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Implementation and evaluation of LMS mobile application: Scele mobile based on user-centered design

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Abstract. The development of mobile technology is now increasing rapidly, demanding all activities including learning should be done on mobile devices. It shows that the implementation of mobile application as a learning medium needs to be done. This study describes the process of defining features, implementing features into the application, and evaluating the application. We define the features using user research and literature study, then we implement the application with user-centered design basis, at the last phase we evaluated the application using usability testing and system usability score (SUS). The purpose of this study is to determine the extent to which this application can help the users doing their tasks and provide recommendation for the next research and development.

1. Introduction
Currently smartphone devices and the accessibility of the internet has become the basic needs of the world community including Indonesia. The Internet sparked new innovations in various fields, one of the emerging innovations in education is e-Learning. An e-Learning process’ has four basic components of infrastructure technology which are e-Learning content, e-Learning users, and the most vital is the e-Learning software platform or so-called Learning Management System (LMS) [1].

The Faculty of Computer Science Universitas Indonesia e-Learning team has developed an LMS known as Student Centered e-Learning Environment (SCELE) based on Moodle. Until now SCELE Mobile application development has never been done, but one of the strategies to increase the use of LMS is by developing a mobile application [2]. At the time of developing the application, the risk of failure also needs to be considered. According to Weinschenk, three of the 12 common causes of failure of software development projects (applications) are closely related to the user experience [3]: the needs are not well defined; Lack of communication between developers and users; And stakeholder politics. Weinschenk also added that the user experience problem can be overcome with user-centered design, which focusing on gaining a deep understanding of the pre-users throughout design and development life-cycle [4].

Therefore, it is necessary to implement and evaluate the SCELE Mobile design with user-centered design into mobile application. In this study, we will develop the mobile applications and then evaluating for known what needs to be improved. The main purpose of this research is to continue the implementation of SCELe Mobile from previous research, evaluation as improvement material for further research, to see suitability of application to user requirement, and get feedback for future research and development.
2. Relevant Literature Review

2.1. SCeLE Based on User-Centered Design
User Centered Design (UCD) is a framework of designing and developing products that focus on understanding the potential users [4]. This framework also guarantees the product (software or website) will be easy to use [5]. The International Usability Standard ISO 13407, which is the basis for UCD, stated six things that must be pointed out in UCD [5]. It emphasizes the user involvement in design, development, and evaluation.

The design prototype of SCeLE based on user-centered design was introduced by Ibadurrahman [6]. He developed the prototype by improving a previously made prototype which designed based on Moodle Mobile, a mobile app created using HTML 5. By using UCD he constructs the prototype using Material Design principal, which is commonly used on Android devices. Using commonly used design principal will make the user easier learning the application.

2.2. Android Platform-Based Application
Platform-based apps are an application that is specifically created and used on a specific platform, for example only on the Android operating system [7]. This type of application is developed using a specific programming language (e.g. Java), but is more dependent on the use of application frameworks, supporting libraries and runtimes in the form of thousands of lines of code typically written in C and C++ [8]. In the Android operating system, applications are usually developed using the Java programming language with the help of application frameworks that provide access to the API framework so that it can be used by core applications [9].

2.3. Mobile Usability
Usability is a qualitative assessment of the user interface in a product such as websites and mobile applications in addition to its purpose that allows users to achieve specific goals [10]. Usability can also be described as "the extent to which a product can be used by a particular user to achieve its goals with effectiveness, efficiency and satisfaction in a particular usage context" [11]. There are three (3) usability aspects on any type of software: 1) more efficient to use: user takes less time to work on a task; 2) easier to learn: the software can be learned by simply observing and trying them; and 3) more user satisfaction: the software used meets the expectations of its users.

Small screen size, limited interaction model, unreliable network connection, limited processing and storage space, and dynamic usage environment and context make mobile usability an important factor in mobile application development [10]. In addition, users prefer mobile apps that are easy to learn, take less time when completing a task, and are easier to use [12]. Therefore, evaluating the mobile application especially in terms of usability needs to be done to know the quality of the application from the user side.

2.4. Usability Evaluation
Evaluation is an activity related to data collection related usability of a product, involving a group of users in a specific environment and context [13]. While the usability evaluation is a series of procedures performed to collect data related to the interaction between users with software products, to find out how big the contribution of a software in helping users achieve goals [14]. So, in the end the results of the usability evaluation can be used to predict the success of a product when it is launched [15]. There are 12 steps that should be done to conduct usability testing [16]: 1) define the usability evaluation’s goal; 2) specify user interface aspects that will be evaluated; 3) identify the target users; 4) determine the usability metric that will be used; 5) decide the evaluation method; 6) select the tasks that will be executed; 7) plan the experiment; 8) gather the usability evaluation data; 10) give improvement recommendation by criticizing the user interface; 11) reiterate the step (when needed); and 12) summarize the result.
3. Method
Methods conducted during the study are as follows. First, we do the review of relevant literatures and make online surveys about the use of SCeLE in general. The survey also contains user-owned smartphone information that is used as the target of the application development platform. The results of the literature study and online survey are used to design the information architecture including what features that will be implemented into the application. The next step is to implement the application on the platform in accordance with the data analysis results. This implementation uses a prototyping methodology.

