An Evaluation of Learners' Satisfaction toward Mobile Learning

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Abstract: - This study explored learners' satisfaction toward a mobile learning system designed to enhance novices' reflective thinking and problem-solving. Instructional multimedia were provided via mobile devices to facilitate novices' learning of the Fedora system. Learners' reflective thinking was enhanced by responding to the reflection prompts and summarizing what they had learned from the instructional multimedia. The results showed that learners satisfied with the employed mobile learning as measured in terms of willingness-to-use, ease-of-use, and helpfulness toward the employed mobile learning. It was concluded that a pedagogically well-designed mobile learning system not only possesses the potentiality in facilitating learning but also satisfies the learners.

Key-Words: - mobile learning, multimedia learning, reflective thinking

1 Introduction

According to the ACM/IEEE-CS Joint Task Force on Computing Curricula [1], the goal of the computing curricula is not only to encourage students to strengthen their communication and technical skills but also to become an effectively problem-solver and active independent learner. To achieve this goal, it is necessary to shift our emphasis from teaching to facilitating authentic learning and raising the concepts of ownership and reflection on learning. Recently, the ubiquitous computing and mobile technologies provide much scope for designing innovative learning experiences that can take place in a variety of outdoor and indoor settings [2]. The utilization of mobile devices for learning has increased learners' motivation, promoted interactive learning, facilitated cognitive skills development, and supported constructivist educational activities through collaborative groups [3][4]. However, Patten, Sanchez and Tangney [5] contended that the use of technology for learning must go beyond the technology determinist viewpoint of claiming that mobile instructional tools inevitably will have a role to play in the way people learn. Instead, the development and use of mobile devices should suit the pedagogical underpinning in order to facilitate learning in a pedagogically sensible manner.

This study examined the use of a wireless personal digital assistant and instructional multimedia in a web-based asynchronous learning environment to facilitate reflective thinking during the processes of solving IT problems. Learners' satisfaction toward the employed mobile learning was examined and several emerging issues concerning the design and utilization of mobile learning were discussed.

2 Literature

2.1 Mobile devices bringing about broader ways of learning

Digital learning system was always coupled with novel arrangements of instructional-embedded objects, providing alternative forms of interactions through familiar actions with unfamiliar effects, and then encouraging learners to reflect and think beyond the present of their actions to higher levels of abstraction [6]. The recent development of mobile devices tends to merge the portability and connectivity features together to allow broader ways and opportunities for real life learning. The portability gives mobile devices the potentiality for pervasive use in students' works, such as notes and photos taking, homework-completing, data-collecting, problem-solving, and writing down reflective thinking real time, that may facilitate learning far more widely and deeply than the desktop

computers. Through mobile connectivity, learners are allowed to download and upload homework, access class announcements, perform collaborative activities, and complete exercises, in the form of synchronous or asynchronous communication anywhere, anytime.

Likewise, after examining many unique characteristics in mobile learning environments, researchers concluded that the most often cited benefits of handheld technology include portability, ease of access, the integration of computers into a variety of education activities, promoting autonomous learning and organization, promoting student motivation, and promoting communication and collaboration [7]. Rochelle also showed that students and teachers respond favorably to handheld applications [8]. In summary, mobile technologies have already had a significant impact on ways to deliver and organize learning for today's learners. Thus, with the help of these features of mobile devices, experts become more reachable and knowledge becomes more available [9]. Most of all, through the integration of mobile tools and web-based asynchronous discussion forums, learners' individual reflective thinking can be conducted to the knowledge community for further debating and synthesizing, and augmenting the learners' elaborative learning and social cognitive processing.

2.2 Mobile devices facilitating reflective thinking

One of the major concerns with e-learning courses is that many of them focus on the traditional knowledge acquisition model of learning rather than on encouraging students in solving complex real world problems [10][11]. Researchers criticized that students are usually unable to apply knowledge in solving complex problems because of producing the inert knowledge by partial materials and surfacing thinking in online environments. Therefore, how to facilitate learners' authentic learning of problem solving and raise the concepts of ownership and reflection on learning, become a valuable issue for e-learning.

