

Towards a Framework of Mobile Learning User Interface Design

Almed Hamzah

Andhika Giri Persada

Ahmad Fathan Hidayatullah

Department of Informatics, Universitas Islam Indonesia
Jalan Kaliurang KM 14,5 Sleman
Yogyakarta Indonesia 55584
almed.hamzah@uii.ac.id

Department of Informatics, Universitas Islam Indonesia
Jalan Kaliurang KM 14,5 Sleman
Yogyakarta Indonesia 55584
andhika.giri@uii.ac.id

Department of Informatics, Universitas Islam Indonesia
Jalan Kaliurang KM 14,5 Sleman
Yogyakarta Indonesia 55584
fathan@uii.ac.id

ABSTRACT

In this mobile devices era, mobile learning is increasingly attracting attention from many educational institutions. It offers several benefits to enhance learning process and environment. In addition, it can improve the students learning performance as they can get access to valuable information that related to their course easily and quickly. One of the important aspect of mobile learning is user interface. This paper reports a result from literature review study on the aspects of user interface in mobile learning contexts. There are 45 articles under reviewed. The result shows that there are four dimensions of user interface that characterized mobile learning application, i.e. (a) design principles, (b) usage context, (c) hardware specifications, and (d) modelling language. Future works are discussed afterwards.

CCS Concepts

• Applied Computing → Education → Interactive Learning Environments

Keywords

Mobile learning; Higher education; User interface.

1. INTRODUCTION

Mobile devices become more pervasive today as it is getting more affordable [4]. It is being used by so many people from various background, including those from educational institutions like students and teachers. The use of mobile devices in academic context is called mobile learning. It is a form of media technologies that used to establish learning activities through the use of mobile devices [14]. Currently, mobile learning is increasingly adopted by many institutions in the educational sector either formal or informal one. In this regards, students are the most potential user of mobile learning [17]. Most of them are already owned mobiles devices, especially smartphone and tablets [6]. There are several benefits that mobile learning can offer to students. Firstly, it can provide enjoyable environment in learning so that student are motivated to improve their learning performance [15]. Moreover, it can provide the students a flexible time in their learning activities [7]. Lastly, students have a choice to study either in the class, out of the class, or combination between the two.

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There are some common activities of learning that could be done with the support of mobile devices. For instance, search for information related to the course, downloading course material, language translation, doing quizzes and assignments, and collaboration. However, this learning context face challenges in terms of user interface design as mobile devices have some limitations, i.e. small sized screen, different screen width among devices, touch screen capability, text typing difficulties, physical environment, and limited attention of user [22]. In addition, there are some specific hardware issues including limited battery power, limited computing ability, limited bandwidth, and limited storage or memory [21]. These challenges are also affecting the design of mobile learning application. Mainly, it has to deal with the screen size. The learning content should be small enough to fit in the devices' screen without giving up the quality of information [9]

One of the solution to overcome the challenges is to design a proper user interface that suited to mobile devices characteristics. In fact, user interface takes a main role in it and contribute to the success of such technology adoption [1]. A proper user interface was proven to attract user to keep using the application. There are several general indicators that can be used to measure the quality of user interface, such as linearity of information and the importance level of information [22]. In addition, user interface should adapt to various size of devices' screen [3] along with other factors that must be considered, including battery power and limited interaction with its user. The limitations of the devices, especially on the screen size, require specific arrangement of information to be displayed so that the information could be conveyed effectively [9, 13]. This paper aims to identify the dimensions of mobile user interface design for mobile learning system. The main contribution of this research is initiate the mobile learning user interface design framework that will be followed by future works. The study employ systematic literature review method to extract an insight from already published research works available on the research database.

This paper is organized as follows. Section two explains the related research. Section three describes the method being used in this research. Section four explains the result of the study. Section five will end this paper with concluding remarks.

2. RELATED WORKS

Mobile devices had been widely used by higher education institutions. It is contemporary method in the recent learning activities [18] and commonly called as mobile learning. It has a role as a communication hub in learning environment [19]. In addition, it supports the establishment of the more fluid communication pattern between students and their teacher [15].

In [13], mobile learning is defined as learning activities carried out in a mobile environment. It is a part of e-learning technologies [21]. In mobile learning, the learning materials are exchanged through

mobile devices so that students can access it and doing their learning activities on demand [2, 10].

There are two main activities in mobile learning, i.e. transmission and acquisition of knowledge [9]. The former means that information and material related to learning courses is transmitted to mobile devices. The material should be in small size, comprehensive, and suited to the students' requirements. The later means that students are expected to acquire specific knowledge based on the information being transmitted.

The information related to learning is increasingly exchanged by the use of mobile devices [11]. There are plenty of learning content available to access by mobile devices [3]. It can take the form of video, audio, text, and images. This offer students a various method of learning [10]. Mobile learning could improve the effectiveness and accessibility of learning activities in the future [20].