The prototype is made in the form of an Android platform-based application. Application development is carried out based on prototypes that have been made from previous research with changes tailored to the results of this research. The prototype development process started by modifying the application that has been made. The original application is an open source application called MDroid (https://github.com/praveendath92/MDroid) developed by Praveen Kumar Pandyala. The principle of the eight golden rules is also used in this development. We use the principle because it has often been adapted into various types of systems to identify usability problems [17].

After the prototype of application is made, we conduct the usability evaluation in the form of usability testing and SUS to 14 participants. Usability testing is used to obtain qualitative and quantitative data used as input application development. While SUS is used to obtain quantitative data from tested applications that are used as a reference value of usability of SCeLE Mobile. Participants consisting of 10-15 peoples were asked to run nine (9) tasks and then we ask them to assess the application through SUS. We also request feedbacks from participants regarding the experience of using the application. Table 1 shows the template task scenario used during usability testing.

| Table 1. Template scenario for usability testing |
|-----------------------------------------------|
| Degree of Success | Difficulty Level (range) | Notes |
|-------------------|--------------------------|-------|
| See All Courses   | S PS F                   | 1 – 4 (easy to difficult) |
| Mark the course to Starred Courses            | S PS F                   | 1 – 4 (easy to difficult) |
| Read the forums on a course                    | S PS F                   | 1 – 4 (easy to difficult) |
| View the assignment                             | S PS F                   | 1 – 4 (easy to difficult) |
| Read the material                               | S PS F                   | 1 – 4 (easy to difficult) |
| View the list of participants in the same course | S PS F                   | 1 – 4 (easy to difficult) |
| View the list of events in SCeLE                | S PS F                   | 1 – 4 (easy to difficult) |
| Read the Vacancy Forum                          | S PS F                   | 1 – 4 (easy to difficult) |
| See notifications                               | S PS F                   | 1 – 4 (easy to difficult) |
After completing the task, participants were asked to rate the difficulty level on a scale of 1 (easy) to 4 (difficult) when working on the requested task. The degree of success is also written with the 'S' code if successful, 'PS' if successful but requires guidance, and 'F' if it does not complete the task. The degree of success is an indicator of success seen from the researcher, while the difficulty level is an indicator of success seen from the participant side. Both indicators are used so that the analysis results are seen from two directions, so the results can be more accurate. At the end of the usability evaluation we ask the participant to fill in the SUS questionnaire which has been translated into Bahasa Indonesia [15]. At last, we performed a data analysis of the findings from the usability testing and SUS score to be concluded for the next research guidelines.

4. Results
The results of online survey analysis from 107 respondents and literature studies shows that the general activities of the user are accessing the tasks and materials of a course. Previously, we have been divided the user activities into five classification which is material, course, assignment, forum, and calendar. Then from these activities, the main problem which faced by the user is a complex display when they look for information [6]. Figure 1 shows the detail of the general activity classification performed by the user. The dominant category of activity that was carried out by 107 respondents is Material (57%) and Assignment (55%). Then the next common category is Course (42%) where 45 of the total respondents do the activity. Subsequently a recessive category was the Forum of 37 out of 107 (35%) of respondents and Calendar 24 out of 107 (24%) respondents.

![Figure 1. General activities that has been classified into categories in percent](image1)

Further data on the smartphone information owned by users (Figure 2) shows that 85% of total participant is using Android, make it become the most widely used platform.

![Figure 2. Smartphone OS distribution](image2)
Implementation is then performed on the Android platform and focuses on the navigation features related to the course including tasks, materials, and information about the course. The example of implemented application can be seen on Figure 3.

![Figure 3](image.jpg)

Figure 3. The example of SCeLE Mobile view

Due to the limited API provided by Moodle, not all features that have been planned before can be implemented. One of the features is uploading assignment on the course. An alternative solution to this limitation is giving users access through a browser that leads to the SCeLE website. The differences between planned features (from design prototype [6]) and implemented features can be seen on Table 2.

| Feature       | Design Prototype of SCeLE Mobile | Application Prototype of SCeLE Mobile |
|---------------|-----------------------------------|--------------------------------------|
| Dashboard     | ✓                                 | ×                                    |
| Course        | ✓                                 | ✓                                    |
| Star Course   | ×                                 | ✓                                    |
| Messages      | ✓                                 | ×                                    |
| Calendar      | ✓                                 | ✓                                    |
| Forum         | ✓                                 | ✓                                    |
| Assignment    | ✓                                 | ✓                                    |
| Notification  | ×                                 | ✓                                    |
5. Conclusion and Discussion

Overall, the results of usability testing of UCD-based SCeLE Mobile applications among 14 participants are good enough and suitable for use by users. This can be indicated from the dominant positive values for each task scenario in terms of the degree of success, as well as the difficulty level of task work according to the participants.

