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Mobile Learning in Distance Education: Utility or Futility?

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Abstract

Can mobile technology improve flexibility and quality of interaction for graduate students in distance programs? This paper reports the results of an innovative study exploring the usability, learning, and social interaction of mobile access to online course materials at a Canadian distance education university. Through a system called MobiGlam, students accessed Moodle course materials on a variety of mobile devices. The Framework for the Rational Analysis of Mobile Education (FRAME) model (Koole, 2006) was used to examine the complexities of this mobile system, its perceived usefulness, and potential impact on distance students. The researchers recommend further study of the balance between the controls and constraints of social technologies and the needs of distance students. Is there a way to achieve a balance so as to encourage adaptation to new technologies and a greater sense of "connectedness" among learners? As a result of the study, the researchers remain supportive of "device-agnostic" mobile tools that permit the greatest freedom of choice to distance learners.

Résumé

Est-ce que la technologie sans fil peut améliorer la souplesse et la qualité de l'interaction pour les étudiants de 2ème et 3ème cycles dans des programmes à distance? Cette étude rapporte les résultats d'une recherche novatrice qui explore la facilité d'utilisation, l'apprentissage et l'interaction sociale de l'accès sans fil au contenu de cours en ligne dans une université canadienne d'éducation à distance. Par l'entremise d'un système appelé MobiGlam, les étudiants pouvaient accéder à du matériel de cours Moodle à partir de divers appareils sans fil. Le Framework for the Rational Analysis of Mobile Education (FRAME) (Koole, 2006) fut le modèle utilisé afin d'examiner les complexités de ce système sans fil, son utilité perçue et son impact potentiel sur les étudiants à distance. Les chercheurs recommandent une étude plus approfondie de l'équilibre entre les contrôles et contraintes des technologies sociales et les besoins des étudiants à distance. Peut-on atteindre un certain équilibre de manière à promouvoir l'adaptation aux nouvelles technologies et un plus grand sentiment de « connexité » parmi les étudiants? À la suite de cette étude, les chercheurs continuent à prôner l'utilisation d'outils sans fil « à dispositif indépendant » qui offrent une plus grande liberté de choix aux étudiants à distance.

Introduction

Many Canadian researchers and practitioners see mobile learning as a panacea for ubiquitous access to learning materials and just-in-time learning. But, what is the reality? Mobile learning extends learners' capacity to communicate and access information by allowing them to carry "wireless, mobile, portable, and handheld devices" (Traxler, 2008). Its impact extends to both the developed and less developed parts of the world where landlines and fibre optics have not reached. In theory, learners can access their email, the Internet, personal notes and reference materials wherever they find themselves. In theory, this amplifies the flexibility of distance and online learning, reducing the significance of geographic location all the while increasing that of contextuality. This innovative project took place at a Canadian university with graduate-level education students. The main intent was to pilot a mobile system, MobiGlam, allowing mobile access to materials and interactive activities in a learning management system (LMS), Moodle. The researchers were interested in a preliminary review of the graduate-level distance students' reactions to the technical, learning, and social aspects of mobile access.

Literature Review

Mobile Learning and Distance Education

As early as the mid-1970s, universities began to use email and asynchronous text-based conferencing to complement their courses (Harasim, 2000). The early 1980s saw the first online courses in adult education (Harasim, 2000). Today, the literature is growing rich with studies of mobile learning. Small, hand-held devices are now being used in language learning, literacy, medical training, music composition, and general education (Kukulska-Hulme & Traxler, 2005). These easy-to-carry tools allow more freedom to interact with others and to access a variety of multimedia information remotely using wireless networking capabilities (Ally, 2005).

Moore (1989) outlined three types on interaction in distance learning: student-student, student-teacher, and student-content. In 1994, Hillman, Willis, and Gunnawardena included a fourth: a student-interface. In mobile learning these forms of interaction remain significant, but with intensified frequency and flexibility. Through mobile-accessible systems, learners can gain more freedom to study according to their own needs and preferences. Paulson (1993) listed six dimensions of freedom: space, time, pace, media, access, and content. To this, Anderson (2008) added freedom of relationship. Mobile learning complements all seven dimensions, potentially making it easier to choose how and when to interact. Furthermore, cellular telephones, in particular, can enhance

social and emotional presence and lead to a sense of ambient co-presence, the sense of continuous availability (Chayko, 2008). Indeed, learners can even suffer from too much contact and loss of privacy. This is a possibility that few distance educators envisioned in the old days of correspondence or more recent e-learning.

In pre-electronic distance education, Berge and Polec (2008) list loneliness, limited access to resources, and the need for prompt feedback and ongoing dialogue as amongst the main concerns for learners. Timely, authentic feedback is a powerful tool for both assessment and personal growth. Frequent feedback helps learners monitor their own progress and adjust their learning strategies (Bransford, Brown, and Cocking, 2001). Mobile devices allow learners to more easily carry reference and communication tools with them into real-world environments. This flexibility permits frequent dialogue with experts and peers, just-in-time retrieval of information, documentation of personal experiences, and integration of course-based knowledge into aspects of the learners' daily lives-all permitting learners to receive feedback and assess their progress. To illustrate, Kenny et. al., (2009) suggest that mobile learning is particularly promising for health care professionals who are completing their practica in remote communities. Using mobile devices, supervisors can monitor, interact with, and assess a learner's progress when direct observation is not possible. In such instances, learners could have access to a variety of tools including medical reference manuals, patient histories, progress notes, and medical experts.

