

Usability Evaluation of an Interactive Educational Mobile Application

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Abstract—Many educational mobile applications are available to help students achieving their goals in the learning process. For example, an interactive Educational (mobile) Application is an educational application that emphasises the interaction among students and between students and teachers. This type of educational application is also available for students, for example, to help them have direct interaction with their teachers, such as outside the class hours to discuss a particular subject further. In the development of such applications, one of the challenging parts is designing an intuitive user interface to help ensure the usability of the application.

In this paper, we present our work on usability evaluation of an interactive educational application to seek feedback and recommendations to improve the developed design. The application is designed to facilitate direct interaction among students and between students and teachers as a form of an online learning activity. The usability evaluation process was conducted remotely (i.e., online) and adopted the Unmoderated Remote Usability Testing (URUT) approach, which involved 25 participants. In this case, an online user interface design and usability tool called Maze was used as a medium to carry out the evaluation. The result shows that the application's design is in medium grade with a score of 78 (out of 100). Furthermore, the result of the measurement of the user satisfaction level using the SUS questionnaire obtained a score of 80, which indicates that the design of this interactive learning application is acceptable. Other than the score of the usability testing, we collected valuable feedback from the participants that will be used to improve the current design of the application.

Index Terms—Usability Evaluation, UI/UX Design and Evaluation, Interactive Educational Application, Mobile Application

I. INTRODUCTION

Teaching and learning can be seen as a process of knowledge transfer from the teacher to the students. It can also be seen as an active activity where the students as the learner and the teacher as instructor or facilitator discuss and exchange ideas about a particular subject [18]. In the learning process,

each student has a different learning speed. Some students may need more time to understand and process a particular topic. In this case, it is possible that these students need some more time and also require more attention from the teacher to help them understand the topic. However, in a classroom teaching set-up, the teaching and learning process is limited by time constraints, i.e., classroom meeting duration. In such cases, the students who need more time to discuss a particular topic may require extra time to discuss with the teacher [5], [11].

Today, learning is even more effective and fun with the help of technology. Teachers and students may use technology to help them interact with each other. An example of the adoption of technology in the educational domain is an interactive educational mobile application. This type of technology utilises the benefits of mobile application technology. The user can use the application to interact with each other with more advantages such as mobility, simplicity and ease of use, and more flexibility than the desktop-based application [7]. Nowadays, the interactive education mobile application is also widely used to support teacher-student interaction outside the classroom to help the students understand a particular topic [3]. One of the challenging parts of developing an interactive educational mobile application is designing an intuitive user interface to help ensure the usability of the application. Without a good user experience, it is unlikely that users will use the developed software or application. In this case, the users have become intolerant and impatient and expect the apps to be simple [2], [4], [14].

In this paper, we present our work related to the usability evaluation of an interactive educational application. The objective of the usability evaluation, in this case, is to identify usability issues and seek feedback from the users in order to improve the current design. The improved design then will be used as part of the development of the application. An easy and intuitive user interface is needed so that the user having a good experience while using the application that will be

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developed. In the usability evaluation process, the participants were invited to evaluate the developed user interface design of the application. The performance-based evaluation using the Unmoderated Remote Usability Testing (URUT) and also the perception-based evaluation using the System Usability Scale (SUS) are adopted in the evaluation.

This paper is organised as follow. In Section 2, we briefly discussed the related work regarding the usability evaluation of mobile educational applications. In Section 3, the usability evaluation methods used in this study is described. In section 4, the methodology in conducting the evaluation is presented along with the developed user interface of the application. In Section 5, the findings from the evaluation are discussed. Finally, the conclusion and recommendation are described in Section 6.

II. USABILITY EVALUATION OF MOBILE EDUCATIONAL APPLICATIONS

Some works have been done related to the usability evaluation of mobile educational applications, such as reported in [2], [4], [8], [12], [14], [15], [17], [18]. The work presented in [18], for example, discuss the usability evaluation of an interactive mobile application that is designed to teach daily living skills to users with intellectual disabilities (ID).

In [2], the authors presented the work related to the evaluation of a mobile educational application in order to improve the current design of the application. The findings of the study show that it is important to identify usability issues and improve the mobile application user interface design and learnability aspects.

In [4], the authors reported the work related to the investigation of the usability aspect of a mobile application that students use as a tool in learning English. The authors used the System Usability Scale method as part of the evaluation process. The result of the study provides the author with important insights on the usability of the mobile applications that are used as learning support tools for learning English, specifically in testing students' grammatical ability.

Based on the literature review, in general, the usability evaluation of a mobile application, including the application used in the educational domain, is important to help identify usability issues and gather feedback from the users to improve the current design of the application.

