learning is appeared in abroad relatively earlier, and about 1994 there is researcher to learn it. The research of mobile learning in China started in 2000 spring. Desmond Keegan who is an expert in the international distance education took a report named "From distance learning to electronic learning, from electronic learning to mobile learning" in Shanghai. The concept of mobile learning appeared in China firstly [8, 9].

During the development of mobile learning, there are many definitions. According to Quinn [10], mobile learning is learning through mobile computational devices. Pinkwert et.al. [11] define m-learning as e-learning that uses mobile devices and wireless transmission. Peters [12] also stated that it was a subset of e-learning, a step toward making the educational process "just in time, just enough and just for me". Alley [13] defines the mobile learning as the process of using device to access and study learning materials and to communicate with fellow students, instructors or institution. These definitions describe the procedure of the research in mobile learning.

In this paper, the definition in [14] is adopted. Mobile learning (m-learning) is characterized by the ability to promote a strong interaction among apprentices and tutors, enabling them to contribute, participate and access the learning materials through mobile devices (e.g., mobile phones, tablets, laptops, among others) at anytime and anywhere. So, the main goal is to provide greater motivation, convenience and flexibility to the learning processes in general.

Characters of the M-learning

The character of the m-learning is as follows in [15, 16]:

Accessibility: The information is always available whenever the learners need to use it.

Immediacy: The information can be retrieved immediately by the learners.

Interactivity: The learners can interact with peers, teachers, experts and institutions efficiently and effectively through different media.

Customized tools of learning: The most unique capability is to be able to offer customized learning information for the users.

Context-awareness: The system can acquire the learners' real situation to provide adequate information for the learners.

Permanency: The information remains unless the learners purposely remove it. Flexible: Large mass covered, reduces students' indiscipline and unrest problem.

Used very where at every time.

Most of mobile devices have lower prices than desktop PCs.

Similar size and light weight than desktop PCs.

Ensure more students engage as m-learning is based on modern technologies, which students use in everyday life.

E-learning, M-learning and U-learning

The 21st century is the Information Age, and it brings with itself an era where computer technologies develop rapidly and become widespread among all levels of the community [17]. Distance Learning (UE), which provides those who possess different demographical and cultural backgrounds in different places and aren't able to continue formal education, is becoming widespread in the entire world and is accepted as the education system in the future [18]. With the developing technology, distance learning has increased to a level to serve the notion of life-long learning. It comes through the normal distance learning, e-learning and m-learning, at last gets the ubiquitous learning, which is called u-learning. Most writers observe m-learning as a naturally evolved form of e-learning. However this opinion has some deficiencies. E-learning occurred as a new form of distance learning and its terminology is close to those of traditional learning. But although the applications of m-learning are seen as an evolution of e-learning, m-learning is a characterized technology and has its own terminology. M-learning also has difference from e-learning in other aspects in Table 1[19].

Table 1: the difference between e-learning and m-learning

	e-learning	m-learning
Terminology	Computer, bandwidth, multimedia, interactive, hyperlinked, collaborative, media-rich, distance learning, more formal, simulated situation, hyper-learning	Mobile, GPRS, G3, Bluetooth, Objects, spontaneous, connected, networked, lightweight, situated learning, informal, realistic situation, constructivism, situationism, collaborative
Students communication	Face-to-face: audio-teleconference common, email-to-email, private location, travel time to reach to Internet site, dedicated time for group meetings, poor communication due to group consciousness	Flexible: audio- and video teleconference possible, 24/7 instantaneous, no geographic boundaries, no travel time since wireless connectivity, flexible time, rich communication on due to one to one communication, reduced inhibitions
Evaluation	In-class or on computer: dedicated time, restricted amount of time, standard test, usually delayed feedback; fixed-length tests	Any location: 24/7 instantaneous, any amount of time possible, individualized tests, instant feedback possible, flexible-length/number of questions

Ubiquitous learning (or u-learning) is similar to some form of simple mobile learning, e.g. that learning environments can be accessed in various contexts and situations. The Ubiquitous Learning Environment (ULE) may detect more context data than e-learning. Besides the domains of e-learning, u-learning may use more context awareness to provide most adaptive contents for learners at the right time at the right place in the right way [20].