While mobile technology enables such flexibility, it is not without its drawbacks. Learners may find it difficult to adjust to study while in transit or in non-traditional environments. "The very nature of mobile interaction is that it is frequently interrupted or fragmented, may be highly context-dependent, and takes place in physical environments that may be far from ideal" (Kulkulska-Hulme, 2003, p. 3). Educators must explore the affective and cognitive effects of this fragmentation on distance learners.

Mobile Technology

While mobile technology offers increased flexibility, learners may be constrained by small screen sizes, limited input and output capabilities, weak processing power, and limited memory (Kinshuk, 2003; Shepherd, n.d.). However, one of the biggest issues for mobile education in Canada is cost and ubiquity.

Comparatively low adoption of cellular technology is partly due to the fact that some Canadians still live in remote areas with few cellular network towers and only dial-up Internet connections. But, in more populated areas, Canadians enjoy some of the best Internet access in the world. Consequently, Canada lags behind other countries in the adoption

of text messaging and mobile access to the Internet. Canadian use of cellular telephones still trails other countries such as the United States, Europe, and Japan. In 2005, approximately 64% of reporting Canadian households told Statistics Canada that they owned a cellular telephone compared with 94% who claim to have access to land lines ("Selected dwelling characteristics and household equipment (household appliances and telephones)", 2007). In contrast, recent reports indicate that 24% of Europeans have switched from land lines to mobile phones exclusively, led by Finland where 61% of the population has already done so (Vucheva, 2008).

Lack of uptake is also related to cost. At the time of this study, Canadian students in urban areas could subscribe to third generation (3G) cellular telephone networks to access the Internet, but at substantial network costs depending on the amount of data they download. While it is difficult to compare wireless pricing within and across countries, a Canadian parliamentary report indicates that due to lack of market competition "Canadians, on average, pay more for wireless services than users abroad" (Kustra, 2008, p. 2). Educators must keep in mind both costs and geographic location (access to networks) for students when developing mobile learning systems.

Choosing the appropriate platform is another difficulty facing course developers. If an institution decides to produce materials for one type of phone such as the iPhone, students without this type of phone must either purchase the specified device and mode of connectivity for it or opt out. Purchasing specific devices for students or expecting them to have specific devices is simply not fiscally realistic for most public institutions (Caudill, 2007). Such expectations would undermine the tradition of flexibility of distance learning. Therefore the researchers of this study wished to implement a system that, in theory, would permit access through a large variety of different devices.

Theoretical Framework

The researchers of this pilot project set out to better understand the complexities of mobile learning, its perceived usefulness, and potential impact on distance students. The Framework for the Rational Analysis of Mobile Education (FRAME) model (Koole, 2006) alongside Dron's (2007) Transactional Control Theory can provide insights into the functioning of technologically mediated learning environments.

The Frame Model

The FRAME model defines mobile learning as a convergence of device, learner and social aspects (Figure 1). The FRAME model positions the mobile learning system within a context of information.

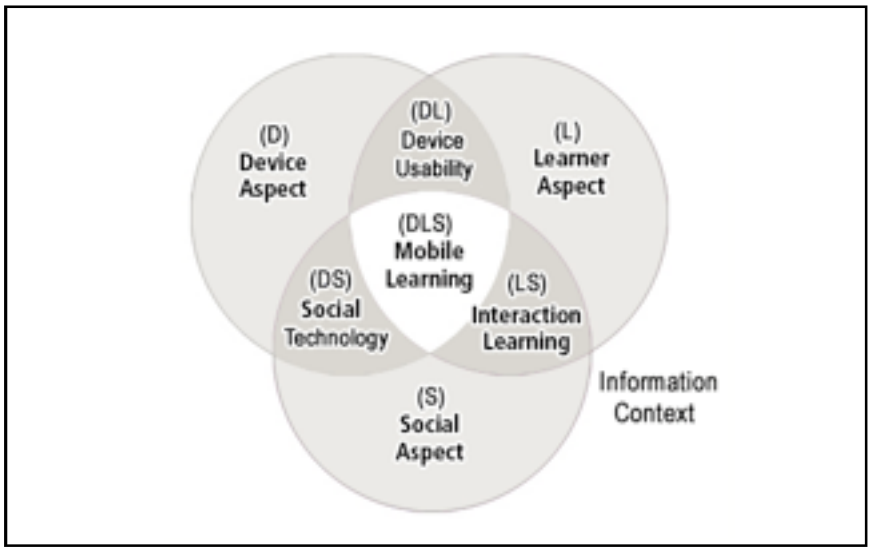

Figure 1. The FRAME Model

The device aspect (D) refers to the mobile devices and their physical and functional characteristics. The learner aspect (L) refers to the learner's cognitive abilities, prior knowledge, memory capacity, values, and motivations. The social aspect (S), describes social rules governing conversation and cooperation among people. When a learner interacts with a device, characteristics associated with device usability (DL) become significant. These characteristics include portability, information availability, psychological comfort, and satisfaction. Within this model, the interaction learning intersection (LS) is strongly social-constructivist in nature. As learners interact with others, they can become part of learning communities, giving and receiving feedback and building understanding. The cross-over between the device and social aspects results in social technology (DS) characterized by networking and collaborative tools. In balance, the three aspects (DLS) can function as a filter through which the learner can assimilate information environment and locate solutions to their unique problems.

