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# Learners' Beliefs and Perceptions toward Mobile Devices for Learning: a Comparison Study of Mobile Phones with Three Different Platforms

**Yong-Wee Sek** [a], **Siong-Hoe Lau** [b], **Kung-Keat Teoh** [b], **Check-Yee Law** [c] **,Shahril Bin Parumo** [a]

[a] Faculty of Information and Communication Technology, Universiti Teknikal Malaysia Melaka, Malaysia.
[b] Faculty of Information Science and Technology, Multimedia University, Malaysia.
[c] Foundation Studies and Extension Education, Multimedia University, Malaysia.

**Abstract**

The aim of this study is to provide educators more insight on the learners' beliefs and perceptions of the different mobile communication devices which contribute to the effectiveness of mobile learning in a higher education institution among a diverse group of users. This paper reports on the results of a survey of three mobile phones on three different platforms with a total of 40 subjects in a between-subjects design. An analysis of the quantitative survey indicates that the students perceived positively the benefits of mobile learning with three different types of mobile phones. Overall, mobile phones integrated with touch screen and full QWERTY keyboard are valuable alternative devices for mobile learning. Findings also show that video and audio are an important mode for communication and interpretation, particularly when paired with pictures for the students to have more control over the learning process.

**Keywords:** mobile device; mobile learning; usability evaluation

## 1. Introduction

The adoption and use of information technology (IT) have influenced every field of society. In the educational and training field, the potential of IT is of great value since it can enhance better quality learning. With the introduction of new IT devices, many research studies have indicated that "the next revolution in technology to affect education and training will be mobile communication devices and palmtop/handheld computers" [1].

There is a huge market of mobile communication devices with the upcoming of smart phones. It is one of the most dynamic markets in the consumer electronics industry. Smart phone is the future of today's mobile phone and its price has decreased significantly which make it affordable for the consumer market. The specifications and performance in the smart phones are determined by the Operating System (OS) [2]. Currently, the smart phone market is dominated by OS such as Symbian, Windows Mobile and Palm OS which consist of combination of related software development libraries, application programming interfaces and programming tools [3].

Many previous studies showed that learners preferred using handhelds devices over notebooks or desktop PCs [4] as the latter are relatively bulky and obtrusive, require a surface to operate properly and typically have short battery life time [5]. Currently, because of the availability of increasing functionalities, storage capacity, network connectivity, flexibility, ubiquity and price, handheld devices appear to be a preferred solution for accessing information on the go [1, 6-8]. Despite all these advantages, there are also many disadvantages which arise due to the handhelds devices' size. The manufacturers decreased usability with smaller screen size and limited user control, availability with a shorter battery lifetime and performance with lower processing speed.

Today, many different smart phone platforms are introduced and available in the market. Thus end users need to know their technical and usability performance to support mobile learning. It has been emphasized that the value of an IT innovation lies not so much in the technology itself, but in its effective and efficient usage [9]. In addition, research has found that, in order to achieve the desired purpose and for its benefits to be realized, IT must be accepted and appropriately used by its intended users [10-12]. Based on the same rationale, smart phones can only make a difference if they are accepted and used by the learners.

The goal of this study is to investigate how different mobile software platforms influence the usability of smart phones when taking into account different features. We set up an experiment to

compare 3 commercially available smart phones with different mobile software platforms. By analyzing the data quantitatively, we aim to provide educators and learners insight into the consequences of emerging technologies on the usability of smart phones with different mobile software platforms for mobile learning.

## 2. Methods

### *2.1. Participants*

This study was conducted with students of a private university, as they are generally familiar and confident using related technologies and therefore resemble the profile of potential professional smart phone users for mobile learning. To ensure that differences in usability would not be attributable to differences of the personal characteristics among the participants, we used a survey to select participants with familiarity with cell phones and computers, subjective expertise of cell phones and computers; and intention to use smart phones. Only students who did not own a smart phone or a PDA were selected for the experiment to ensure that there were no significant differences between the groups in terms of level of contact with related technology and confidence in using this technology. Participants were 40 IT major students who are taking the Digital System Course from the same instructor. Among them, there were 23 males and 17 females. Participants were familiar with the Internet, computers, and keyboarding skills, but without previous mobile learning experience.