A ubiquitous learning environment is any setting in which students can become totally immersed in the learning process. So, a ULE is a situation or setting of pervasive or omnipresent education or learning. Ubiquitous Learning Materials (ULM) is defined as learning materials that may be transferred to mobile devices via cable or wirelessly and be operated in these mobile devices.

Ubiquitous learning implications for education includes: [21]
 Shift the classroom from a traditional to non-traditional context.
 Prepare and encourage students to become lifelong learners.
 Create an environment in which interaction is “free of stress.”
 Prepare students for “real life.”
 Provide several representational modes.

So, at the first stage of distance learning, the e-learning is adopted. As the development of the mobile technology and the computation technology, the m-learning is appeared. And finally the u-learning is realized.

M-LEARNING SYSTEM DESIGN

Components in m-learning

Mobile learning is currently in the early stage of developing the next stage of e-learning technology and helping increase formal education. M-learning is not trying to replace the use of computers to aid the evaluation and learning, but rather complement it with new interesting methods available to teachers. An M-Learning system is composed of the components presented in Table 2. Any m-learning system must use at least one component from each group presented in Table 2 [7].

Table 2: the components in m-learning

Equipments	Platforms	Programming languages	Data transfer	Data transmission	Media options
Mobile phones	Android	C/C++/C#	GSM	SMS	Text
Tablets	iOS	Java	GPRS	MMS	Audio
PDA	Windows	Perl	IrDA	WAP	Video
Notebooks	Symbian	Flash	Bluetooth	E-Mail	teleconferences
iPAD	J2ME	HTML/XHTML	Wireless	HTTP	
		CSS			

Fast growing internet facility in the form of Wi-Fi is another attribute to this method of learning. The other most important element in m-learning is the internet connectivity in the mobile device. Talking about m-learning, wireless data communications in the form of Short Message Service (SMS) and Wireless Access Protocols (WAP) browsers have gained global popularity [16]. The form of SMS mainly includes text or MMS whose content is simple. And the WAP is the protocol in wireless environment. It is important to distinguish between mobile website and mobile applications (apps). Mobile websites are HTML websites reconfigured for the small display size of mobile devices. They are instantly available, compatible across different computing platforms, easily upgradeable, can be found easily, and have a broader outreach. Mobile apps are platform specific. Android apps only run on the Android operating system. Apps are installed on the device for specific purposes. Apps are the fuel driving m-learning. The problem teacher faces is that the curriculum is not designed for computational thinking, and yet the instructional environment is now requiring this skill. Teachers are confronted with decisions regarding app choice for classroom

activities [6].

Proposed m-learning system design

Regarding methodology and organization, preparing and carrying out m-learning is not significantly different from e-learning. This process could be realized following the next main stages [7]: preparatory stage, structuring learning content, designing user interface, building and supporting data base, process of m-learning, individual control and tracking, statistics and conclusions and predefinition and adaptation of the course.

In the context of distance learning, M-Learning includes the use of mobile devices to perform any of the following jobs [16]:

- Deliver Education/Learning
- Foster Communications/Collaboration
- Conduct Assessments/Evaluations
- Provide Access to Performance Support/Knowledge
- Capture Evidence of Learning Activity