There are three dimensions of mobile learning adoption, i.e. mobility of learning, mobility of technology, and mobility of learner [13]. First, the mobility of technology means that the devices being used to deliver learning content should have the ability to connect to the Internet so that the information being able to be accessed anywhere and anytime by students. Second, the mobility of learner means that the learning activities should be able to support the students' mobility as well as the freedom to access the learning material based on their needs. Third, the mobility of learning means that the material contents should also adjusted to be more suitable for mobile devices.

3. METHODS

The objective of this research is to identify the dimensional aspects of user interface of mobile learning application. In order to do that, previous published works in journal are collected as a data source for analysis. This research employs content analysis methodologies to review and gain an insight from these literatures. Figure 1 depicts the steps taken in this study.

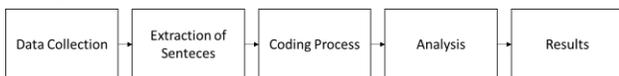


Figure 1. The Distribution of Published Paper

The literature source is sciencedirect.com. The keywords that being used to search the publications was “user interface” and “mobile learning”. There are several criteria in choosing the articles, i.e. published date which is between 2007 and 2017 (10 years), the topic is “learn”, “mobile application”, and “student”. In addition,

Based on the availability of full articles, there are n=45 publications chosen to be analyzed and reviewed in the research. The papers then analyzed to extract some useful information regarding to the topics. We use qualitative coding method to searched the related keywords, looking for themes that related to the keywords, and categorized the keywords into specific themes.

To collect raw data sources for coding process, specific sentences that containing words “interface” are extracted from the collected papers. The extraction process is automatically done by the use of macro add-ons for word processor.

After the extraction process of 45 papers under reviewed, 223 valid sentences that contains the “interface” words are selected and coded. The example of sentences is showed in Table 1.

Table 1. Sentences Containing “Interface”

No	Sentences
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1	<i>“the m-learning application user interface should include different features, such as ease of use, user satisfaction, attractiveness and learnability.”</i>
2	<i>“when developing the user interface, designers should consider the type of users interacting with the application, special user requirements and functionalities of the application.”</i>
3	<i>“m-learning applications should be robust and of very high quality for wider acceptance of the system the developer should minimize functionality in favor of a simple user interface that users can easily perceive and understand.”</i>
4	<i>“m-learning applications should have a well-designed user interface to ensure improved adaptation of the application.”</i>
5	<i>“the first main type of mobile user interface is the graphical user interface (GUI), in which the user's input information is accepted through various mobile computer keyboards or pointing methods that react to the screen.”</i>

The coding process consists of two phases. First, open coding to find representative concept for each sentences. These concepts are then coded into three themes. The themes are based on three concepts of mobile learning, i.e. mobility of technology, mobility of learning, and mobility of learner [13].

Each sentences are being matched with one of these three concepts. The objective is to obtain the more detailed view about the user interface aspect of each given concepts. Lastly, the initial form of framework was built based on the result from coding process and related literatures.

4. RESULTS AND DISCUSSION

The papers under reviewed are categorized into the following categories. First, Figure 2 shows the distribution of articles based on publication year. It can be seen that the study about mobile learning begin to emerge at 2011 upwards. In 2014 the number has decreased slightly before reached a peak in a year later. Overall, the number of research on this topic is increasing from year to year.

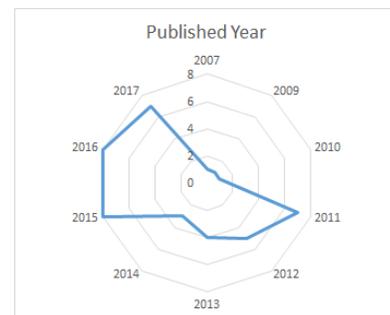


Figure 2. The Distribution of Published Paper

Second, as can be seen in Table 2, there are six groups of people that currently being a user of mobile learning applications. Of these groups, students become the most frequent user of mobile learning as almost 30 percent of the papers discuss on this context. The professor, lecturer and instructor follow in the second position with 9%. These two groups are coming from educational institution. The

other three groups with insignificant amount is coming from non-educational institution.

Table 2. Group of Users in the Use of Mobile Learning

No	Groups	N	%
1	Students	15	33.3
2	Workers	1	2.22
3	Professor, Lecturer, Instructor	4	8.88
4	Consumer	2	4.44
5	Children	1	2.22
6	Elderly	1	2.22

Third, the first step of coding process generates 94 open codes from 223 sentences. These codes are the representative concepts coming from sentences. For example, sentence “*m-learning applications should have a well-designed user interface to ensure improved adaptation of the application*” is coded into concept of “*adaptation*”. These 94 concepts are then mapped into three dimensions of mobile learning. As can be seen in Figure 3, 5% of codes are categorized as learner dimension, 7% of codes are categorized as learning dimension, and most of the concepts are categorized as technological dimension.