### *2.2. Study Devices*

In this study, three commercially available smart phones were selected. They were Nokia E55 (Symbian), HTC Touch Pro 2 (Windows Mobile 6) and Palm Treo680 (Palm OS). All of them offered similar functionality and were configured for use by the same mobile network operator. An overview of the selected smart phones is shown in Table 1.

Table 1 Comparison of smart phones

| | Nokia E55 | HTC Touch Pro2 | Palm Treo 680 |
|---|---|---|---|
| Operating system | Symbian OS, S60 rel. 3.2 | Windows Mobile® 6.1 Professional | Palm OS® 5.4.9 |
| CPU | ARM 11 600 MHz processor | Qualcomm® MSM7200A™, 528 MHz | Intel® PXA270 312 MHz processor |
| Input | Half-QWERTY keyboard | Slide-out 5-row QWERTY keyboard with touch screen | Full QWERTY key layout with TFT touch screen |
| Display | 2.4 “, 240 x 320 pixels, TFT screen | 3.6”, 480 X 800 pixels, TFT-LCD touch screen | 2.75”, 320 x 320 pixel, TFT touch screen |
| Browser | WAP 2.0/xHTML, HTML | Opera 9.5 mobile web browser | WAP 2.0 / HTML (Blazer 4.5) |

### *2.3. Procedures*

At the start of the experiment the participants were instructed that the experiment was set up to examine the usability of the smart phone and not to test the participants. The participants were provided with information on the capabilities of smart phones in general and were asked to read through a list of instructions. Each subject had a chance to familiarize himself/herself with the devices and the test software before the test, and completed five selection tasks with each device before data was recorded. During the test, the subjects sat in a quiet campus lab and were directed to complete the tasks presented as quickly and as accurately as possible.

The counterbalancing approach was applied as the experimental design in this study was likely to be order effects. The students might find the second device easier to use just because they have had practice on the first one, and therefore we could not conclude confidently that the second one is easier to use. As a solution, we divided the students into three groups by randomly assigning them to conduct the devices testing in the reverse order to the rest of the students.

They were asked to perform the tasks in the predefined order by retrieving and interacting with the learning objects and to fill-in the questionnaire after completing the tasks. Furthermore, they were asked to go back to the main menu of the smart phone before starting a new task to ensure that every task in every test was started from the same position in the menu. The whole experiment lasted 30 to 40 minutes depending on the working speed of the participant.

## 3. Results

### *3.1. Descriptive statistics*

Table 2 presents the means and standard deviations of the overall perceptions in terms of learning experience, learning content and usability. Overall, students viewed usage of these three devices positively. In general, the mean scores from three

devices indicated that, device B has highest scores on overall perceptions in learning experience, learning content and usability.

Table 2 Descriptive statistics

| | Device A | | Device B | | Device C | |
|---|---|---|---|---|---|---|
| | Mean | S.D. | Mean | S.D. | Mean | S.D. |
| 1) Overall learning experience | 3.12 | .676 | 3.66 | .661 | 3.45 | .679 |
| 2) Overall learning content | 3.04 | .684 | 3.53 | .873 | 3.49 | .816 |
| 3) Overall usability | 2.84 | .908 | 3.35 | .556 | 3.25 | .665 |

### *3.2. Perceptions and Beliefs*

In this study, a Friedman two-way analysis of variance was conducted to find the differences within group. The significance level (Alpha) was set to .05 for the data analysis

*Learning experience*

The results of this test suggest that there are significant differences in the overall learning experience mean rank scores across the three devices as shown in Table 3. This is indicated by a Sig. level of, $p < .001$. Comparing the ranks for the three sets of scores, it appears that device B has the highest score (2.46), follow by device C (2.05) and device A (1.49).