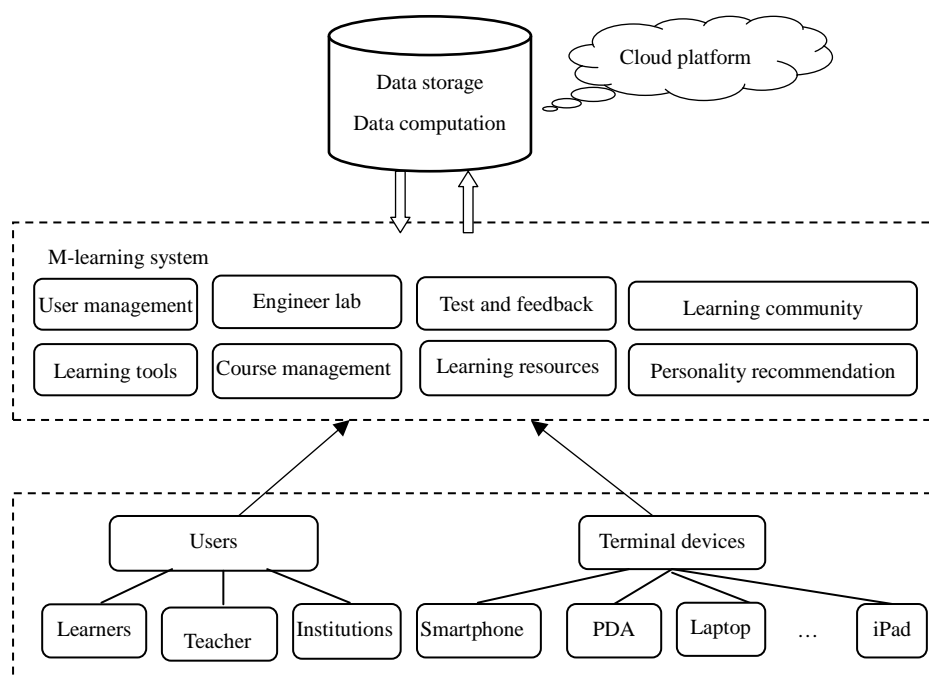


Fig. 1 the proposed m-learning system

This proposed m-learning system is based on the system in [22]. It also uses cloud computing technology. It includes engineering lab, learning community, personality recommendation, test and feedback compared to the original system. The database includes two components, the main database which is located on the server and the second database which is located on the mobile device of the learner. This is good at the individual control and tracking.

The engineering lab: It is designed especially for the engineering learners. The common objects beside the normal include textual information, graphical information, formalization and mathematical interpretation and experimental investigation [23].

The learning community: The discussion and communication in m-learning system is not only including the learner and the teacher, but also the learners themselves. The learners who have the same background or interesting can make up a learning community. They can learn and communicate from each other in the similar topics. This contributes to social network.

Personality recommendation: The m-learning system should records all the information of each history of the learner activity, the time, the place, the content. All the information are transferred and stored in the database in the server at last. Then it uses the data mining analysis technology and social network analysis technology to find the similarity of the learners and resources. At last it makes intelligent learning plan and personality recommendation for each learner. Figure 2 shows the procedure.

The test and feedback: According the test and the communicating with the teachers and other learners, the learner can get feedback immediately. The conclusions of the feedback from the statistics can conduct the learning behavior, and form the dynamic of learning.

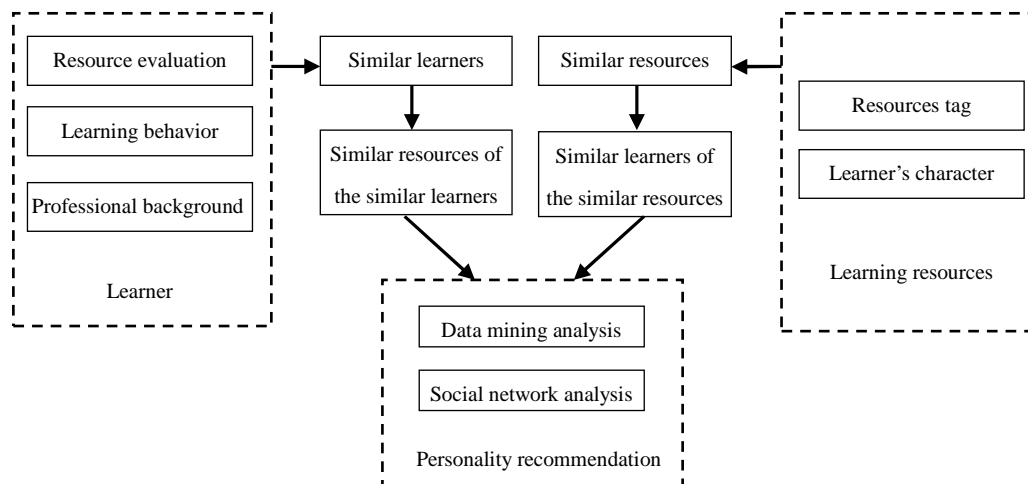


Fig. 2 the personality recommendation of the learning resources

EVALUATION OF M-LEARNING SYSTEM

Now, more and more literatures are regarding quality guidelines for mobile applications. As a consequence, there is no well-defined and widely used mechanism to support the quality evaluation of mobile educational environment.