Superficially, this Venn diagram appears to hold some similarity to the Community of Inquiry (COI) model (Garrison, et. al., 2000). Although technology is not posited to be determinant of human interaction, the FRAME model, nevertheless, recognizes it to be a significant factor in shaping such interaction. The aspects in the FRAME model embody a greater scope than that of the presences in the COI model. For example, the learner aspect represents not only the internal cognitive activity, but

also the physical and emotional characteristics of the learner. Physical characteristics, for example, will have an impact upon how or if a learner can physically manipulate certain devices. Furthermore, the social aspect does not differentiate between teaching and other social interaction. Rather, the COI's teaching presence may be located within the interaction learning intersection_but not to the exclusion of other means of social learning. The social aspect also acknowledges social rules, including culture, economics, and politics as forms of social control. The FRAME model can help researchers generate a 360-degree view of the learning environment.

The FRAME model can also help us better understand the controls and constraints within mobile learning environments. Dron's (2007) Transactional Control (TC) theory was based on Moore's (1973) Transactional Distance (TD) theory. In TD theory, distance results from the gap in comprehension between individuals. It is influenced by structure of the learning situation, dialogue between the teacher(s) and student(s), and learner autonomy. The more structure imposed upon students, the less their freedom of choice. The more structure, the less the dialogue. The more autonomous the learner, the less the need for structure and dialogue. The most significant aspect of TC theory, for the purposes of this project, is the idea of control and constraints in learning systems. The constraints and controls must reach a level to which the learner is motivated to adapt. If the learner is unable to adapt within these constraints, the learning situation may break down.

Constraints, however, are not necessarily negative elements (Dron, 2007). The aspects of the FRAME model (Figure 1) are the raw materials-the basic characteristics of the system-that afford the constraints and controls of the intersections. Although one might expect that the limitations of typing speed and data transfer limitations would cause short, superficial interactions, Batpurev & Uyanga (2006) suggest that it may instead "force the learner to prioritize his messages … possibly promoting higher-order thinking" (Batpurev & Uyanga , 2006, p. 60). In some cases, the constraints upon the system can be so great as to curtail some choices completely-such as a lack of network access.

The learner's choice to interact may also be affected by motivational factors. For example, if the learning situation were merely hypothetical for the student (as in this research project), motivation to use text messages might be lower. If the benefits are perceived as high, the student may be more determined to learn how to type text messages on the limited cellular telephone keypad. The student might think more strategically about how and when to use the medium-though it may be physically cumbersome. Motivation may temporarily increase simply through the novelty of having a mobile device to access a course

(Batpurev & Uyanga, 2006). But, over the long term, motivation may increase or decrease depending on the levels of interaction, course design, and immediacy of feedback.

Background

This study was conducted with graduate students enrolled in a distance master of education program. While students receive textbooks, manuals, and other materials through the postal system, there is also provision for person-to-person interaction through telephones, the learning management system (LMS), and email. The courses are delivered in a semester-based system, typically in a cohort fashion.

The university has adopted an open-source, Internet-based LMS called Moodle. Through Moodle, students can access reading materials, quizzes, and a variety of other interactive exercises online complemented with instant messaging, discussion forums, chat rooms, wikis, blogs, and internal mail. The full features of the LMS are normally accessed via desktop computers.

To enable mobile access, students were given access to Moodle through a tool called MobiGlam. This is a low-bandwidth, generic J2ME application (Java) which allows browsing of the Moodle (or any LMS) database through cellular or Wireless Fidelity (WiFi) networks (Elsayed Meawad & Stubbs, 2007). In keeping with Paulson's (1993) *freedom of media* dimension, the learner is free to use cellular telephones, PDAs, smart phones, or any Java-aware handheld device. Hence, a mobile user can send and receive LMS-generated text messages through an SMS (Short Message Service) and quickly check for updates to forums or other modules from anywhere. By allowing the respondents to freely choose their preferred devices, the researchers hoped that they could paint a realistic picture of how graduate-level education students would access MobiGlam revealing their control-constraint balance. The main questions we set out to answer were: What is the perceived utility of mobile devices for graduate-level distance students? And, how would mobile access change their study behaviour, interaction patterns, and feelings of connectedness?

Methodology

Procedures

The project was conducted completely at a distance and divided into two phases. Phase 1 involved 4 students and helped the researchers better understand training needs and delivery mechanisms. As a result, the researchers improved the email instructions, produced training videos,

adjusted the activities within the Moodle environment and refined the questionnaires. Phase 2 was the actual project, the results of which are the primary subject of this paper.

Both phases of this project involved the selection of student volunteers from a graduate program in Education. Respondents of all computer-comfort levels were invited to participate so long as they had data access on any Java-enabled mobile device. All students received an honorarium to cover data transfer costs on cellular networks so as to reduce the effects of cost on participation levels.

