A USABILITY STUDY ON CONTENT DISPLAY IN MOBILE LEARNING

Riaza Rias (Faculty of Information Technology and Quantitative Sciences, MARA University of Technology, Shah Alam, Selangor, Malaysia; riaza@tmsk.uitm.edu.my); Fazilah Ismail (Faculty of Information Technology and Quantitative Sciences, MARA University of Technology, Shah Alam, Selangor, Malaysia; fazilah@tmsk.uitm.edu.my); Azlan Ismail (Faculty of Information Technology and Quantitative Sciences, MARA University of Technology, Shah Alam, Selangor, Malaysia; azlan_a@tmsk.uitm.edu.my)

ABSTRACT

Mobile technology has started to play many important roles in our lives. In education, mobile technology could assist learning while students are on the move by using mobile devices such as personal digital assistant (PDA), mobile phones or a laptop. We look at PDAs in this study. One of the problems faced by small devices are the way to display information on a small screen size. A navigation technique is implemented to display the content for learning programming in C++ on a PDA. A usability study is also conducted on the prototype design using QUIS guidelines on 10 students. We discuss the results of the usability study.

Keywords: Mobile technology, PDAs, usability, programming in C++

1. INTRODUCTION

Mastering C++ is not an easy task for many students since C++ has been well known as a tough subject that must be taken by computer science students. The toughness of this subject has caused students not to be interested in learning more about C++. That is the reason why C++ records the highest failure rates compared to other subjects taught in Faculty of Information Technology and Quantitative Sciences (FTMSK). Mobile technology is not new in our daily lives, which includes in the learning environment. Instead of reading passive reference textbooks, students can learn in an interactive way using Personal Digital Assistant (PDA) that is believed to further enhance and motivate learning. In order to motivate and assist students to build a tough understanding on the most important concept in programming, a prototype for mobile learning application is developed and focused on designing interface for learning C++ on a PDA. A navigation technique and other user interface aspects of the development are also focused in the study. To evaluate the usability of the prototype devel oped, a Questionnaire for User Interaction Satisfaction (QUIS) was used as a guideline.

1.1 Mobile Learning Concept

Mobile learning is a flexible transformation from traditional learning into different learning situation using mobile device. Mobile device is any computing device like PDA that can be carried anytime, anywhere with the ability to provide information and enable users doing activities while on the move. Unlike traditional classroom learning which is located in fixed place with common resources, a single teacher and agreed curriculum, mobile learning have no specific time and place, but totally depends on the flow of daily activities (Sharples, Corlett & Westmancott, 2002). Mobile learning complements the existing practice inside the classroom with informal learning situation outside the classroom. Mobile learning only functions as a supplementary for education using new mobile technology and does not replace formal education (Sharples, 2005). Mobile technology can be used as a bridge between this formal and informal learning environment. Mobile learning has a good potential as a new learning strategy in which people can manage their own learning to enhance their knowledge and skills (Sharples, 2000).

1.2 Possibilities of a PDA

PDA has been foreseen to become prominent computing devices in the future by combining easy carry-on feature of mobile phones with the processing capacity of personal computers. Although the PDA is not intended to fully

replace conventional computers, it is able to run most applications that are normally supported on the desktop. To be competent with this new learning approach, students need to integrate this technology into their daily instructional activities. According to research conducted at Open University in United Kingdom, people are interested on learning using PDA due to its portability (Waycott & Kukulska-Hulme, 2002). PDA strongly supports distance education by assisting students' self-managed learning activities around other tasks. The capability in assisting learning anytime and anywhere, students are able to use their time effectively. The PDA is very good in recording notes where it is able to effectively summarize course material and keep notes better organized. By keeping handy course material, reading can be done in various situations. The PDA is important in revision process where students can grasp good understanding on what they learn from reading. In addition, most PDA technologies today are equipped with browsing facility and Wireless Application Protocol (WAP) service for Internet surfing, which are beneficial for all users. Therefore, the PDA is very good as a supporting tool for printed material.

