

A USABILITY EVALUATION OF TARCAPP MOBILE APPLICATION

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ABSTRACT. TARCApp mobile application is an application used by Tunku Abdul Rahman University College students on a daily basis to access necessary resources. Therefore, this study attempts to evaluate the usability of the application by comparing with the Concordia mobile application from the aspects of effectiveness, efficiency and satisfaction. Instruments such as Test Task, Single Ease Question (SEQ) and Software Usability Scale (SUS) questionnaires have been used to measure the usability of these mobile applications. Results indicate that the TARCApp mobile application had high degree of effectiveness and efficiency. However, the satisfaction was poor, and some usability issues have been discovered during this study.

KEYWORDS: usability, mobile application, effectiveness, efficiency, satisfaction

1 INTRODUCTION

Mobile phones are versatile than ever, with originally built for communication over voice. However, mobile phones now can do much more than calling over voice, such as, taking pictures, playing games, watching videos, GPS navigations or even a modem, making the accessibility of omnipresent information at any time a reality (Wong, 2010; Hussain et al., 2017). Not only has mobile phones revolutionized the way the world operates but also the teenagers' lifestyles (Danesh, 2010; Toto et al., 2018). Users are able to customize their mobile devices with applications that suit their needs (Kortum et al., 2015).

In the past, Tunku Abdul Rahman University College (TARUC) students accessed their attendance record, timetable and various study materials via the TARUC Intranet. This kind of document accessing has created inconvenience in flexibility (Mohammed et al., 2018; Jacksi et al., 2018). Similar to other higher learning institutions, student attendance in TARUC was taken by passing down the attendance sheet between each student in the

class to be signed. It was inefficient because some students never received the attendance sheet during large classes, and it was a hassle for the staff registering the attendance of students into the system (Mohammed et al., 2018; Jacksi et al., 2018). However, recently TARUC has introduced their mobile application, TARCApp. This mobile application has not only implemented paperless class attendance registration, but also assists students to access various necessary resources such as their semester grades, overall grades, timetable and announcement. Usability of an application is considered to be one of the key issues in an application usage (Niranjnamurthy et al., 2014; Swaid & Samar, 2017; Hussain et al., 2016; Harms & Schweibenz, 2007), but TARCApp has not been evaluated properly yet. Hence, the objective of this research study was to evaluate the usability of TARCApp from the aspects of effectiveness, efficiency and satisfaction.

2 BACKGROUND

Usability has not been defined homogeneously, it is either defined by the researchers or by the standardization bodies (Abran et al., 2003). It is a multi-dimensional concept that opens areas for research and has evolved over time to gain relevance in many aspects (Madan et al., 2012). Many definitions and perspectives of usability have been developed over the years (Van et al., 2019). For example, Nielsen (1994) identified usability with five attributes: Efficiency, Satisfaction, Learnability, Memorability and Errors. Besides, PACMAD identifies total of seven attributes: Effectiveness, Efficiency, Satisfaction, Learnability, Memorability, Errors and Cognitive Load. PACMAD usability model

aims to address some of the shortcomings of Nielsen usability models when applied to mobile applications. However, ISO 9241-11 standard is considered a widely accepted definition of usability (Jokela et al., 2003): “...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.”.

Single Ease Question (SEQ) is a post-task questionnaire which contains a single question: “Overall, how difficult or easy did you find this task?”. It is normally used after the completion of every task to capture the task difficulty (Sauro et al., 2009; Wetzlinger et al., 2014). SEQ uses a 7-step Likert scale rating system where the difficulty is rated from “Very Difficult” to “Very Easy”. SEQ performs as well as more complicated task difficulty measures such as Usability Magnitude Estimation (UME) and Subjective Mental Effort Questionnaire (SMEQ). This measure has greater validity since the metric is recorded right after each task, compared to the end of the test session (Sauro et al., 2009).