After participants completed and returned the pre-questionnaire, access to the Moodle test site from their desktop computers and from their mobile devices was provided. For reasons of security, MobiGlam was not used with a real course as we did not want to reveal personal data over the Internet. In this way, the participants could protect their identities by using pseudonyms and fictitious backgrounds rather than their official student identities. Within the test site, the research assistant hosted weekly activities that included chats and asynchronous discussions in which the participants talked about themselves and the usability of the system. For support, participants could interact with the project research assistant whenever needed. After one month, participants completed a post-questionnaire.

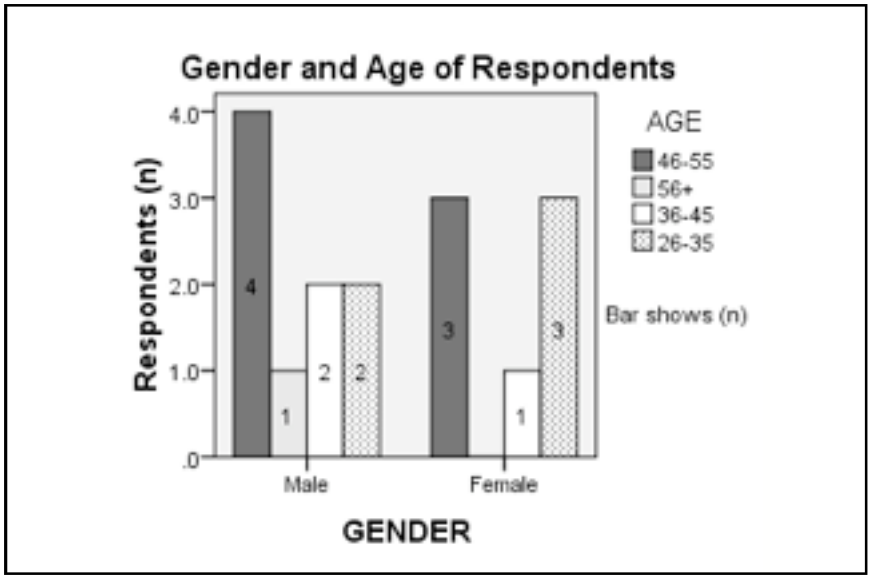

Figure 2: Gender and Age of Respondents

Instruments

The primary source of data was from 5-point Likert scale questions and open-ended comments. The questions in the questionnaires were derived from the aspects and intersections of the FRAME model (Figure 1).The pre-questionnaire set a baseline for the respondents' computer-comfort levels, experience with Moodle, and attitudes towards online study. The post-questionnaire mirrored the pre-questionnaire but the questions were phrased to assess mobile access to Moodle.

Pre-Questionniare Demographics

In total, 16 students volunteered with 2 officially withdrawing before the end of the study. It is not surprising that only 16 students volunteered for the study as it involved rather unusual technology that was not already known to the students and required a month of participation time. Ages ranged from 26 to over 56 years. The majority of the respondents (7) were between 46 and 55 years of age. In terms of gender, 7 of the respondents were female while 9 were male (Figure 2).

The respondents were asked to rate their computer proficiency as advanced, high intermediate, low intermediate, or beginner (Table 1).

Table 1. Computer Proficiency of Respondents

Proficiency	(n/16)	Description
Advanced	3	Able to develop multimedia applications using Authorware, Flash, Director, some server-side scripting, or graphics programs.
High Intermediate	12	Able to install drivers or software, use advanced features of word processors, spreadsheets and other common programs, and able to develop Web pages using HTML.
Low Intermediate	1	Comfortable with word processors, spreadsheets, email, calendar programs and browsers.
Beginner	0	Able to use basic features of email, word processors, but frustrated at times and requiring assistance for set up and troubleshooting.

Of the 16 respondents, 12 self-reported as high intermediate. All respondents were already familiar with Moodle. Thirteen of the 16 respondents indicated having taken 3 or more Moodle-based courses.

The researchers were also interested in the respondents' prior experience with mobile devices in general. Table 2 shows the number of respondents who indicated having used mobile devices such as cellular telephones, PDAs, smartphones, MP3 players, digital cameras, and other devices.

Table 2. Prior Experience with Mobile Devices

Device	(n/16)	(%)
Cellular Telephone	14	87.5%
Personal Digital Assistant (PDA)	11	68.8%
Smartphone	3	18.8%
MP3 Player	14	87.5%
Digital Camera	14	87.5%
Other	1	6.2%

It is notable that 2 people reported never having used a cellular telephone before. The distribution of mobile devices used by the respondents included 8 small flip-phones, 5 smartphones, 1 PDA, and 1 Sony Play Station, and 2 unidentified devices (Table 3):

Table 3. Devices Used by Respondents

Respondent	Phone	Network	Comments
1.	Sanyo Katana 6600 (flip phone)	Bell (CDMA)	
2.	Blackberry 8700 (smartphone)	Rogers (GSM)	
3.	Blackberry (smartphone)	Bell (CDMA)	
4.	Samsung SGH-d807 (flip phone)	Rogers (GSM)	
5.	Motorola e815 (flip phone)	Not available.	Could not access system since phone was not Java-enabled.
6.	Samsung SPHM510 (flip phone)	Not available	