III. USABILITY EVALUATION METHODS

There are methods that can be adopted to evaluate the usability of a system [16]. In our study, we considered the Unmoderated Remote Usability Testing (URUT) method that can be used to evaluate the users' performance while using and testing the current design of the application. We adopted this method due to the current COVID-19 pandemic situation that requires physical distancing that makes the designer and the users who help evaluate the application's design could not be in the same place.

In addition to the evaluation of the usability of the design based on the user's performance, we also adopted the System

Usability Scale method as part of the evaluation process to gather the user's perception after experiencing the design of the application.

A. Unmoderated Remote Usability Testing (URUT)

URUT is a usability evaluation method that nowadays is widely adopted by the UI/UX designer to evaluate their user interface design. This method provides several benefits; for example, it is cost-effective, there is no need for designer and users as the observer to be present during the evaluation, it also allows for quick recruitment of users, and users can conduct and complete the evaluation in their natural environment [6], [10], [13]. There are several tools available that can be used as medium to conduct the usability evaluation based on URUT, for example, using Maze.

Using Maze it is possible to evaluate usability of an user interface design by measuring the following usability indicators with the involvement of the users in the usability evaluation process:

- Success rate: the users' success rate when completing the given scenarios based on the expected path.
- Misclicks: the average of the click area (by the users) outside the hot-spots (the intended area).
- Duration: the average time spent by the users to complete the give scenarios.
- Bounce: the average number of users who stop or decide not to complete the evaluation process.

The average score gathered from each indicators then can be mapped into the following usability evaluation result criteria:

- 80 - 100: High
- 50 - 80: Medium
- 0 - 50: Low

B. System Usability Scale

One of the most widely adopted user satisfaction measurements regarding system usability is the System Usability Scale (SUS). The popularity of SUS among HCI researchers is due to several factors; among others, it is related to its desirable psychometric properties (i.e. high reliability and demonstrated validity). Other factors such as relatively short length (10 items) and low cost to implement the SUS [1]. The following is the ten items in the SUS:

- I think that I would like to use this application frequently.
- I found the application unnecessarily complex.
- I thought the application was easy to use.
- I think that I would need the support of a technical person to be able to use this application.
- I found the various functions in this application were well integrated.
- I thought there was too much inconsistency in this application.
- I would imagine that most people would learn to use this application very quickly.
- I found the application very cumbersome to use.
- I felt very confident using the application.

- I needed to learn a lot of things before I could get going with this application.

The ten items of the SUS were designed to measure the perceived usability of a system/application from the targeted user's (respondent) point of view. The respondents need to rate the magnitude of their perception regarding their experience while completing the given task regarding the usability of the system/application with each item using a 5-point scale from 1 (strongly disagree) to 5 (strongly agree). To compute the SUS score, for each odd statement, the participant's answer scale is subtracted by 1. For each even statement, the value obtained is 5 minus the scale position. Then all the scores are added up and then multiplied by 2.5. After that, the total results are calculated on average. The value range of the SUS questionnaire is 0-100 [9].

IV. METHODOLOGY

A. Evaluation Objective

The objective of the evaluation is to seek feedback from the participants regarding the initial design proposal of an interactive educational application called Hai Mentor. The feedback from the participants will be used as input to improve the current design of the application.

B. Target Participants

The target participants in this evaluation study are high school students and teachers, university students, and lecturers. The participants were selected through a non-probabilistic sampling approach using the convenience sampling method, which means they were selected based on their availability to participate in the study. The participants were invited via email and personal chat application consisting of the description of the study and the link to complete the tasks within the study.

C. Pilot Study

Before conducting the main usability study, a pilot study was conducted in order to identify the potential problems that might occur when conducting the main study. The design of the pilot study is developed identical with the main study. The pilot study is conducted online using a maze usability evaluation tool.

Five participants participated in the pilot study, and there was no substantial problem found regarding the study. The feedback from the pilot study only related to the typography of the given question text. Based on the feedback then the text on the main study is revised.

D. Main Study

The evaluation study was conducted online using a usability evaluation tool: Maze. The evaluation study consists of two sections: performance and perception section. In the performance section, the participants were asked to complete several tasks. These tasks are related to the design of the features of the Hai Mentor application. The description related to the task that needs to be completed by the participant was provided in

the maze usability evaluation tool. The design of the following features were prepared to be evaluated by the participants:

- Registration
- Mentor appointment
- Online chat
- Mentor rating

After completing the tasks, the usability score will be generated by showing several indicators: success rate, bounce, duration, and miss-clicks. A general feedback question is also provided for the participant to answer after completing all the given tasks.

The perception section is related to the use of SUS. The participants were asked to rate the given SUS statements (questionnaire) based on their experience when interacting with the design of the application (tasks on the performance section). The questionnaire was prepared in an online questionnaire platform.

V. RESULT AND DISCUSSION

In total, 25 participants were involved in the main study. These participants did not participate in the pilot study to avoid bias in completing the study. Table I shows the background of the participants.