Software Usability Scale (SUS) is a post-test questionnaire, first used in 1986, which now has become an industry standard questionnaire for measuring usability of a system and application with references in over six hundred publications (Sauro, 2011; Bangor et al., 2008). It is reliable (α cronbach=0.91) with small sample size (Lewis & Sauro, 2009; Bangor et al., 2009). SUS is used after the test session to capture the overall system satisfaction and measure usability of a system (McLellan et al., 2011; Brooke, 1996). It consists of 10 questions that uses a 5-step Likert scale rating system where the scale is rated from “Strongly Disagree” to “Strongly Agree” (McLellan et al., 2011). SUS is well-balanced since it consists of five questions with negative connotations and five with positive connotations. The SUS scores are calculated using the method developed by John Brooke (1996). All the recorded scores are converted to a systematic score and the mean score is used to represent the usability of a system. SUS scores are not percentages. A mean score greater than 68 (50% percentile rank) is considered above average since this is the accepted mean score from a distribution of scores previously collected from usability tests (Kortum & Sorber, 2015; Peres et al., 2013; Sauro, 2011). For example, referring to Figure 1, a SUS score of a 70 is about 56% percentile

rank, indicating that this score is higher than 56% of 500 tested applications and results as grade “C”.

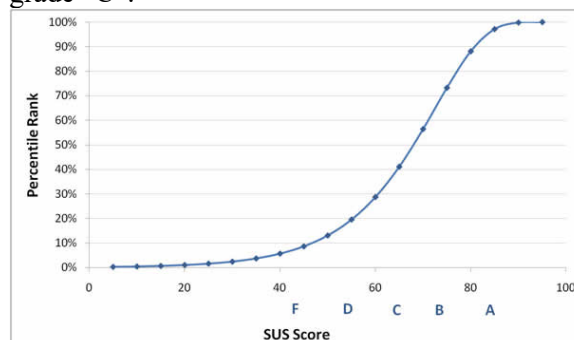


Figure 1 – SUS scores as percentiles and grade (Sauro, 2011).

3 METHODOLOGY

In this study of mobile application usability evaluation, it is more appropriate to select a mobile application that is similar to the TARCApp. “Concordia” from Concordia University has been used in this study, because of its similar features with TARCApp, which helping students in accessing various study material and announcement. However, it would not be a fair comparison since TARUC students do not use the Concordia mobile application before. Therefore, we allocated up to an hour to let the participants learn and get comfortable with Concordia before the evaluation.

Faulkner (2003) had demonstrated that with twenty participants, it is possible to discover 95% of usability problems. Therefore, we invited twenty participants to test the TARCApp mobile application. Ten of the participants were bachelor’s degree students (50%), the other ten from diploma year 2 (50%). To avoid gender being an influence on the evaluation, ten (50%) male and ten (50%) female with equal distribution between bachelor and diploma programs have been selected. All the participants were aged between eighteen to twenty-two years old. Participants were divided into two groups, ten of the participants using TARCApp mobile application and the rest ten using the Concordia mobile application.

Participants had to conduct all the tasks using an iPhone 7 running iOS 11.1. To eliminate the factor of variation mobile devices toward participants performance, only a single mobile device was used for

both applications during the test. A test task list was used and listed as follow: 1) Latest news checking; 2) Accessing class schedule; 3) Exam results checking; 4) Finding emergency numbers; 5) Offered courses checking;

The test sessions were carried out in the discussion room located in the TARUC Library, because of its quiet environment which minimizes distraction to the participants.

4 RESULTS AND DISCUSSION

4.1. Effectiveness

Effectiveness was measured by the task completion rate. If the participant successfully completes the task in one attempt, will be marked as “E” (Easy) with one point. If the participant successfully completes the task in two attempts, will be marked as “H” (Hard) with half the point, if not, will be marked as “F” (Failed) with zero point.

To achieve perceived effectiveness (PE), we will use the following Eq. (1)

$$PE (\%) = \frac{"E" + ("H")}{Total Num of Tasks Taken} \times 100\%, \quad (1)$$

where:

“E” (Easy) = 1 point

“H” (Hard) = 0.5 point

Total Number of Tasks = 5

Table 1 illustrates the completion rates for the TARCApp mobile application. In Task 1, all the participants successfully completed the task in one attempt. There was only a single participant who could not successfully complete the task in two attempts in Task 4. All the tasks were successfully completed in Task 2, Task 3 & Task 5 with some participants who completed it in two attempts. The calculated effectiveness of the TARCApp mobile application is 86%.