1.3 Constraints of a PDA

There are also several limitations in which limited screen size has become a big constraint. In a situation where font sizes are enlarged, the amount of information that can be viewed on the screen is reduced, while smaller font size causes reading difficulties that result in slower reading and less accuracy. Navigation is also difficult especially when users need to move back and forth the entire document. Text-input mechanism on a PDA is equipped with a touch-sensitive screen that enables direct manipulation on the screen interface. Small on-screen keyboard and writing on screen in a special handwriting script which is then converted by handwriting recognition system contribute in slower speed and decrease accuracy, make it not so beneficial for entering text (Waycott & Kukulska-Hulme, 2002).A PDA as a learning aid is not intended to replace desktop computers but it is used in conjunction with other tools like desktop computers to enhance learning capability.

1.4 Navigation Technique

Navigation is a path taken to find certain information on pages and get back whenever needed (Kaikkonen & Roto, 2003). According to Chan & Sharples (2002), navigation involves tapping activity on an outer node that brings to an inner node and consequently open the item associated with it. Navigation that was based on point-and-click interaction style finds intended location by highlighting on words, maps and iconic buttons (Dix, Finlay, Abowd & Beale, 2004). Navigation assisted by arrows was a good guidance for users' way finding and was easily used (Ekman & Lankoski, 2002). Kaptelinin (1995) indicates that the scroll bar navigation causes the slowest performance in navigating sites. Otherwise, Overview-based navigation technique limits the amount of scrolling by providing context information that enables users to make decision on which path to take (Jones, Buchanan & Thimbleby, 2002). Therefore, overview-based navigation was more effective than using scroll bar (Kaptelinin, 1995). Mackay (2003) emphasizes that navigation technique involves data modification technique and data overview technique.

2. THE PROTOTYPE DESIGN

The hierarchy diagram shown in figure 1 follows the rules of a navigation technique. The hierarchy links screens or pages in logical groupings. According to Dix et al. (2004), deep hierarchies are difficult to navigate. Therefore, this prototype structures broad top-level categories in hierarchy while others are in linear sequence. The linear part contains next and previous links between items in the same group. Figure 1 illustrates the hierarchical diagram for the prototype of learning C++.

3. USABILITY STUDY

The prototype is evaluated to measure how well it meets user requirements and subjective satisfaction. The usability testing or evaluation can help to find hidden and overlooked problems in the prototype design. Usability testing requires users to test the prototype and detect where they encounter difficulties with the interface. For prototype of learning C++ on a PDA, the usability testing

is organized to measure users' impressions about using this prototype in terms of the presentation styles. Most importantly, this testing gives an accurate result on how well navigation technique applied in displaying information on a PDA affects user satisfaction.Ten students are selected in this usability testing. All of them are FTMSK students who have taken CSC 125 paper. During this testing, they are given a set of questionnaires. Then, a short briefing is given to ensure all of them get a clear message and the same understanding. This is important in order to get a valid result. After that, all of them test the prototype prior to their feedback in the questionnaires that has been given earlier. The result of the usability testing is presented in Table 1. Table 1 shows that most of the respondents do not face much usability difficulties while navigating the prototype. For backtracking facilities, only one respondent feels unsatisfied because she prefers Breadcrumb navigation.