Reflective thinking refers to the processes of analyzing and making judgments about what has happened. Learners are aware of and control their learning by actively participating reflective thinking during learning. Reflective thinking is especially crucial in prompting learning during complex problem-solving situations because it provides learners with an opportunity to step back and think about how a set of problem solving strategies is appropriated or un-appropriated for achieving the goal. Therefore, Dewey [12] suggested that reflective thinking is "an active, persistent, and careful consideration of a belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends".

The ubiquitous computing enable mobile technologies the potentiality to become a powerful tool for facilitating reflective thinking. For example, reflective dialogues are always used to offering opportunities for reflective thinking by means of questioning and feedback [13]. Despite it is affirmed that the use of digital augmentation in mobile learning environment offers a promising way for enhancing the learning process, however, rare efforts had been made to explore what and how influences of reflective thinking to urging students' problem-solving [14][15]. Therefore, there is still shortage of empirical validation of the performance and attitudes on the utilization of mobile tools in web-based reflective learning environments.

2.3 Mobile technology suiting learners' individual characteristics

Recently, the role of mobile technology and the Internet continues to expand for delivery and support of learning activities. Many studies examining this trend have focused on technology issues, student achievement, or collaborative design [16][17][18]. Previous studies, however, rarely addressed the issues of learners' attitudes that were perceived as contributing factors to the design of better mobile learning activities. Various disciplines have considered the issue of learners' attitudes and perceptions of mobile technologies in educational environments, such as computer proficiency, class interaction, class satisfaction, perceived-initiative, willingness-to-use, ease-of-use, and helpfulness [19]. Besides, some study further suggested that prior experience on resemblance technologies is an influential factor to affect learners' acceptance of novel technologies [20].

Zimbardo and Leippe [21] asserted attitude as an evaluative disposition toward some object based upon cognitions, affective reactions, behavioral intentions, and past behaviors. Some studies also proposed the attitude construct of mobile technologies as cognitive, affective and behavioral that may prompt the motivation of learning or enrich the production of learning [9]. Whether attitudes influence behaviors or be influenced by behaviors, however, is still a challenge in studying attitudes. Besides, measurement of attitudes can also be problematic because of attitude typically involves multiple evaluations. To take the full benefits of mobile technologies in facilitating learning,

researchers claimed that the development and use of mobile technology should suit the individual characteristics in order to facilitate learners' learning in a pedagogically manner. The present study, therefore, aimed to examine learners' satisfaction be means of attitude aspects toward mobile learning.

3 Methods and Results

3.1 Participants

This study was conducted in a college-level computer laboratory with one-to-one student-computer ratio. Participants were 79 Information Management major freshmen who are taking the Computer Networks Course from the same instructor. Among them, there were thirty-three males and forty-six females. Participants were familiar with the Internet, computers, and keyboarding skills, but without previous mobile learning experience. Due to the amount of mobile devices, each laboratory session was limited to twenty persons. Participants were randomly assigned to four laboratory sessions to "build a Linux system from the very beginning" on a PC individually. After the 2-week hands-on laboratory sessions (three hours for each week), a satisfaction questionnaires were conducted to collect participants' perceptions toward the employed mobile learning.

3.2 Research design

In this study, a factorial design was employed with prior web-based learning experience (high vs. low), and perceived-initiative (high vs. low) as the independent variables and satisfaction aspects of willingness-to-use, ease-of-use, and helpfulness toward the mobile learning as the dependent variables. Multivariate Analysis of Variance (MANOVA) was conducted to analyze the main effects of the three independent variables (individual difference factors) on the dependent measures, respectively. The high-low group procedure was employed to identify the top 43% of participants as the high-group and the lowest 43% of participants as the low-group for the independent variables of prior web-based learning experience and perceived-initiative, respectively. The 14% of participants in the middle (1 standard deviation) were excluded from the analysis. The significance level (Alpha) was set to .05 for the data analysis.

3.3 Mobile technology and learning tasks

IT education is experiencing a paradigm shift from simply delivering established facts and procedures to engaging students in active learning that resembles more of the "inquiry–oriented" practice of computer engineers. Hands-on activities have been commonly recognized as an important way to foster inquiry-based learning for novices. In this study, the Linux Fedora system was introduced in the Computer Networks Course for learners to practice the computer networks practitioners' skills during the hands-on laboratory sessions. The instructional multimedia of the Fedora system were delivered to scaffold learners' successful learning experiences through mobile devices.