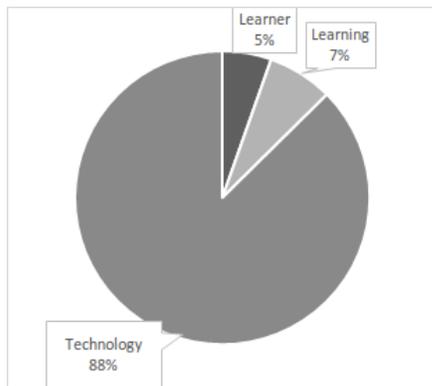


Figure 3 Sentence's Themes

Table 3 explains the distribution of coding result among the three concepts.

Table 3. Identified Concept of Mobile Learning

Concept	Number of codes	Percentage
Mobility of Learning	6	6.38
Mobility of Learner	15	15.96
Mobility of Technology	73	77.66
	94	

Of these 94 initial code, there are 20 most frequent codes identified and becoming an issues that will be discuss further in the next section. Figure 3 shows the frequency distribution of these codes.

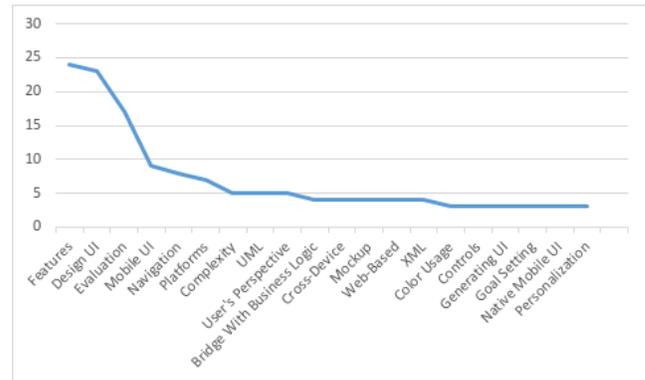


Figure 4. The Most Frequent Issues

As can be seen in Figure 4, the design of user interface is being the second most discussed topic on the list. The sentences on this topic is then coded further to identify the themes. It consists of four themes as depicts in Figure 5, i.e. Design Principle, Hardware, Context, and Modelling Language.

4.1 Design Principle

The user interface of mobile learning application should follow certain design principles. There are four identified specific design principles. Firstly, the size of any elements in application should consider the size of the screen and the size of user's finger at the same time. Secondly, the contents should consider proximity of the surrounding elements. Thirdly, there must be a transition mechanism between elements or contents displayed on the screen so that the interface looks more natural [8]. Lastly, minimalist element design is strongly encouraged to maximize the user enjoyment [5, 16].

4.2 Hardware Specification

Recent technology advancement support the design of user interface that accommodate not only individual needs [12]. It also supports for collaborative works among user with which becoming more important feature in mobile learning. Additionally, the layout of interface should highly considered the screen size of the device so that it can be displayed properly [1].

4.3 Usage Context

Doing learning activities through mobile devices are not dependent in terms of time and place. It has limited attention from the user [22] which affected the level of user's concentration in doing particular task [21]. Therefore, the interface should designed based on the user's context, especially their mobility [12].

4.4 Modelling Language

The use of modelling language in designing mobile learning application's user interface is important. It deals with the modification of the design during the development as well as the improvement phase of application. Object-oriented approach is suggested as modelling language in user interface design [18]. In particular, there are specific modelling language that can be employed to design user interface, such as the Interaction Flow Modelling Language and Unified Modelling Language for Interactive Systems [23].

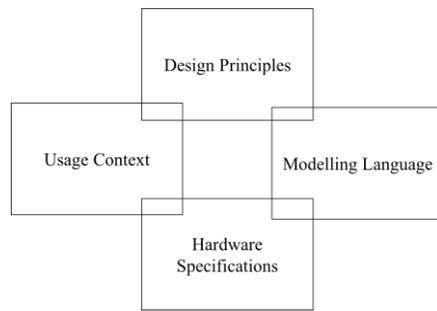


Figure 5. The Dimensions of Mobile Learning UI Design

5. CONCLUDING REMARKS

User interface takes an important role in a mobile learning system development. It is affecting the way the application would be developed and the adoption process or user acceptance in particular.

This study is proposed a framework for user interface design of mobile learning application. There are four major dimensions that must be considered regarding to the design of mobile learning application user interface, i.e. design principles, usage context, modelling language, and hardware specifications.

This study is limited in terms of paper resources. There are only 45 papers from one database. It would be better to increase the number of papers from various databases. The future research could be done in several topics. Firstly, the use of alternative method to code the sentences, for instance by using the clustering approach. Secondly, designing a mobile learning application based on the research findings. Lastly, finding the other dimensions of user interface design in mobile learning context could be an interesting topic.

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