The identification and understanding of quality criteria, requirements and metrics for m-learning environments is a complex task [24, 25]. Different factors are involved in the development and adoption of such environments. Additionally to technical aspects, educational components, attributes of ubiquitous computing, criteria of mobile usability, among others, should also be taken into consideration. Besides that, there is a need for the establishment of specific processes for quality evaluation in the context of mobile learning. The idea is to ensure that evaluations can be effective and capable of being replicated in different organizations, for a wide range of m-learning systems [14].

A successful assess mode is Capability Maturity Model (CMM) which is maturity model for measuring the maturity in the area of software area. It also can be used to evaluate m-learning system. In [26, 27], the author modified CMM to come up with an m-learning model. The maturity model is used to assess whether an institution is capable of establishing and sustaining efficient collaboration of a new learning platform, in this case m-learning by providing adequate support in both direct and indirect ways. The idea is to first assess the current level of capability and grade it on the maturity scale. Following this the key requirements subsequent higher maturity level are adapted for the current institution in order to suggest changes that will increase the maturity of the institution in terms of adopting a new learning platform successfully [26]. So it classifies the procedure into two steps. The first and most important step is to correctly identify the critical success factors for the adoption of technology. The next step is to device a method for measuring the critical success factors precisely.

In [4], the evaluation process is composed of six main steps: define objectives and contextualization of the evaluation, define and configure the quality model, identify the evaluation metrics, define punctuation levels and judgement criteria, design the evaluation and execute the evaluation. And it uses the scoring to the scheduling problem method to measure the quality. The main quality criterion of the questions includes nine aspects, such as functionality, usability, security, performance, pedagogical, support, service level, portability, communication. According the research applying in two universities, the criteria of “functionality” gets the good scores. It shows that the function of the m-learning is the most important aspect and the learner takes care of it heavily.

The most character in the proposed m-learning system is the data mining analysis and the social network analysis. The purpose of the analytic is the effective use of data and gather new insight. In education, analytics is of great importance since it can assist in solving many educational problems. Moreover, student engagement identifies the nature of the relationships that exist between students, academics, university resources and academia in general. Identifying these relationships might help to provide insights into the relationship between student engagement and their academic achievement, and the potential for improvement [28]. For teachers, having the ability to analyse the learning activities of mobile learners is likely to be of great value. In the m-learning system, educators can

understand the level of learners through his learning activities and speech from learning community, replace or update the learner materials and improve the teaching pattern through the response of learners. For learners, the analytics will help them to be struggling academically as early as possible, to allow for implementing some early intervention strategies that might help such students to succeed. The collection of the data might be of great use in tracking the progress of learners and assisting them effectively during the learning experience.

There are many methods of analyzing the collected data [28]. For instance, it can be done using statistical methods such as mean, standard deviation. In addition, data mining techniques can be used; data mining has two famous objectives, which are predictive and descriptive objectives. The predictive objectives of data mining, such as classification and regression, can be achieved using part of the available variables to predict one or more of the other variables. On the other hand, the descriptive objectives of data mining, such as clustering and association rule discovery, can be achieved by identifying the patterns that describe the data. This approach has the advantage of being easily understood by the user [29]. Analysis can also be done by using the social network analysis methods in which the interactions between students can be understood [30].

CONCLUSION

Now more and more experts pay attention to the m-learning. The news that the UNESCO held the 2014 mobile learning week explains the reality. The m-learning makes the portable device applying to effective learning inside and outside the classroom, lets people review and re-thinking the learning activity, proposes a concept of seamless learning with connectivity learning [31]. It is ubiquitous learning which can learn at anytime and anywhere in personalized pattern. The data mining and social network technologies play an important role. M-learning can make a useful contribution to attracting students to learning, maintaining their interest and supporting their learning and development. But now, the mobile technologies are mainly used in entertainment field. The reasons result that are the concept of m-learning is not popular in students, teachers and institutions, the lack of m-learning systems and materials, the performance and cost of the wireless is not satisfied, and so on. So there have a long way to go.

In this paper, we discuss the definition of the m-learning, the characters of it and the difference and connection with e-learning and u-learning. A new m-learning system with intelligent personality recommendation for engineering learner is proposed. At last, we describe the evaluation method of the m-learning system. The next work is applying the m-learning to higher students, and using the quality evaluation method to measure the system.

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