



# The construction and validation of a usability evaluation survey for mobile learning environments



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## ABSTRACT

The advent of mobile technologies in learning context, has been increased the requirements for developing appropriate usability model to align with mobile learning applications. Even though mobile learning has been studied from different aspects of pedagogy environment and technology acceptance, there is little scientific and published research on usability of mobile learning applications. To fill up the gap, in this study, a usability evaluation model with the inclusion of timeliness is developed to assess the usability of mobile learning applications. Timeliness or response time as an important feature in mobile learning, which influences learning satisfaction, can be considered to evaluate the peers and instructors' timely response. The main objective of this study is to construct and validate a usability evaluation survey for mobile learning environments. This study employed a two round Delphi method to empirically verify the usability questionnaire by obtaining a consensus from fourteen experts regarding the questionnaire items. Results indicate that over 88% of experts have consented on all usability items represented in the usability questionnaire. The usability evaluation survey for mobile learning applications can help to improve user satisfaction and reductions in training costs. The decrease in costs attracts many researchers, interface designers and project managers to employ the usability evaluation when designing the interfaces for mobile learning applications.

## 1. Introduction

Mobile learning promotes active learning and classroom accountability, encourages the interaction and contribution of shy students (Markett, Sánchez, Weber, & Tangney, 2006). Mobile learning permits educators to generate online learning solutions for learners which can be used anywhere and anytime as necessary in order to gain results that cannot be reached using existing educational models (Jou, Tennyson, Wang, & Huang, 2016). There are some limitations in mobile devices employed in mobile learning including limited processing power, small screen size, connectivity, and data entry methods (Nielsen & Budi, 2013). Due to these issues for developing a mobile application, the usability evaluation methods have to be studied specifically (Nielsen & Budi, 2013).

Usability is significant, not only to increase accuracy, but also to decrease the response time of the range of tasks accomplished by the users of the system. Usability is also imperative where application is used to control interactive processes for example in mobile-learning

(Taharim et al., 2013). Usability has been specified as one of the important fundamentals of mobile-learning applications (Albert & Tullis, 2013; Anani, 2008; Capretz, Ali, & Ouda, 2012). Assessing the usability of mobile technology has been identified as one of the main challenges in mobile learning and has a high priority for mobile learning evaluation (Vavoula & Sharples, 2009). A previous literature review on the mobile-learning studies showed a lack of specific usability metrics for mobile-learning environments (Ivanc, Vasiu, & Onita, 2012). Specifying the characteristics and required attributes of usability has become a challenging issue depends on the context in which the product is used (Ivanc et al., 2012; Witold et al., 2003). Evaluating the projects of mobile learning has both theoretical and methodological challenges (Traxler & Vosloo, 2014).

The advent of mobile learning applications has presented new usability metrics that are difficult to measure using traditional models of usability. Current usability evaluation methods are based on traditional techniques that were designed for traditional computer systems, and not for emerging mobile computing technologies (Swart, Bere, &

*Abbreviations:* CIMLA, cooperative and interactive mobile learning application; OIES, online information evaluation skills; PACMAD, People At Center of Mobile Application Development; DB, database; SUS, System Usability Scale

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Mafunda, 2017). In other words, usability evaluation of mobile device app has become a significant issue because several software products that previously ran using desktops and laptops, are currently run using smart phone technologies (Hussain, Mkpjojogu, Musa, & Mortada, 2017).

Although there are many usability models for desktop applications (Bevan, 1998; Nielsen, 1994b), a study by Harrison, Flood, and Duce (2013) in particular reported the limitations of existing usability models when applied to mobile devices. The usability model presented by Bevan (1998) as well as the one constructed by Nielsen (1994a, 1994b) were basically designed for traditional desktop applications. For instance, Nielsen's model was largely based on the design of telecoms systems, rather than computer software. In addition, there is a singular lack of reliable usability guidelines, specifically meant for designing and developing m-learning with user friendly interfaces. In fact, usability has been less extensively covered than the technological aspects of the m-learning (Ali, Alrasheedi, Ouda, & Capretz, 2015). The PACMAD (People At Center of Mobile Application Development) usability model developed by Harrison et al. (2013) is designed for usability evaluation of mobile applications, but is not considered the required features of mobile-learning applications.

From previous literature it is visible that many existing usability models do not consider timeliness (interactive response time) as an attribute of usability. To cope with this issue, our study included timeliness as a feature of usability to argument existing usability models for use in mobile learning context. In addition, a usability evaluation questionnaire is developed to assess the usability of mobile learning applications.

## 2. Literature review

This part has provided the foundation to this research through the literature review carried out preceding the usability and timeliness, which forms the groundwork of the study.