Respondent	Phone	Network	Comments
7.	Motorola W510 (flip phone)	Fido (GSM)	
8.	Blackberry 8100 (smartphone)	Rogers (GSM)	
9.	LG (flip phone)	Sasktel (GSM)	
10.	Motorola v262 (flip phone) Sony PSP	Rogers (GSM) WiFi (PSP)	Unable to access with Motorola, but could receive SMS; tried Sony Playstation, could not install MobiGlam, but could navigate like a website.
11.	Samsung SPHA660 (flip phone)	Bell (CDMA)	
12.	Blackberry 8700 (smartphone)	Rogers (GSM)	
13.	PDA	WiFi	No SMS through PDA.
14.	Blackberry Pearl	Telus (CDMA)	

Of the 16 respondents, 13 successfully logged into MobiGlam. There was a fairly even distribution of networks (CDMA and GSM) used to access MobiGlam. Two respondents successfully connected through Wireless Fidelity (WiFi), but could not receive text messages.

Post-Questionnaire Demographics

Of the 16 original respondents, 9 completed the post-questionnaires: 6 male and 3 female (Figure 3). Similar to the pre-questionnaire demographics, ages ranged between 26 and 56 with the majority in the 46 to 55 age range.

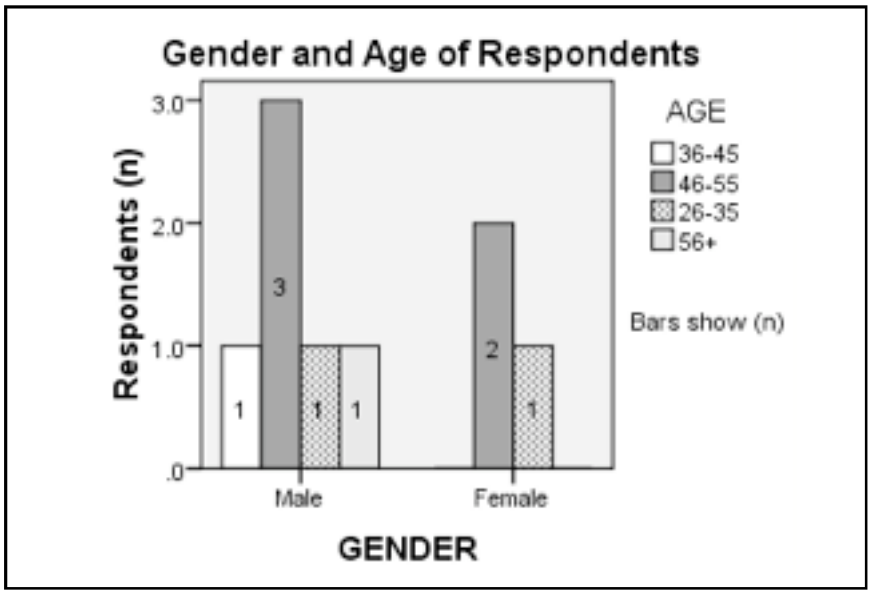

Figure 3. Gender and age of respondents for post-questionnaire

Of the 9 respondents who completed the post-questionnaire, 7 indicated that they had sent and received text messages (SMS) prior to the study, while only 3 had ever used a mobile device to access the Internet prior to this study.

Results

To analyze the data, the researchers first looked at indicators of system activity, then examined the pre- and post-questionnaire responses for each intersection of the FRAME model: device usability, interaction learning, and social technology.

System Activity

System activity reports indicated that for the 13 respondents who had successfully logged onto MobiGlam, total frequency of access per user ranged between 3 and 35 times over the month-long testing period (Figure 4).

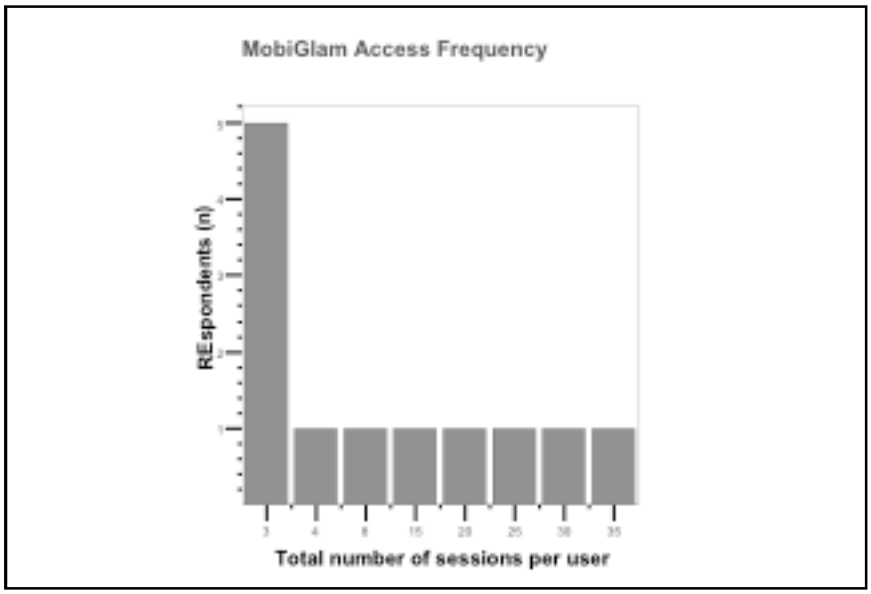

Figure 4. Frequency of access to MobiGlam

On average, each respondent received approximately 63.5 SMS messages over the month-long testing period (Table 4).

