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A Conceptual Framework for Measuring the Quality Aspect of Mobile Learning

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A Conceptual Framework for Measuring the Quality Aspects of Mobile Learning

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***Abstract*—With the continuing growth of mobile phones outpacing that of desktops and laptops, mobile phones are now the new personal computer. These devices started becoming increasingly sophisticated and extremely powerful. In addition to making phone calls they have the capabilities to perform a variety functions, one of the most important functions is using it as a classroom tool. However, mobile phone applications must be designed and developed with respect to different technology skills, learning capabilities, and language proficiency, in order to be accepted by wide audiences (e.g., students and instructors). Substantial work has been done to measure the quality of mobile applications, and many researchers have attempted to figure out the most important reasons that make those applications fail. A software prototype to assess the quality aspects of mobile learning application has been implemented. Based on the experience with this prototype, we raise some design issues of mobile learning application, specifically the usability issue and its implications. We conclude with some suggestions to enhance the quality aspects of mobile learning applications.**

I. INTRODUCTION

UNLIKE personal computer (PC), mobile phones have some restrictions for displaying content, e.g. screen size and resolution. However in the last two decades, mobile phones and wireless communications technologies have been widely utilized in higher education to deliver different materials because of the availability and accessibility of wireless connectivity. Learning using mobile phones and specifically smartphones, nowadays is highly integrated within education systems in order to support real-time communication and to deliver learning materials. It is used in many universities as a classroom tool to engage and support student in communicative, collaborative, supportive and constructive activities. Also, mobile technologies enable learners to build knowledge, construct understandings, changes the pattern of work activity/learning [1]. Furthermore, the use of mobile technologies offers more opportunities for new types of learning because they change the nature of the physical relations between instructors, students, and the objects of learning.

It is a great way to ensure mobility and ubiquity in learning without technical limitation, time and place restrictions. However, mobile application that are used for education purposes have a very complex user interface with many options hidden. The need to design and develop attractive and user-friendly mobile applications has already become hot topic in order to be accepted by the younger generations who have grown up with the mobile devices in their hands [2]. These applications in order to be accepted by wide audiences must be robust and be of high quality.

Today, most of the applications of the market are difficult to use and learn, difficult to attract or keep users and also difficult to remember. The key component of a successful and acceptable educational application is the usability issues. Thus, when designing user interface for mobile phones, especially for education purposes, we should consider the special user requirements and the capabilities of this type of devices.

This paper is structured as follow: Section II provides some background in the usability issues of mobile learning. Section III introduces a conceptual framework for measuring the quality aspects of mobile learning. Section IV provides analysis and discussion on the Busuu project based on our framework. Finally, the conclusion is stated in section V.

II. MOBILE USABILITY

According to ISO/IEC-9126-1; usability includes the understandability, learnability, operability, attractiveness, and usability compliance sub-characteristics [3]. Usability is known as a qualitative attribute that determines how easy the user interface can be used [4]. It measures the quality of user's interaction to the system environment. In general, mobile applications should be simple, and the input should be easy to insert, simplified by using location aware functions [5] [6]. Mobile applications must have a well designed interface with appropriate color and font sizes because mobile users may not be able to concentrate on the system use [7].

However, recent usability studies illustrate that it is more difficult to read, learn and understand content while using mobile phones than using laptops and desktop computers. For instance, Singh [8], conducted a Cloze test of software user agreements on mobile phones and desktops, and he found that readability and understandability were over 50% lower on a mobile phones than on laptop and desktop screen.

According to Nielsen [9], the difficulty of reading on mobile phones is due to the small screen size and resolution that those devices have which make it harder to understand the content. Users cannot simply scan through text at once, because of the screen size of this type of devices. This enforces them to navigate and scroll to view the entire page, which requires them to remember what they have seen [10].

To overcome this limitation, Iliisky [11] suggested that "it is important to use design techniques that would help users to understand the hierarchy of information on the screen".

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Designers, in this case, must identify the learning material that is important, necessary and then displaying it visually by making it "bigger, bolder, brighter, and more detailed, or called out with circles, arrows, or labels." Otherwise, designers should display less relevant learning material "with less intense color, lighter line weight, or lack of details" [11]. However, educational mobile applications will be embraced and accepted or not based on its features in terms of acceptability and usefulness which include its utilization and usability [12]. Mobile usability issues are considered to be one of the main reasons that make the mobile applications fail [7].

III. A CONCEPTUAL FRAMEWORK FOR MEASURING THE QUALITY ASPECTS OF MOBILE LEARNING

Based on the quality issues discussed, we have developed a conceptual framework for measuring the quality aspects of M-learning [13]. Basically, this framework is a combination of structural factors [14]; it also integrates dimensions of learning context [15]. Fig. 1 shows the design issues of our framework. However, our framework includes three design issues; in addition, to the previous design issues that were identified [16]. These three design issues are: usability, communication and interactivity.