TABLE I
PARTICIPANT'S DEMOGRAPHY

Occupation	Total
High School Student	7
High School Teacher	3
University Student	13
Lecturer	2
total	25

The result of the study is discussed in the following sub-sections.

A. Performance Based Test – Unmoderated Remote Usability Testing

In the performance test, the following usability indicators were used as provided in the Maze usability evaluation tool:

- Misclick rate: The misclick rate is the average number of misclicks outside the clickable areas in the given design. The misclick typically occurs because users cannot find what they are looking for or fail to understand the purpose of a particular function in a design.
- Average duration: indicates the average time for the participants to complete the task.
- Average success: Average (in percentage) of missions completed by the expected path.
- Average bounce: Average (in percentage) of participants who left or gave up the mission.

The participants were asked to complete all the given tasks that are related to the example features of the application. Figure 1 illustrates the example of the task related to the registration process of a user to the application. The participants were asked to complete the registration process by doing a

simulation based on the given design in the registration task. A click heatmap (in red and yellow), as shown in the Figure 1 is a representation of clicks on a particular screen.

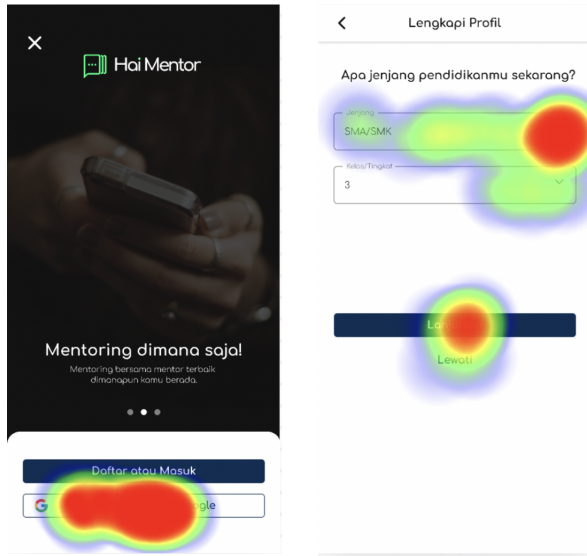


Fig. 1. Registration task

Table II shows the participants' performance test result.

TABLE II
PERFORMANCE TEST RESULT

Feature	Misclick Rate	Average Duration	Average Success	Average Bounce
Registration	12.5%	5.5 s	76%	0%
Mentor Appointment	12.1%	10.08 s	44%	0%
Online Chat	12.0%	7.0 s	88.0%	0%
Mentor Rating	19.5%	10.07 s	88.0%	0%

Based on the result, we considered the misclick rate, in general, to be relatively low; only the Mentor rating misclick rate is found higher than the others (19.5%); this is due to the design of the rating feature (in a scale of 1-5 star rating) is relatively small hence the participants might struggle to click the rating feature. Related to the average duration result, we considered the result is relatively good since the participants were relatively quick to complete the given tasks.

Regarding the average success rate, only the Mentor Appointment test result produced a score below 50%; in this case, the result is 44%, which indicates that more than 50% participants failed to complete the given task. We found that most participants tend to click the 'chat now' feature rather than the 'booking the appointment' feature; however, the task description clearly states that the participants were asked to book an appointment to chat with the targeted mentor. Related to the average bounce result, we found that no participants chose to leave or gave up the study.

From the data processing results conducted through the Maze tool, the overall usability score of the Hai Mentor application design is 78. Therefore, based on the measurement scale, a score of 78 has a grade: Medium.

B. Perception Based Test - System Usability Scale (SUS)

After completing the performance test, the participants were asked to rate the given statements related to the SUS evaluation. We calculated the SUS score from the results of the SUS questionnaire responses. The SUS score is 80. According to the SUS assessment guidelines, a score of 80 means that the application's usability is Good with acceptability Ratings is Accepted.

At the end of the evaluation, we provided a comment field so that participants could provide their feedback related to the design of the Hai Mentor application. Overall the response was positive, including the participants' feedback that related to the improvement of the design of the mentor rating feature; they considered the design of the rating to be too small, and it could be better if the design is created in a bigger size.

VI. CONCLUSION

In this paper, we have discussed our work on progress related to the design and evaluation of an interactive educational mobile application. The Unmoderated Remote Usability Testing approach was adopted in the study along with the System Usability Scale. The study was conducted in order to seek feedback from the targeted users related to the initial design of the application that needed to be developed. The result from the study shows that the initial design is relatively good (with an 80 SUS score), and some improvements are needed to enhance the initial design after involving 25 participants in the study.

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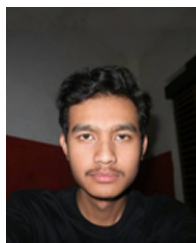
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