Table 1 – Completion rates for the TARCApp.

Participant	T1	T2	T3	T4	T5
1	E	E	E	E	E
2	E	E	E	H	E
3	E	E	H	H	H
4	E	E	E	F	E
5	E	H	E	E	E
6	E	H	H	E	E
7	E	E	E	H	H
8	E	E	E	H	E
9	E	E	E	H	E
10	E	H	H	H	E
Effectiveness (%)	100	85	85	70	90
	86%				

Table 2 illustrates the completion rates for the Concordia mobile application. Similarly, in Task 1, all the participants successfully completed the task in a single attempt. Unlike the TARCApp, all the participants in Concordia mobile application successfully completed the task in one or two attempts. The calculated effectiveness of the Concordia mobile application is 92%.

Table 2 – Completion rates for the Concordia.

Participant	T1	T2	T3	T4	T5
1	E	E	E	E	E
2	E	E	E	E	E
3	E	E	E	H	E
4	E	H	E	E	H
5	E	E	E	E	E
6	E	H	H	E	E
7	E	E	E	H	E
8	E	E	E	E	E
9	E	E	E	E	H
10	E	E	E	H	E
Effectiveness (%)	100	90	95	85	90
	92%				

As shown in Table 1 & Table 2, Concordia mobile application has slightly higher effectiveness compared to the TARCApp mobile application with 6% difference. This result could be due to a participant who failed in a task of the TARCApp or the participants in the Concordia test completed the tasks successfully more in a single attempt or the participants in the TARCApp test completed the tasks successfully more in two attempts.

However, from the calculation above, the effectiveness of the TARCApp mobile application is 86%. This implies that the TARCApp is able to help users to achieve their goals and perform their tasks.

4.2. Efficiency

Efficiency was measured by the task completion time. Table 3 & Table 4 illustrate the recorded time taken from twenty participants (ten participants for each application) for each task. Figure 3 shows the results of both mobile applications with the mean time in seconds for each task. Participants who failed to complete a task were not considered in the calculation.

Mean completion times for the TARCApp mobile application are ranged from 1.88s to 4.66s (Table 3). Task 1 took the shortest time to complete with 1.88s average. Task 2 & Task 3 have similar completion time with 2.94s and 2.56s respectively. However, Task 4 and Task 5 took more than 4s with Task 5 which took the longest time to complete (4.66s). The average task time for the five tasks on TARCApp mobile application is 3.26s.

Table 3 – Completion times for the TARCApp.

Participant	T1 (s)	T2 (s)	T3 (s)	T4 (s)	T5 (s)
1	1.42	2.78	2.53	3.13	5.16
2	2.11	3	2.70	5.10	4.10
3	1.71	2.95	2.60	4.10	4.09
4	1.98	2.89	2.59	-	4.78
5	2.09	3.1	2.25	3.82	5.05
6	1.96	2.42	2.78	3.50	4.30
7	2.45	2.83	2.22	5.08	5.07
8	1.47	2.95	2.58	4.34	4.48
9	1.65	2.87	2.62	4.85	4.92
10	1.92	3.62	2.68	4.50	4.65
Average (s)	1.88	2.94	2.56	4.35	4.66

Mean completion times for the Concordia mobile application range from 4.17s to 7.11s with all the tasks timed more than 4 seconds (Table 4). In Concordia mobile application, Task 3 took the shortest time to complete with mean time of 4.17s. While, Task 5 took the longest time with 7.11s. The average task time for the five tasks on the Concordia mobile application is 5.56s.