Firstly, all the design issues are linked to the dimensions of learning context. Secondly, the dimensions of learning context are linked to the structural factors. From these two steps we are targeting social skills, new knowledge, team building and improved skills. Key features of the framework are that it identifies the importance of design issues, dimensions of learning context and structural factors in order to address the learning objectives that have a user or a platform focus.

To illustrate, the usability design issue, which includes ease of use, understandability, attractiveness, learnability and user satisfaction, all these sub-characteristics can be achieved if the application meets all the previous features and users were able to use the applications (usability design issues). This also may be performed by using identifier of each user that must be unique in the name-space that is used by the application via a logon system (user name and password, etc.). Identifier can be classified under the (identity dimension of learning context). This will enable the users to perform some tasks such as reviewing the lessons, tutorials, doing assignments and group sessions with other users with the support of mobile devices. This can be classified under the (structural factors: business rules and learning roles).

Finally, the learning objectives will be addressed which may include improving of improved skills, new knowledge, social skills or team building; however, and as we have mentioned in this paper that each design issue may be linked with more than one of the dimensions of learning content.

For instance, the communication, collaboration and interactivity issues can be affected by more than one of the learning contexts community, facilities, time and location, activity and learner. Furthermore, in some cases the design issues can affect each other; for example, the usability issues can be affected by communication, media type or by the wireless connectivity while using the application on the move.

IV. ANALYSIS AND DISCUSSION

Based on the metrics that the (ISO/IEC) provides for measuring software quality in process and use, the analysis of our framework from the quality point of view requires us to put in consideration the boundary between quality metrics that are use focused, from ISO/IEC, and those that are product related.

The relationship between the quality in use, internal quality and external quality metrics is shown in Fig. 2. Based on the analysis of our framework, if we can apply some extensions to the ISO/IEC metrics, we will be able to map these metrics to our framework in order to measure the design issues of learn on the move, user role and profile, media type and usability issues. However, additional metrics are needed to complement the contexts of use dimensions of the quality in use metrics.

To analyze our framework, we are considering a case study and the metrics that (ISO/IEC) provides. The most suitable example that can be analyzed as a case study is Busuu Project [17]; the Busuu Project is an on-line social network application. This application was designed to enable users to set up a profile (quality metric of user role and profile). Developers were careful with the learning content that displayed on the screen, they target as much learning content as possible (existing quality metric of media type).

Since the application can be downloaded to mobile phones, users are free to use it wherever a network connectivity is available (existing quality metric of learn on the move). In addition, each individual user of this application is not only a student of a foreign language but also a tutor of his or her own mother tongue. Another feature of this application is that the users can select one or more of these languages and work through the self-paced units [17]. From these analyses, we can apply some relevant and appropriate metrics from ISO/IEC (e.g., functionality, scalability, service quality, etc).

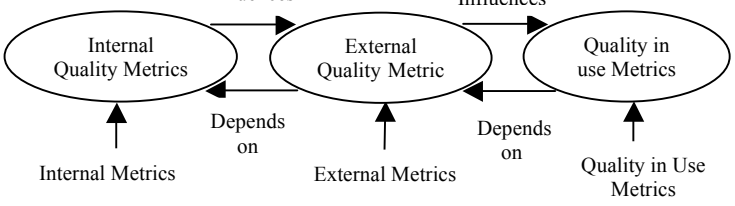

Fig. 2. The relationships between the quality metrics based on ISO/IEC

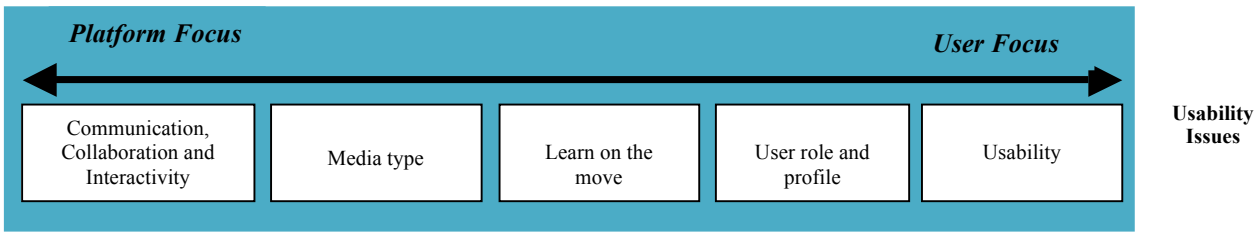

Fig. 1. Design issues of mobile learning based on our framework [14].