The role and functions of mobile technology and web-based technology for the present study are illustrated in Figure 1. During the IT problem-solving processes, learners can access to instructional multimedia through mobile devices to learn how to solve the encountered problems. For fostering reflective thinking and problem-solving, reflective prompts are embedded in the instructional multimedia and delivered to the learner through the mobile device during learners' interaction with the multimedia. The laboratory guidelines were also provided through the mobile device to guide the learners how to install a Fedora system smoothly. Thus, the employed mobile technology gives participants the opportunities to learn how to solve the encountered problems by means of instructional multimedia and reflective prompts.

Meanwhile, the web-based learning module provides web-based interactions to facilitate learners' reflection and knowledge construction. Through the web-based technology, learners can access to discussion forum, discuss issues and share experiences with others. Online discussion is considered to be a situation where learners can achieve higher conceptual knowledge through interaction of cognition and experience among participants. To achieve the goal of effective learning, learners have to be active learners in the discussion forum and constantly focus on the course content [22]. However, learners are reported to prefer asynchronous communication, which is more time-independent [23]. Asynchronous discussion offers opportunities for learners to provide reflective and thoughtful responses to posted questions, and insightful reactions to other learners' opinions and ideas, with an adaptable timeframe. The web-based discussion forum provided opportunities to facilitate a learner thinks back on what he had done to cause the unexpected result during problem-solving and shares experience with others. Therefore, problem-solving performance can be enhanced.

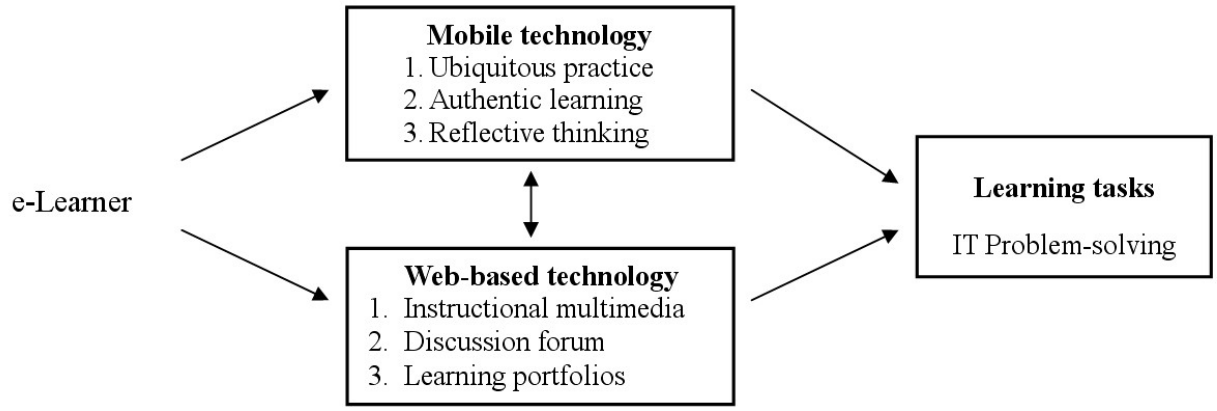

Figure 1. Mobile and web-based technologies provide the learners with the opportunities to learn to solve problems successfully

3.4 The satisfaction questionnaire

The participants' individual factors, including prior web-based learning experience and perceived-initiative, were collected before the experiment. In contrast, participants' satisfaction toward mobile learning was collected by conducting a 5-point Likert-type questionnaire developed by the researchers immediately after the last hands-on laboratory session. The satisfaction questionnaire measured participants' attitudes of willingness-to-use, ease-of-use, and helpfulness. A 5-point Likert-type scale was selected to allow participants to express their perceptions toward mobile learning in a more confident manner with 1 to 5 standing for "strongly disagree", "disagree", "neutral", "agree", and "strongly agree", respectively. The questionnaire was reviewed by two educational technology experts' and was revised for use in this study. The overall reliability coefficient of the questionnaire was .910 as measured by Chronbach's α, and and its component measures were .688, .826, and .920, respectively. According to the reliability coefficients, it was concluded that the questionnaire and its component measures were reliable.