Table 4. Number of SMS Messages Received

	Number of SMSs	Download SMS	Send Messages	News Notifications	Forum Notifications
Average per person	63.5	3.67	3.58	4.33	46.3

The average numbers of attempts to download MobiGlam was 3.67 times. The researchers had to assist some of the respondents with the download and install process. In some cases, the participants had successfully installed the application, but were unable to locate it on their devices. Some of the respondents also needed a tutorial about the browser and SMS features of their devices. Table 4 also shows that forum activity produced the largest number of SMS messages.

Interaction Learning

The interaction learning intersection (Figure 1) takes into account the interaction between the individual learner and others in their learning and social environments. The researchers wanted to explore the degree of exchange experienced by the respondents in MobiGlam as compared to what they normally experience in their Moodle courses.

Table 5. Frequency of interaction per Week

Activity	Moodle (Pre-questionnaire)	Mobile (Post-Questionnaire)
Check News	3.25	3.0
Check Forums	3.81	2.12
Access Static Information	2.94	N/A
Contact other Students	1.19	1.71
Contact Instructor(s) (Using any technology)	0.93	1.14
Average	2.42	1.99

(Scale: 0 = 0 times, 1 = once, 2= twice, 3 = 3 times, and 4 = 4 or more times)

Table 5 shows that the respondents' reported "normal" frequency of checking news and forums in Moodle were higher than those of the pilot project. Yet, it is notable that on the pre-questionnaire, respondents reported only directly contacting others in their Moodle course 1.19 times per week and their instructors only 0.93 times per week.

Table 6. Motivation to Interact

Opinions	Moodle (Pre-questionnaire)	Mobile (Post-Questionnaire)
Motivated to Interact	3.31	1.13

(Scale: 0 = not at all, 1 = not very, 2= neutral, 3 = somewhat, and 4 = very)

Table 6 shows that the respondents reported being very motivated to interact with each other in the Moodle environment, but that their motivation would not likely increase as the result of mobile access. It is interesting to note the low frequency of interaction reported (Table 5) compared to their reported levels of motivation to interact with other students in Moodle here.

Table 7. Sense of Connectedness

Opinions	Moodle (Pre-questionnaire)	Mobile (Post-Questionnaire)
Feelings of "connectedness"	2.94	1.15

(Scale: 0 = not at all, 1 = not very, 2= neutral, 3 = somewhat, and 4 = very)

Questionnaire results shown in Table 7 indicate that the respondents feel quite connected in their interactions through Moodle. However, they indicated that mobile access would not make them feel more connected to others (1.15, "not very").

Social Technology

The social technology intersection (Figure 1) represents the effectiveness of the technology to permit users to access each other as well as external systems and information.

Table 8. Flexible and Networking

Opinions	Moodle (Pre-questionnaire)	Mobile (Post-Questionnaire)
Importance of flexible access	3.56	2.25
Satisfaction with network connection	N/A	2.0
Average	3.56	2.13

(Scale: 0 = not at all, 1 = not very, 2= neutral, 3 = somewhat, and 4 = very)

Table 8 shows the participants reported that the importance of flexible access to their Moodle courses was very high (3.56). However, when asked the same question regarding mobile access on the post-questionnaire, the response was substantially lower (2.25). A rating 2.25 suggests the respondents may not consider mobile access as important as basic desktop computer access to their LMS. When asked how satisfied they were with their network connections for their mobile devices, the respondents rated it as 2.0 on the scale of 0 to 4.

Device Usability

The device usability intersection (Figure 1) is an indicator of how usable a system is. Usability is affected by navigation, learnability, memorability, and portability.

Table 9. Device Usability Ratings

Opinions	Moodle (Pre-questionnaire)	Mobile (Post-Questionnaire)
Satisfied with Moodle/mobile device	3.38	2.75
Easy to navigate	3.75	1.88
Easy to learn	3.88	2.88
Average	3.67	2.50

(Scale: 0 = not at all, 1 = not very, 2= neutral, 3 = somewhat, and 4 = very)

The respondents indicated a higher satisfaction level with Moodle (3.38) compared to how satisfied they were with their mobile devices (2.75). These two responses cannot be compared directly, but can be used to get a sense of a baseline for Moodle and the mobile devices themselves. Both responses were somewhat positive. Table 9 shows that the respondents almost universally indicated that the navigation and learnability of Moodle was good. Ratings for navigation were significantly lower for MobiGlam (1.88) compared to those for Moodle (3.75).

In order to explore the effects of device familiarity, the respondents were asked to rate their satisfaction with the input (i.e., typing and texting) and output (reading) of the devices themselves. Table 10 shows the respondents rated these features low (1.63).

Table 10. Mobile Device Input and Output Ratings

Opinions	Mobile (Post-Questionnaire)
Satisfied with input	1.63
Satisfied with output	1.63

(Scale: 0 = not at all, 1 = not very, 2= neutral, 3 = somewhat, and 4 = very)

The researchers also tracked reported locations of access. Most respondents indicated accessing the system from home, work and transit (Table 11).