Table 3 Comparison of overall learning experience

| | Mean Rank | | | | | |
|---|---|---|---|---|---|---|
| | Device A | Device B | Device C | Chi-Square | df | Sig. |
| Overall learning experience | 1.49 | 2.46 | 2.05 | 21.592 | 2 | .000 |

Further analyses for each item under this category reveal that there are significant differences for item 1, item 2 and item 3 mean rank scores across the three devices as shown in Table 4. Overall students had good experience with device B. They perceived the learning experience as fun and would like to take another mobile learning course if it is relevant to their studies. In addition, they recommend this method of study to others. However, for long term learning experience (item 4 & item 5), there are no significant differences in mean rank scores across the three devices.

Table 4 Comparison individual item for learning experience

| | Mean Rank | | | | | |
|---|---|---|---|---|---|---|
| | Device A | Device B | Device C | Chi-Square | df | Sig. |
| 1) The mobile learning experience was fun | 1.49 | 2.46 | 2.05 | 26.661 | 2 | .000 |
| 2) Based on my experience, I would take another mobile learning course if it is relevant to my studies | 1.69 | 2.21 | 2.10 | 9.314 | 2 | .009 |
| 3) I would recommend mobile learning as a method of study to others | 1.65 | 2.48 | 1.88 | 24.250 | 2 | .000 |
| 4) Mobile learning increases the quality of e-learning | 1.94 | 2.09 | 1.98 | 4.333 | 2 | .115 |
| 5) I was able to meet the learning objectives in my course by using mobile learning | 1.95 | 2.05 | 2.00 | 4.000 | 2 | .135 |

*Learning Content*

In terms of learning content, the results of this test show that there are significant differences in the overall learning content mean rank scores across the three devices. This is indicated by a Sig. level of, $p < .001$ as shown in Table 5. Comparing the ranks for the three sets of scores, it appears that device B (2.25) and device C (2.24) have almost equal score, follow by device A (1.51).

Table 5 Comparison of overall learning content

| | Mean Rank |
|---|---|

| | Device A | Device B | Device C | Chi-Square | df | Sig. |
|---|---|---|---|---|---|---|
| Overall learning content | 1.51 | 2.25 | 2.24 | 23.051 | 2 | .000 |

Further analyses for each item under this category reveal that there are significant differences for item 1 and item 3 mean rank scores across the three devices as shown in Table 6. Overall students had good perceptions towards learning content with device B and device C. They perceived the course content with video and sounds as more effective than text based content and the evaluation method (questions, quizzes, etc.) for this learning course was effective. However, there are no significant differences mean rank scores across the three devices for item 2. All three devices are suitable to use graphics and illustration for mobile learning to be effective.

Table 6 Comparison individual item for learning content

| | Mean Rank | | | | | |
|---|---|---|---|---|---|---|
| | Device A | Device B | Device C | Chi-Square | df | Sig. |
| 1) Course content with video and sound were more effective than text based content | 1.85 | 2.13 | 2.03 | 11.273 | 2 | .004 |
| 2) It is necessary to use graphics and illustration for mobile learning to be effective | 2.01 | 2.05 | 1.94 | 3.000 | 2 | .223 |
| 3) The evaluation method (questions, quizzes, etc.) for this mobile learning course was effective | 1.55 | 2.24 | 2.21 | 22.894 | 2 | .000 |

*Usability*

The results of this test suggest that there are significant differences in the overall usability mean rank scores across the three devices as shown in Table 7. This is indicated by a Sig. level of, $p < .001$. Comparing the ranks for the three sets of scores, it appears that device B has the highest score (2.40), follow by device C (2.21) and device A (1.39).

Table 7 Comparison of overall usability

| | Mean Rank | | | | | |
|---|---|---|---|---|---|---|
| | Device A | Device B | Device C | Chi-Square | df | Sig. |
| Overall usability | 1.39 | 2.40 | 2.21 | 25.265 | 2 | .000 |

Further analyses for each item under this category reveal that there are significant differences for item 1, item 4, item 5 and item 6 mean rank scores across the three devices as shown in Table 8. Overall students had positive usability experience with device B. They felt that with device B, accessing and reading text on the device are relatively easy, activities involving manipulation of graphical materials on the device are relatively easy, navigation through the mobile learning course was easy and it was easy to input data into this device. However, for item 2 and item 3, there are no significant differences mean rank scores across the three devices. All three devices are relatively easy for accessing and listening sound materials or watching video materials.