4 Findings

The mean scores of satisfaction aspects of willingness-to-use, ease-of-use, and helpfulness toward the employed mobile learning are shown in Table 1. Participants showed positive attitudes in all satisfaction aspects with overall mean score of 4.184 in a 5-point scale. The positive finding of this study is similar to the previous studies conducted by Jong, Wang, and Lee [19] and Waycott and Kukulska-Hulme [20]. The effects of participants' prior web-based learning experience and perceived-initiative on satisfaction aspects of willingness-to-use, ease-of-use, and helpfulness toward the employed mobile learning were further analyzed by means of Multivariate Analysis of Variance (MANOVA).

Table 1 Mean scores and SD by satisfaction aspect

Aspect	N	Mean	SD
Willingness-to-use	79	4.182	.690
Ease-of-use	79	4.223	.596
Helpfulness	79	4.147	.710
Average		4.184	.665

4.1 Analysis of the effect of prior web-based learning experience

The group means of participants' satisfaction aspects of willingness-to-use, ease-of-use, and helpfulness for the independent measure of prior web-based learning experience are shown in Table 2. The mean scores of the high prior web-based learning experience group were slightly higher than the mean scores of the low prior web-based learning experience group on aspects of willingness-to-use, ease-of-use, and helpfulness. The slightly higher mean scores indicated that the high prior web-based learning experience group tended to obtain higher attitudes than the low prior web-based learning experience group. Box's test of the equality of covariance matrices was not significant (Box's M = 27.486, F = 1.336, p = .154), the homogeneity assumption of MANOVA was sustained.

The MANOVA summary on satisfaction aspects for the prior web-based learning experience is shown in Table 3. The main effects of prior web-based learning experience on the dependent measures of willingness-to-use and ease-of-use were not significant (willingness-to-use: $F_{(1, 64)}$ = .101, p = .752; ease-of-use: $F_{(1, 64)}$ = 2.328, p = .132), but the

main effect on helpfulness was significant ($F_{(1, 64)}$ = 5.540, p = .022). The results indicated that the learners' satisfaction aspects of willingness-to-use and ease-of-use toward mobile learning were not affected by prior web-based learning experience. In other words, no matter participants possessed high or low web-based learning experience, they showed positive attitudes toward the employed mobile learning (mean = 4.173) and felt that mobile learning could be handled easily (mean = 4.214).

For the helpfulness aspect, however, the high prior web-based learning experience learners valued the employed mobile learning higher than the low prior web-based learning experience learners did (high-WBL mean = 4.318 vs. low-WBL mean = 3.918). This result indicted that web-based learning experience helped the experienced learners benefit from mobile learning. Further research was suggested to examine whether the help of web-based learning will bring about significant effect on learning performance besides satisfaction.

4.2 Analysis of the effect of perceived-initiative

The group means of participants' satisfaction aspects of willingness-to-use, ease-of-use, and helpfulness for the independent measure of learners' perceived-initiative are shown in Table 4. The mean scores of the high perceived-initiative group were higher than the mean scores of the low perceived-initiative group on aspects of willingness-to-use, ease-of-use, and helpfulness. The higher mean scores indicated that the high perceived-initiative group tended to obtain higher attitudes of willingness-to-use, ease-of-use, and helpfulness toward mobile learning than the low perceived-initiative group did. The Box's test of the equality of covariance matrices was not significant (Box's M = 12.809, F = 2.026, p = .059), the homogeneity assumption of MANOVA was marginally sustained.

The MANOVA summary of satisfaction for the independent measure of learners' perceived-initiative is shown in Table 5. The main effects of the dependent measures of willingness-to-use, ease-of-use, and helpfulness were significant (willingness-to-use: $F_{(1, 66)}$ = 4.133, p = .046; ease-of-use: $F_{(1, 64)}$ = 5.062, p = .028; helpfulness: $F_{(1, 64)}$ = 7.777, p = .007). According to the mean scores shown in Table 4, the high initiative learners showed more positive attitude in satisfaction aspects of willingness-to-use, ease-of-use, and helpfulness toward mobile learning than the less initiative learners did. In other words, active learners possessed positive attitude toward mobile learning and they were expected to achieve better performance from learning.