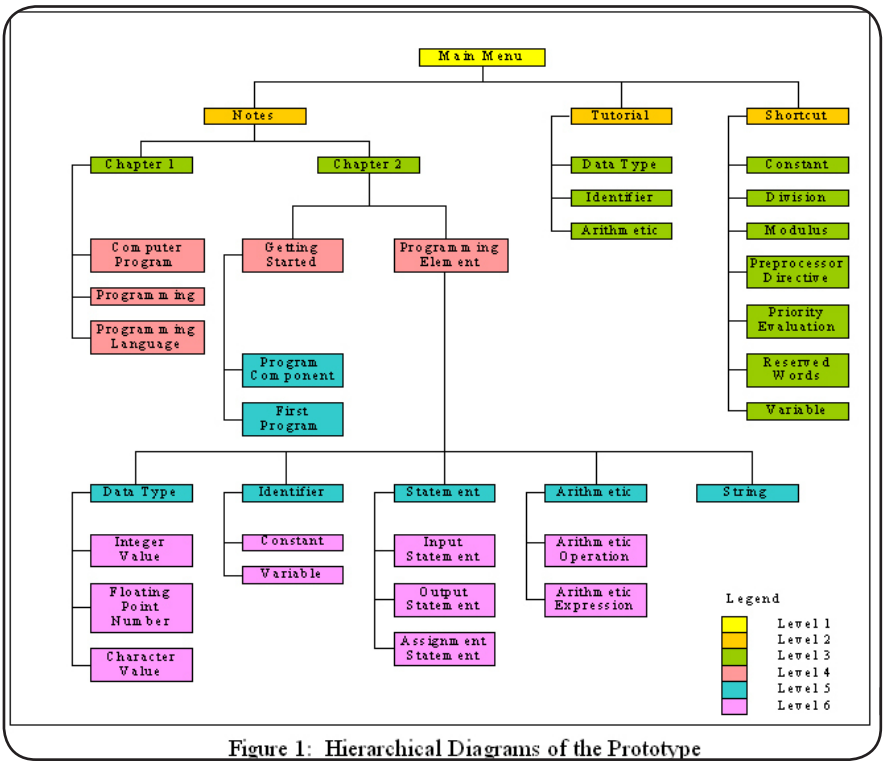

Figure 1: Hierarchical Diagrams of the Prototype

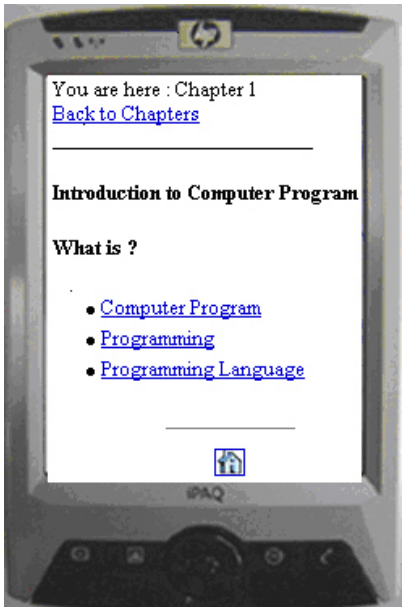

Figure 2: Sample screen shows Introduction to Chapter 1

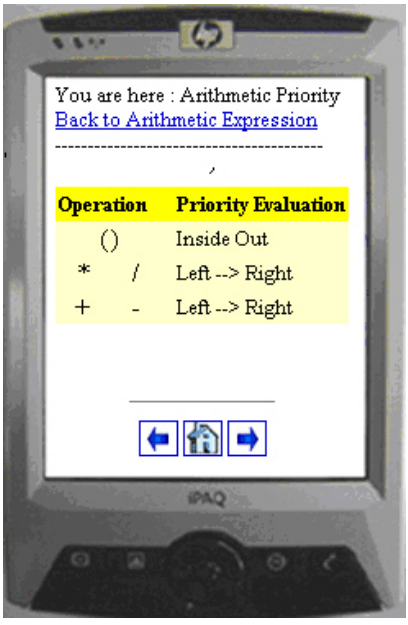

Figure 3: Sample Screen shows topic on Arithmetic Expression

Table 1: Result of Usability Testing Based on QUIS

Items	Number of Respondents						
	Bad	1	2	3	4	5	Good
Overall user reactions							
Overall reactions to the system.	Terrible	0	0	2	7	1	Wonderful
	Frustrating	0	0	2	7	1	Satisfying
	Difficult	0	0	1	6	3	Easy
Screen							
Characters on screen	Hard to read	0	0	1	6	3	Easy to read
Use of colors for highlighting	Unhelpful	0	0	2	4	4	Helpful
Amount of information displayed on screen	Inadequate	0	0	4	5	1	Adequate
Arrangement of information	Illogical	0	0	1	5	4	Logical
Sequence of screens	Confusing	0	0	0	7	3	Clear
Back to previous screen	Impossible	0	0	1	5	3	Easy
Terminology							
Use of work related terminology	Inconsistent	0	0	2	5	3	Consistent
Learning							
Learning to operate the system	Difficult	0	0	0	7	3	Easy
Task can be performed in straight-forward manner	Never	0	0	2	7	1	Always
Number of steps per task	Too many	0	0	1	8	1	Just Right
Icons usage are meaningful	Confusing	0	0	4	3	3	Clear
Comment							
Interesting style of learning	Disagree	0	0	2	3	5	Agree

that shows paths through prototype hierarchy. However, Breadcrumb navigation backtracking cannot be applied to this prototype due to limited screen space. Most users claim that this prototype provides clear sequence of screens, easy backtracking, enables task to be performed in straight forward manner and provides suitable number of steps per task. This finding is believed to be resulted from the navigation technique applied. The presentation styles evaluated in this usability testing are studied previously in literature and produce a positive result. From Table 1, it can be concluded that respondents are satisfied with the legibility of characters on screen, the use of colors for highlighting, the amount and arrangement of information, the use of work related terminology and the easiness to operate the prototype. Nobody feels unsatisfied with the items tested while only a small number stands on moderate level. A casual discussion with some of the respondents indicates that they feel easy to operate by following links in hierarchical structure without getting lost. When navigating through this prototype, they can determine their current location, find way forward and backward, and easy to predict where the focus will move next. The information contained also can be easily understood. Eight out of ten respondents claim that the prototype provides interesting style of learning.