Table 11. Locations of Access (Post-Questionnaire)

Location	Home	Work	Transit	Waiting Room	Outside	Other
(n)	7	5	5	3	3	0

Study Patterns and Attitudes

The pre- and post-questionnaires both contained questions regarding the respondents' sense of control, organization, and preferences for online study.

Table 12. Control, organization, and preference for online study

Opinions	Moodle (Pre-questionnaire)	Mobile (Post-Questionnaire)
Sense of control	3.31	2.13
Sense of being organized	3.44	1.63
"Like" to study online/mobile	3.88	0.88
Average	3.51	1.55

(Scale: 0 = not at all, 1 = not very, 2= neutral, 3 = somewhat, and 4 = very)

Table 12 shows that the student's sense of control with online study through Moodle was quite high (3.31), but that they did not feel strongly that mobile access would increase their sense of control (2.13).

Similarly, the respondents were asked to rate their sense of organization. Table 12 shows that the respondents indicated feeling very organized while using Moodle (3.44), but that mobile access would not increase this sense (1.63).

The most striking result became apparent when the respondents were asked how they like online learning. The average rating on the pre-questionnaires for online learning with Moodle was very high (3.88). But, when asked on the post-questionnaires if they would like to study through a mobile system, the rating was extremely low (0.88).

To assess the impact of mobile learning on the participants, the post-questionnaire also contained two questions about their likelihood of using mobile technology in the future. The participants were asked if they would continue using SMS and continue accessing the Internet through their devices (Table 13).

Table 13. Effects upon Student Activity Patterns (Post-Questionnaire)

Intended Future Use	Yes	No	Maybe
Continue to use SMS personally	5	3	1
Continue to access the Internet through mobile device	3	5	1

Of the original 16 respondents, only 7 indicated having experience sending and receiving SMS messages (44%) and only 3 indicated having used their mobile devices to browse the Internet (19%). Of the final 9 who completed the post-questionnaire, 5 indicated they would continue using SMS (56%) and 3 indicated that they would continue accessing the Internet with their mobile devices (33%) (Table 13).

Respondents General Ratings and Recommendations for Implementation

Although the ratings for Moodle usability, interaction, and networking were all significantly higher than those for mobile access, there was support for university-wide provision of mobile access (Table 14).

Table 14. Student recommendations for university-wide implementation of mobile technology (Post-Questionnaire)

Recommendations	Yes	No	Maybe
Offer SMS service	5	4	0
Provide mobile access to courses	5	2	2

Discussion

Within the context of the current study, the researchers discovered that the controls and constraints of the device usability (DL), interaction learning (LS), and social technology (DS) intersections were at such a level so as to impede the learner's choices and motivation (Figure 1: The FRAME Model). While the mobile learning system did not break down entirely, it was less effective than it could have been. Usability, interaction, and social networking ratings were consistently higher for Moodle than for MobiGlam. Nevertheless, the respondents showed support and optimism with regard to the potential of mobile access.

Interaction Learning

The respondents indicated having interacted more overall in this mobile pilot than they reported as their normal interaction levels in the

LMS. However, learners reported checking their news and forums (specific activity modules) more in their real Moodle courses than this pilot project—possibly because the sample course used in this study was not a real course. It is also important to note that the respondents did not necessarily have to log in to be kept informed of activity in the project; they were kept abreast of the activity through real-time, event-triggered SMS messages associated with the forums and other LMS modules. Further testing over a longer period of time should be done to ascertain if these notifications, the novelty of the technology, or scheduled activities truly influence the respondents' behaviour and to what degree.

Overall, the majority felt that mobile access would not increase their motivation to interact or their sense of connectedness. Although the participants reported that they were normally in contact with other students and their instructors approximately once per week, they also reported normally feeling very connected (without mobile access). One respondent commented on the post-questionnaire, "the major benefits from using mobile devices is the possibility of real-time communication with instructors or fellow students." Hence, there is some ambiguity regarding the respondents' motivation and needs for interaction. A sense of emotional and intellectual connectedness, therefore, may be dependent upon quality of interaction more than quantity or mode of interaction. It is also possible that online learners depend highly on those of their immediate social circles rather than on direct contact with instructors and fellow distance students.

Social Technology

Many respondents on the post-questionnaires indicated that mobile access would be helpful for those who were traveling and did not have computer access or network connections: "students who don't have access to typical computer-based Internet connections can still access various parts of the learning environment." They acknowledged the constraints of computer network connections and the possibility of increasing their ability to maintain contact through mobile networks. However, they rated the importance of flexible mobile access fairly low while their preferences for flexible access to their LMS remained higher. Certainly, the bandwidth limitations for the smartphones and flip phones would have been much more limited than for their desktop computers. Therefore, this result is not entirely surprising. It is possible that the constraints of network access and the student's need to accomplish a task must reach a particular balance to trigger greater use of mobile networks. If so, the nature of this balance must be explored further.