Table 4 – Completion times for the Concordia

Participant	T1 (s)	T2 (s)	T3 (s)	T4 (s)	T5 (s)
1	6.49	4.00	3.86	7.28	7.60
2	6.36	5.22	4.99	3.42	6.86
3	6.51	4.83	4.32	5.25	6.59
4	6.81	4.51	4.87	6.77	7.39
5	5.72	4.21	3.76	7.72	7.07
6	6.43	4.40	3.90	3.60	6.90
7	6.38	5.15	4.35	4.87	7.35
8	6.49	4.11	4.18	4.39	7.28
9	6.48	4.70	3.95	6.85	6.72
10	6.35	4.35	3.55	5.29	7.33
Average (s)	6.40	4.55	4.17	5.54	7.11

Comparing each mean task time on both mobile applications results show that all tasks were carried out faster on the TARCApp mobile application as shown in Figure 2. In the case of Task 1, the difference in task mean time was significantly high with 240.43%, even though all

the participants in the Concordia mobile application completed the task in a single attempt, they had trouble completing the task. Moreover, Task 2, Task 3 & Task 5 had a considerably high difference in mean task time with 54.76%, 62.89% and 52.58% respectively. Lastly, Task 4 had the lowest difference in mean task time with 27.26%.

□

Task Completion Time (Mean)

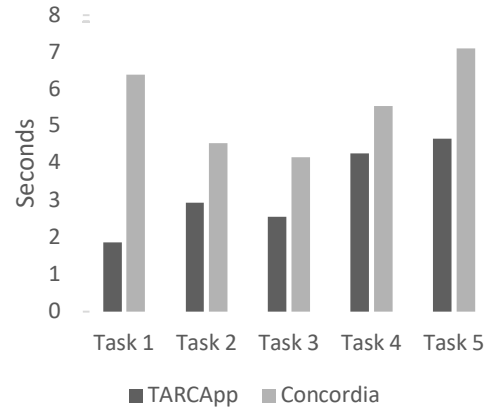


Figure 2 – Task completion time results.

Efficiency is measured based on Overall Relative Efficiency (ORE) as shown in the Eq. (2)

$$ORE (\%) = \frac{\sum_{j=1}^R \sum_{i=1}^N n_{ij} t_{ij}}{\sum_{j=1}^R \sum_{i=1}^N t_{ij}} \times 100\%, \quad (2)$$

where:

N = Total number of tasks

R = Total number of participants

n_{ij} = The result of task i by user j ; if the participant successfully completes the task in one attempt, then $n_{ij} = 1$, if the participant completes the task in two attempts $n_{ij} = 0.5$, if not, then $n_{ij} = 0$

t_{ij} = The time spent by user j to complete task i . If the task is not successfully completed, then time is not added into the calculation

Table 5 illustrates the overall relative efficiency for both mobile applications. Concordia mobile application has a slightly higher efficiency compared to the TARCApp mobile application with 5.06% difference, as illustrated in Table 5.

The overall relative efficiency of TARCApp is 86.94%. Thus, this implies that the TARCApp mobile application is efficient and able to supports users in achieving their

goals in minimal time and minimal mental efforts.

Table 5 – Overall Relative Efficiency results for both applications.

Mobile Application	Overall Relative Efficiency (%)
TARCAApp	86.94
Concordia	92.00

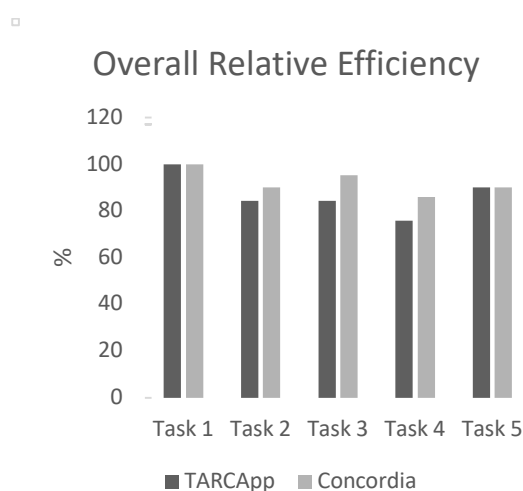


Figure 3 – Overall Relative Efficiency results comparison shown as bar chart.

4.3. Satisfaction

4.3.1. Task Level Satisfaction

Satisfaction at the post-task level was measured using the Single Ease Question (SEQ). Results were rated on a 7-step Likert scale from one (*very easy*) to seven (*very difficult*). The results are summarized in Table 6 using the mean value instead of the median because the total number of participants were low.