### 2.1. Usability

Many recent researchers have identified the benefits of commitment to usability in application development life cycle (Harrison et al., 2013; Iacob, Harrison, & Faily, 2013; Shitkova, Holler, Heide, Clever, & Becker, 2015). Investigating usability and its contribution or integration to the learning procedure is valuable (Anani, 2008). Nielsen states that “usability is a necessary condition for survival on the web” (Nielsen, 1994b). Usability is an important issue for the success of mobile application. Usability or “ease of use” can mean to make products and systems easier to use, and to adapt them more closely to learners' requirements. Poor usability reduces user and student productivity and accordingly causes it dropped out user and student (Shitkova et al., 2015). Advantages of usability include reductions in training costs, enhanced quality of work, increased productivity, improved user satisfaction (ISO13407 ISO, 1999). The decrease in costs has involved many interface designers and project managers to engage the usability theory when designing the interfaces.

International Organization for Standardization ISO 9241-11 (1998) defined usability “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” (Bevan, 1998). Further, ISO/IEC 9126-1 (2001), claims that usability is “the capability of the software product to be understood, learned, used and attractive to the user, when used underspecified conditions” (ISO, 2001).

Harrison et al. (2013) conducted a systematic literature review of mobile usability evaluation models based on the usability attributes developed by Nielsen (1994a, 1994b) and the International Organization for Standardization (ISO) by (Bevan, 1998). A new usability model name PACMAD was developed by Harrison et al. (2013) to evaluate the usability of mobile applications. The PACMAD usability model

identifies seven attributes for usability measure of a mobile application including “Effectiveness, Efficiency, Satisfaction, Learnability, Memorability, Errors and Cognitive load” (Harrison et al., 2013). Each of these usability attributes has important effect on the usability of the application so they can be used to assist assessment of the usability of application. The PACMAD usability model can be used to assess the usability of mobile applications.

### 2.2. Timeliness

Timeliness can be considered in system quality as response time (Gorla, Somers, & Wong, 2010). Timeliness (response time) defined as whether students perceive instructors responded promptly to their problems (Sun, Tsai, Finger, Chen, & Yeh, 2008). Lan and Sie (2010) identified timeliness as “the degree to which users think a received message is time-sensitive or has immediate feedback” (Lan & Sie, 2010). For example, when the teacher posts a class announcement, students can receive the message immediately or when peer replies to a discussion topic, students can receive this replied message automatically (Lan & Sie, 2010). Timeliness concerns the timely, current, and up-to-date messages (Cheung & Thadani, 2012).

Timeliness has an understandable link to responsiveness. A timely response to students' questions or requests is certainly beneficial to students (Sun et al., 2008). When the information or questions are delivered on time, the teacher is able to respond to student's question very quickly. Immediate feedback to students' questions increases student satisfaction. Student satisfaction has become more significant in today's competitive environment.

Previous research indicated that timely responses of teacher significantly affect students' satisfaction (Arbaugh & Duray, 2002; Thurmond, Wambach, Connors, & Frey, 2002). The rationale is that when learners face problems in an online course, timely support from the teacher encourages students to continue their learning. Teachers' failing to respond to students' problems in time has a negative effect on students' learning (Soon, Sook, Jung, & Im, 1999). Hence, if a teacher is able of handling online learning activities and responding to learners' questions and problems promptly, the satisfaction of learning will improve (Arbaugh & Duray, 2002; Ryan, Carlton, & Ali, 1999; Thurmond et al., 2002).

Mobile-learning represents a revolution in the future of learning because the characteristics of mobility and timeliness enable anywhere and anytime learning which make it easier to access information and to freely join discussion (Lin, Huang, Zhao, & Dai, 2013). Some researchers have discovered that interactive response time has a positive effect on user satisfaction (Jalal & Al-Debei, 2013; Wixom & Todd, 2005; Wu & Wang, 2006; Xu, Benbasat, & Cenfetelli, 2013; Zelazny, Belanger, & Teagarden, 2012).

From above studies, it can be found that timeliness is an important attribute of usability that needs to be considered in the context of mobile learning. This attributes has an impact on the overall usability of mobile learning applications and as such can be used to help assess the usability of mobile learning applications. Thus, to develop a usable model for evaluating mobile-learning application, timeliness (response time) should be considered to evaluate the peers and instructors' timely response. Timeliness as an important feature in mobile learning, which influences learning satisfaction, has not been considered in previous usability models. In order to apply prior usability models in mobile-learning context timeliness must be included as a feature of usability.

Thus, in this study, timeliness was added to PACMAD usability model, in order to provide a usability model, which can be used to assess the usability of mobile applications in education context. The usability model proposed for this study, improved the PACMAD model in order to make the PACMAD usability model useful for using the usability model in mobile learning context. Fig. 1 indicates the proposed usability model for mobile learning applications.

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