The result of SUS score processing according to SUS calculation rule shows that SCeLE Mobile application get 71.25 point. Table 3 below explained the results from each participant. SUS scores with these values can be categorized as having a good usability as they are over 68, as defined by Sauro [15]. Then, the SUS score can also be an indicator that the SCeLE Mobile application has a 'good' property of grade 'C', if judged by the Bangor categorization method [18].

| Participant | SUS Score |
|-------------|-----------|
| 1           | 72.5      |
| 2           | 77.5      |
| 3           | 62.5      |
| 4           | 75.0      |
| 5           | 72.5      |
| 6           | 57.5      |
| 7           | 67.5      |
| 8           | 62.5      |
| 9           | 80.0      |
| 10          | 72.5      |
| 11          | 70.0      |
| 12          | 75.0      |
| 13          | 90.0      |
| 14          | 62.5      |

**Total Score**  71.25

Although the results of the usability evaluation are good enough, there needs to be improvements that must be done. These improvements include hiding unnecessary progress status at login, changing the content writing on the confirmation box when marking the course into the starred course, changing the icon and mentioning the starred course become more representative, making the thread reply feature, changing the content icon inside the course, rearrange the layout of the content in the form of a list or thread, provide a download indicator in progress or finish, add photos to the participant list of the course, click date mechanism and range of events that appear on the calendar, add search features in the forum, and notification feature improvement.

The enthusiasm of the participants of this study when trying to use SCeLE Mobile application is quite high. Many of them are looking forward to the development of this application. In addition, the applications developed in this study are still in prototype form, so there is still an opportunity for further development. Therefore, the next SCeLE Mobile application development should continue to be implemented.

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References

[1] Harrati N, Bouchrika I and Mahfouf Z 2016 e-Learning: on the Uptake of Modern Technologies for Online Education Proc. of the 6th Int. Conf. on Communication and Management.

[2] Mtebe J S and Kondoro A W 2016 Using Mobile Moodle to Enhance Moodle LMS Accessibility and Usage at the University of Dar Es Salaam IST-Africa Week Conf. Durban.

[3] Weinschenk S 2011 ROI of User Experience YouTube.

[4] Usability.gov [Online] Available: https://www.usability.gov/what-and-why/user-centered-design.html

[5] Userfocus [Online] Available: http://www.userfocus.co.uk/consultancy/ucd.html [Accessed May 2017]

[6] Ibadurrahman H 2016 Pengembangan Alternatif Desain Interaksi SCeLE Mobile dalam Perspektif Mahasiswa Berdasarkan User-Centered Design (Depok: Universitas Indonesia).

[7] Rajapakse D 2008 Techniques for De-fragmenting Mobile Applications: A Taxonomy Proc. of 20th Int. Conf. on Software Engineering and Knowledge Engineering Conf. (SEKE’08).

[8] Tarkoma S and Lagerspetz E 2011 Arching over the Mobile Computing Chasm: Platforms and Runtimes Computer IEEE 44 pp 22-28.

[9] Okediran O O, Arulogun O T, Adesina G R and Akinwale O C 2014 Mobile Operating Systems and Application Development Platforms: A survey Int. J. Advanced Networking and Applications (IJANA) 6 pp 2195-2201.

[10] Az-zahra H M, Pinandito A and Tolle H 2015 Usability Evaluation of Mobile Application in Culinary Recommendation System IEEE Asia Pacific Conf. on Wireless and Mobile (APWiMob).

[11] ISO 9241-11:1998 [Online] Available: https://www.iso.org/standard/16883.html.

[12] Nayebi F, Desharnais J-M and Abran A 2012 The State of the Art of Mobile Application Usability Evaluation 25th IEEE Canadian Conf. on Electrical and Comp. Eng. (CCECE).

[13] Yvonne R, Sharp H, Preece J, Benyon D, Holland S and Carey T 1994 Human-Computer Interaction (Essex: Addison-Wesley Longman Ltd).

[14] Fernandez A, Insfran E and Abraho S 2011 Usability Evaluation Methods for the Web: A Systematic Mapping Study Information and Software Technology 53 pp 789-817.

[15] Sharfina Z and Santos H B 2016 An Indonesian Adaptation of the System Usability Scale (SUS) Int. Conf. on Advanced Comp. Sc. and Information Systems (ICACSIS).

[16] Nielsen J 1993 Usability Engineering (Boston, MA: Academic Press).

[17] Sharp H, Rogers Y and Preece J 2007 Interaction Design: Beyond Human-computer Interaction 4th ed. (Chichester: Wiley).

[18] Bangor A, Kortum P and Miller J 2009 Determining What Individual SUS Scores Mean: Adding an Adjective Rating Scale J. of Usability Studies 4 pp 114-123.