Results show considerably similar resemblance, with each task mean rated less than five scores. Task 1 is considered to be the easiest task with mean of 1.00 rating, possibly because it is located in the homepage of the application and every participant has seen or checked it before. Task 2 & Task 3 has a mean of 2.20 and 2.30 respectively which is considered to be an easy task. Possibly it is a task that is regularly done by the participants because students check their class schedule on a regular basis and their exam results when it is announced. However, Task 4 & Task 5 received a mean rating of 4.30 and 4.00 respectively which is considered to be somewhat easy and close to moderate. Perhaps, these two tasks are not frequently performed by students.

The results in Table 6 illustrate the overall mean value for the task level satisfaction is 2.76. Thus, this implies that the tasks tested in the study were not found difficult by the participants.

Table 6 – Single Ease Question (SEQ) results for post-task satisfaction.

Tasks	Mean
Task 1 (Latest news checking)	1.00
Task 2 (Accessing class schedule)	2.20
Task 3 (Exam results checking)	2.30
Task 4 (Finding emergency numbers)	4.30
Task 5 (Offered courses checking)	4.00
Total	2.76

4.3.2. Test Level Satisfaction

Satisfaction at the post-study level was measured using the Software Usability Scale (SUS). Results were rated on a 5-step Likert scale from one (*strongly disagree*) to five (*strongly agree*). The SUS score and frequency of each score are summarized alongside the mean value in Table 7. Calculation method used for SUS is explained as follows:

- For every odd-numbered question, subtract one from the score: $(X - 1)$
- For every even-numbered question, subtract the score from five $(5 - X)$
- Sum the scores from even and odd-numbered questions. Then multiply the sum with 2.5 $(N \times 2.5)$

Where:

X = the score given

N = the sum of even-numbered and odd-numbered questions

Furthermore, the TARCAApp mobile application was considered to be used moderately (Q1). Participants found the TARCAApp to be less complex (Q2), easy to use (Q3) and easy to learn (Q7). Results from (Q4) indicate that participants do not need a support from a technical person to use the application. Also, participants found various function in the application to be well integrated (Q5), moderately cumbersome to use (Q8) and confident when using the application (Q9). Moreover, participants deduced the application to have too much inconsistency (Q6).

The resulting SUS score calculated was 63.3. According to the general guideline on SUS scoring interpretation (Peres et al., 2013), this result is considered as grade D with about 35% percentile rank. This indicating that the TARCApp has higher score than 35% of all 500 tested applications. This implies that the mobile application is not able to fulfill the user needs. Participants had a feeling of discomfort and thus, a negative attitude towards the application.

Table 7 – SUS score & frequency with mean for each question.

System Usability Scale 63.3 SUS Score:	Strongly Disagree			Strongly Agree			Mean
	1	2	3	4	5		
Q1	1	3	7	4	5		3.450
Q2	6	5	4	4	1		2.450
Q3	0	0	8	7	5		3.850
Q4	9	5	3	2	1		2.050
Q5	3	2	4	7	4		3.350
Q6	3	5	9	2	1		2.650
Q7	1	2	3	7	7		3.850
Q8	3	3	7	5	2		3.000
Q9	2	2	8	5	3		3.250
Q10	5	6	5	2	2		2.500

5 CONCLUSION

The purpose of this study was to test and evaluate the usability of TARCApp mobile application from the aspects of effectiveness, efficiency and satisfaction. This study was conducted with twenty randomly selected participants from TARUC KL Main Campus with the instruments such as test task, SEQ and SUS questionnaire.

The results conclude that the TARCApp mobile application had a high degree of effectiveness, efficiency and satisfaction. This indicates that the application was perceived to be usable by the participants. Besides, participants also rated that this application was less complex, easy to use and easy to learn.

However, there are some issues that require improvements. Participants have found that the TARCApp had design inconsistencies. Additionally, the application received low SUS score which reflects to the participants' satisfaction. Even though, participants rated the completed tasks as satisfactory and easy to

perform using the Single Ease Question, the post-study satisfaction was perceived to be poor.

Future studies should consider using different mobile devices with different platforms to investigate more usability issues.

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