4. CONCLUSION

From literature and this study, it is found that there are three factors that need to be considered when designing interfaces on a PDA;

i)Reduce scrolling to prevent to be lost in hyperspace situation

ii)Avoid text entry due to slower text input mechanism and

iii)Avoid excessive information.

Navigation techniques, which employ hierarchical structure, provide solution for scrolling. Additionally, navigation technique that is based on point-and-click interaction on links provides alternative for text entry interaction on a PDA. Generally, it is concluded that the navigation technique and presentation style applied in this prototype help to boost user satisfaction.

REFERENCES

Chan, T. & Sharples, M., A concept mapping tool for pocket PC computers, Proceedings of IEEE International Workshop on Wireless and Mobile Technologies in Education, Sweden (2002), 163-164.

Dix, A., Finlay, J., Abowd, G. D. & Beale, R. (2004). Designing the user interface: Strategies for effective human-computer interaction (3rd ed.). USA: Addison Wesley.

Ekman, I. & Lankoski, P., What should it do?: Key issues in navigation interface design for small screen devices, CHI '02 extended abstracts on Human Factors in Computing Systems, Minnesota (2002), 622-623.

Jones, M., Buchanan, G. & Thimbleby, H., Sorting out searching on small screen device, Proceedings of the 4th International Symposium on Mobile HCI, Pisa (2002), 81-94.

Kaikkonen, A. & Roto, V., Navigating in a mobile XHTML application, Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Florida (2003), 329-336.

Kaptelinin, V., A comparison of four navigation techniques in a 2D browsing task, Conference companion on Human Factors in Computing Systems, Colorado (1995), 282-283.

Mackay, B., The gateway: A navigation technique for migrating to small screens, CHI '03 extended abstracts on Human Factors in Computing Systems, Florida (2003), 684-685.

Sharples, M. (2000). The design of personal mobile technologies for lifelong learning. Computers and Education, 34, 177-193.

Sharples, M., Corlett, D. & Westmancott, O. (2002). The design and implementation of a mobile learning resource. Personal and Ubiquitous Computing, 6, 220-234.

Sharples, M. Learning as conversation: Transforming education in the mobile age. Paper presented at Conference on Seeing, Understanding, Learning in the Mobile Age, Budapest (2005).

Waycott, J. & Kukulska-Hulme, A. (2002). Students' experiences with PDAs for reading course materials. Personal and Ubiquitous Computing, 7, 30-43.