Device Usability

While the device usability questions may appear to be asking about the usability of Moodle or MobiGlam, it is difficult to separate the usability of the system (software) from the usability of the computer or device (hardware) being used to access the system. On the post-questionnaire, a participant commented, "perhaps communication would be better with a Blackberry, but the cell phone screen has too many drawbacks to be used to extend online learning services." Another indicated that "the tiny screen and limited input capabilities make the mobile devices much less useful than the computer installations we use normally." Along with difficulty entering text and limited screen size, others commented on the inefficient navigation on the small devices. In actual usage for the average learner, the software experience is naturally mediated by the hardware. The low ratings for usability may be considered a realistic indicator of the user's dissatisfaction, but it is important to understand this distinction: if a user is unfamiliar with the device, his/her perception of the usability of the system, as a whole, will decrease. To more accurately assess mobile software alone, one would have to control for the influences of hardware characteristics (breaking Paulson's freedom of media dimension).

There is little doubt that some of the low ratings for device usability resulted from lack of familiarity with the mobile devices as well as a lack of familiarity with text messaging and mobile Internet browsing. Of the original 16 volunteers, 2 had never used a cellular telephone. Of the 9 respondents who completed the post-questionnaires, 7 had previously sent or received text messages, but only 3 had ever used their mobile devices to access the Internet. One respondent openly admitted "My frustration stems from not knowing the functions of my phone. Had I taken the time to learn my phone's capabilities better, then my experience would have been more positive. The constraints were with me, I'm sure." During the study, some respondents commented on the fact that the SMS messages only contained truncated versions of the discussion forum postings. Few of them were aware of the 160 character limit on SMS messages and that the messages were only notifications to determing whether or not logging would be worthwhile. Usability, therefore, was constrained to some degree by the respondents' skill and knowledge of the hardware and software systems.

Training videos for introducing the project and showing how to download, install, and navigate in MobiGlam were available. However, 4 of the 9 post-questionnaire respondents indicated that they had not viewed the videos. None of the respondents had logged into the emulator to learn how to navigate through the system prior to actually installing

the application. One participant commented on having difficulty accessing MobiGlam. Coincidentally, this respondent indicated not having watched the training videos. More effective training methods to help the respondents become familiar with their devices and gain confidence with the mobile software may have improved device usability ratings.

On the question of portability, the researchers attempted to model behaviour by texting messages such as "Hello from the forest trails at the university." Yet, few respondents indicated having attempted to access the system from remote locations outside or in more unique situations. In fact, post-questionnaire comments indicated that portability was not always perceived as a positive characteristic: "Using the mobile device anywhere doesn't get me involved in thinking about topics. I just checked postings without really engaging in any 'learning'." Another respondent alluded to the potential intrusiveness of mobile learning: "I would prefer to access Moodle than have it access me." Such comments suggest that these respondents had not yet reached the control-constraint-need threshold necessary to stimulate adaptation.

Study Patterns and Attitudes

Some respondents indicated that email remained their preferred method of communication: "I'm happy with the email communications medium. I rarely telephone my instructors or peers and rely solely on email. Would text-messaging help me? No, it wouldn't." Five respondents indicated that mobile learning would not affect their study patterns. One respondent did not appear to be swayed by the promises of text messaging: "I prefer to type rather than text message. Tutors should be checking the Moodle site regularly anyway. If a tutor doesn't check the site regularly, why would they be more inclined to respond to an SMS message?" This response does not acknowledge that an instructor might respond to a message if her cellular telephone were to ring with a real-time notification from a student. Contrary to the low Likert scale ratings, some respondents' comments revealed that they *would adapt* their behaviour to the mobile environment:

> It would not change the way that I study or interact. The only major advantage would be the ability to instant message when a very rapid response was required.

> I probably wouldn't use the messages MORE; I'd just use them at different times, rather than waiting until I was co-located with my computer.

While the mobile system left one student feeling less organized ("I felt disorganized and did not really know what course of action to take"),

another respondent indicated that mobile access would increase her sense of control over communication as there is "more security in knowing the person will get the message, rather than hoping they check their messages, or have attached messages to their email."

All of the respondents in this study were over 25 years of age with the majority falling into the 46 to 55 year range. This age range is consistent with overall program demographics which show students to be in their mid-40s (Fahy et. al., 2009). One respondent noted: "My kids in university thought this was the greatest idea (ages 19 and 20)-to be contacted via phone for important messages about classes, or to access some class info. For me, it was a hassle to read and post …" The researchers would like to better understand the mobile comfort and skill levels of learners of varying age ranges.

Overall, the respondents showed support for the implementation of MobiGlam across the Master of Education program. One participant commented, "I enjoyed testing the system, but wouldn't use it on my cell phone if it was implemented in a course." Another felt that mobile access was not necessary if a student "has enough discipline to check on their courses every day."

Conclusion

The researchers of this study recommend two important avenues for further research:

1. this study should be replicated in a real course and larger sample size to control for motivational effects, and
2. test MobiGlam with all respondents using the same devices. Although in the real world, this is an unlikely scenario, such as test would allow a controlled assessment of the software itself.

Depending on the results of the above tests, the researchers recommend replicating the pilot with greater numbers of students. Technical support requirements must also be assessed.

Because of ongoing changes in cellular telephone technology and communications networks, the results of these studies may never be fully generalized among different countries and varying demographic groups. Particularly, within the Canadian context, cellular network costs and changing hardware make it increasingly difficult to design course materials for mobile delivery. But, the researchers maintain the importance of "device-agnostic" tools that permit learners the freedom to use whichever tools they prefer-be they accessibility-enhancing or simply for convenience.

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