Table 8 Comparison individual item for usability

| | Mean Rank | | | | | |
|---|---|---|---|---|---|---|
| | Device A | Device B | Device C | Chi-Square | df | Sig. |
| 1) Accessing and reading text on the device are relatively easy | 1.70 | 2.25 | 2.05 | 11.402 | 2 | .003 |
| 2) Accessing and listening to sound materials on the device are relatively easy | 1.94 | 1.98 | 2.09 | .780 | 2 | .677 |
| 3) Accessing and watching video materials on the device are relatively easy | 1.94 | 1.96 | 2.10 | 1.032 | 2 | .597 |
| 4) Activities involving manipulation of graphical materials on the device are relatively easy | 1.68 | 2.29 | 2.04 | 11.673 | 2 | .003 |
| 5) Navigation through the mobile | 1.63 | 2.24 | 2.14 | 17.494 | 2 | .000 |

| | | | | | | |
|---|---|---|---|---|---|---|
| learning course was easy | | | | | | |
| 6) It was easy to input data into this device | 1.84 | 2.14 | 2.03 | 11.308 | 2 | .004 |

## 4. Discussions

On the whole, the main characteristics of device B which differ from the other two devices in the study are full QWERTY keyboard and larger LCD touch screen (0.85 inches more than its nearest competitor in this study).

In terms of learning experience, respondents found that device B allowed them to a more fun learning experience (mean rank 2.46). A large number of respondents who used this device reported that they would like to take another similar course relevant to their studies after the experience (mean rank 2.21) and are willing to recommend mobile learning to others (mean rank 2.48). In short, the learning experience with device B has been generally very positive.

The results also show that respondents using device B found learning more effective with video and sound compared to text (mean rank 2.13). Device B also proved more efficient for evaluations (such as quizzes and questions) in mobile learning (mean rank 2.24). The findings imply that learning content is more effective when the device has a full QWERTY keyboard and has larger screen.

Users of device B reported that its usability is significantly better than other devices used in the study. They reported that accessing and reading texts are relatively easier (mean rank 2.25) and activities which require the manipulation of graphics are also easier (mean rank 2.29). In addition, navigation of the course content using the device is also easier (mean rank 2.24). The availability of a QWERTY keyboard probably led the users to report that it is easier to input data (mean rank 2.14).

In addition, although every operating system has its own method and style to present the information on screen, it does not seem to affect the students' perceptions and beliefs and usability of the device.

The results of this study present a few implications to educators and instructional designers of mobile learning.

First, it is important that content is kept short and simple. For example, the length of videos or animation sequences should be kept to only a few minutes. In addition, it is also recommended that navigation be kept to a minimum as the users generally require quite a bit of effort to navigate mobile devices due to the restraints of the limited screen and keyboard size.

Second, we recommend cautious use of rich media (e.g. graphics, audio, video, or animation) in mobile learning, which should only be used if necessary. It would also be a good idea to deliver some of the learning content through a PC and pre-load it to a memory card before being viewed on-the-go through a mobile device.

Third, menus, toolbars, and buttons should be easy to use. Designers should hence facilitate the device's usage when designing these. In addition, they should be made as simple as possible, with considerations to support touch-screens, including the inclusion of short-cut functions which would be useful for ease of access. The content of the mobile learning materials should also be organized and structured in a manner which allows easy navigation and access to files and specific content or topics.

Finally, the mobile device should also be able to support a variety of multimedia formats including text, diagrams, maps, photos, sound, video, etc.). Users should find different formats of media presentations easy to read, write, draw, record, play or print.

## 5. Conclusion

The goal of this study is to investigate how different mobile software platforms influence the usability of smart phones when taking into account different features. When looking at the three tested devices, they were about equal in their overall performance, but device with the full QWERTY keyboard and larger touch screen were best suited for mobile learning. The choice of the display size with touch screen capability could influence the students' beliefs and perceptions towards the mobile learning. Future studies should focus on usability enhancements. The devices' small size enforces limitations on the devices' user friendliness. Thus, innovative methods such as voice-based user-device interaction should be explored to assist the students using such devices for learning.

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