Table 2 Group means of participants' satisfaction aspects for prior web-based learning groups

Attitude aspect	Independent measure	Mean	SD	N
Willingness-to-use	Low-WBL	4.146	0.729	33
	High-WBL	4.200	0.666	33
	Total	4.173	0.693	66
Ease-of-use	Low-WBL	4.106	0.517	33
	High-WBL	4.321	0.624	33
	Total	4.214	0.579	66
Helpfulness	Low-WBL	3.918	0.751	33
	High-WBL	4.318	0.623	33
	Total	4.118	0.714	66

Table 3 Summary of MANOVA on satisfaction aspects for prior web-based learning experience

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Web-based learning experience	Willingness-to-use	.049	1	.049	.101	.752
	Ease-of-use	.764	1	.764	2.328	.132
	Helpfulness	2.640	1	2.640	5.540	.022*
Error	Willingness-to-use	31.202	64	.488		
	Ease-of-use	20.994	64	.328		
	Helpfulness	30.498	64	.477		

Note. * p < .05

Table 5 Group means of participants' satisfaction for perceived-initiative

Attitude aspect	Independent measure	Mean	SD	N
Willingness-to-use	Low-initiative	3.970	0.747	33
	High-initiative	4.312	0.648	33
	Total	4.141	0.715	66
Ease-of-use	Low-initiative	4.055	0.505	33
	High-initiative	4.376	0.646	33
	Total	4.215	0.598	66
Helpfulness	Low-initiative	3.867	0.734	33
	High-initiative	4.342	0.650	33
	Total	4.105	0.728	66

Table 5 Summary of MANOVA on satisfaction for perceived-initiative

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Perceived-initiative	Willingness-to-use	1.972	1	1.972	3.955	0.046*
	Ease-of-use	1.702	1	1.702	5.062	0.028*
	Helpfulness	3.735	1	3.735	7.777	0.007*
Error	Willingness-to-use	31.305	64	0.489		
	Ease-of-use	21.522	64	0.336		
	Helpfulness	30.734	64	0.480		

Note. * $p < .05$

5 Conclusion

In this study, the development and use of mobile learning was based on pedagogical needs in order to facilitate IT skills learning in a pedagogically manner. Although the employed mobile device was limited in the size of screen and ways of input, learners showed high preferences toward its interactive and convenient features in facilitating learning. The researchers' reflections on the responses from the participants during and after the trial of the mobile learning can be summarized as follows.

First, handheld device has become the most conveniently used and portable learning platform for various educational purposes. The desktop application such as notepad, calculator, video and audio recording, scheduling management are gradually shifting to outdoors settings for better authenticity. Learners are likely motivated to be more engaged and activated in learning activities when the new technology is used in a meaningful way. Thus, it is desirable to develop some instructional implications on how these fascinating technologies can be proportioned to the conventional learning activities.

Second, the cognitive function of reflective thinking not only includes awareness of reasoning and reflecting but also controls one's cognitive skills and processes. The results of this study suggested that mobile learners may need more skillful self-regulation in order to focus on goal-oriented actions during the active learning process. Reflection-in-action and reflection-on-action seem to be an important and effective strategy for scaffolding effective mobile learning.

Third, mobile devices as a leading-edge technology, such as PDA, smart phone, or Tablet PC, are exciting to learners with some technology novelty. This study examined learners' attitudes through perspectives of previous web-based learning experience and perceived-initiative. Learners in all groups seem to become more initiative in information comparing, more curious in experimenting phenomena, and more frequent in communicating with each other in coordinating classroom works. Based on self-reports and questionnaires, initiative learners showed more positive attitude in ease-of-use and helpfulness aspects than less initiative learners. In other words, initiative learners enjoy and benefit from mobile learning than less initiative learners.

In conclusion, learners' intention in using technological resources begins with positive attitudes toward using them in the classroom. Given the rapid growth of applying mobile technologies to learning, learners' satisfaction towards mobile technologies will be critical in establishing appropriate interventions that help instructors integrate these resources into the education situations. In this study, the use of mobile technology has been proved to be a feasible way in facilitating reflective thinking.

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