Table 1: Analysis of the Busuu project based on our framework

Objectives	Learning experience	Learning contexts	Design issues
Learning new language 1. Exploring, discovering and getting familiar with the software. 2. Communicating, interacting and collaborating with peers by asking and answering questions. By sharing and exchanging information between users, users can obtain new knowledge that will help them to improve their language skills and help them to conduct the following objectives: **1. Team building** **2. Social skills** **3. New knowledge** **4. Improved skills**	**Rules: Business rules, learning roles**: different users meet in the context of a simulation. **Outcome and Feedback:** asking questions and getting answers. **Goals and objectives:** to get familiar with the application. **Conflict, competition, challenge, opposition**: discussing and challenging opinions (team work and new skills) **Interaction: Blogs, wikis, discussion groups, test, teamwork:** One to one, one to many and many to one.	**Identity:** user name and password for each individual user. **Learner:** different users. **Activity:** To engage in participatory simulation of a dynamic system. **Time - Location:** Co-located same time and different time. **Facility:** different mobile devices. **Community:** different user with different background using the mobile devices with the support the wireless connectivity can discuss many different topics in order to improve their language skills.	**User roles and profiles:** New users - few ideas of how to use the application. **Learn on the move:** Mobile devices with the support of wireless connectivity. **Media type:** text, images, comprehensive audiovisual learning material with photos and recordings by native speakers, avoid information overload. **Communication, collaboration and interactivity:** users can communicate, collaborate using text, verbal and video-chat communication support.

Table 1 shows the analysis of the Busuu Project [17] based on our framework, The purpose of this reverse engineering is to see how successful the Busuu Project is and also to know if our framework can be used as a guideline for designing and developing mobile applications.

The result showed that the Busuu project is a successful project. First, each user of the Busuu project has a unique name and password (user role and profile: design issues). Second, once the user downloads the application on his own device he can communicate and interact with other users. Also, the use will be able to share and exchange different types of media with the other users (communication, interactivity and media type: design issues). Finally and more importantly, users can use the application wherever there is a wireless connectivity (learn on the move: design issues). The emphasis here is on the nature of the physical environment in which the learner is placed, and hence the digitally-facilitated that is now possible with mobile technologies that were not possible with a desktop. For instance, while walking through urban spaces, mobile technologies allow users to be constantly connected to the Internet.

Also our analysis shows that mobile learning collectively offers a wide range of learning activities that could be supported through mobile environments; for instance, exploring and investigating (real physical environments) and discussing (with peers, synchronously or asynchronously).

It is clear that the current metrics cover all the design issue except the usability issue. Usability is one of the most important fundamentals of M-learning applications. For example, if the applications have the following weaknesses: i) different to use, ii) user interface that is hard to learn to use, iii) user interface that is difficult to remember how to reuse; iv) learning content structure that is unclear; v) the process's work-flow that is difficult to perform; users will not be efficient, effective and productive. The user interface must be effective and easy to use, which will help the users to focus of the learning goals, learning content and activities instead of how the system works. Furthermore, utilizing design guidelines are vital in developing reusable learning systems and the effective and the most valuable method is evaluating and testing users.

V. CONCLUSION

Without a doubt, mobile phones are the way of the future. Designers and developers of mobile applications need to consider usability issues of those applications in order to be accepted by the new generation. This paper illustrates how the quality aspects can be measured in the context of a conceptual framework for mobile learning applications. A case study has been considered based on our framework; it showed which design issues can be measured using established quality metrics from (ISO/IEC). Also, we suggested that additional metrics are needed to complement the contexts of use dimensions of the quality in use metrics. However, this is not the last result of our research; we are designing and developing a prototype application. This prototype will be tested and evaluated by real students, as well as a questionnaire and statistical analysis will be conducted in order to measure the quality of the user interface. Also, all the usability sub-characteristics including ease of use, user satisfaction, attractiveness and learnability. Appendix A shows the questions that will be used in our survey.

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APPENDIX

Student Name: Student ID: User interface Number:

Section 1: ease of use attributes:

1. I found navigating around the prototype screen to be:
2. How easy was it to find the appropriate icon for information you wanted?
3. How easy was it to scan the prototype in text to find the information you wanted?
4. How easy was it to scan the prototype in graphic to find the information you wanted?
5. How easy was it to understand and to know the purpose of each icon in the prototype?
6. How user friendly is the prototype?

Section 2: user satisfaction attributes:

7. Do you agree that the font size is easy to read and understand?
8. Do you agree that the prototype has all the features required by a user?
9. Do you agree the prototype provides you enough suggestions and prompt you towards the right usage?
10. Are the terminologies that have been used familiar to you?
11. Was the information in the prototype well-organized?

Section 3: learnability attributes:

12. Learning to operate the system is:
13. Remembering names and use of commands is:
14. Understanding the structure of the prototype is

Section 4: attractiveness attributes:

15. Did you find the prototype attractive?
16. How would you rate the flexibility of the prototype?
17. Are the colors and graphics clear and attractive?
18. What is your overall impression of the prototype