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Using Mobile Learning to Enhance the Quality of Nursing Practice Education

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Abstract

In this chapter, we first review the research literature pertaining to the use of mobile devices in nursing education and assess the potential of mobile learning (m-learning) for nursing practice education experiences in rural higher education settings. While there are a number of definitions of m-learning, we adopted Koole's (2005) FRAME model, which describes it as a process resulting from the convergence of mobile technologies, human learning capacities, and social interaction, and use it as a framework to assess this literature. Second, we report on the results of one-on-one trials conducted during the first stage of a two stage, exploratory evaluation study of a project to integrate mobile learning into the Bachelor of Science Nursing curriculum in a Western Canadian college program. Fourth year Nursing students and instructors used Hewlett Packard iPAQ PDAs for a two week period around campus and the local community. The iPAQs provided both WiFi and GPRS wireless capability and were loaded with selected software, including MS Office Mobile, nursing decision-making and drug reference programs. Our participants reported on a variety of benefits and barriers to the use of these devices in nursing practice education.

Key Words: Nursing education, practice education, mobile learning, m-learning, FRAME Model

Mobile Learning to Enhance the Quality of Nursing Practice Education The Promise of Mobile Learning

Wagner (2005) has claimed that evidence of the widespread adoption in North American society of mobile wireless technology such as cell phones, personal digital assistants (PDAs), laptop computers, and MP3 players, is irrefutable. Current mobile technologies (especially wireless) - frequently referred to as third generation (3G) - provide an unprecedented opportunity for inexpensive and beneficial computing power for learners (Hill & Roldan, 2005; Wagner, 2005).

Wagner (2005) then asks why, with the continuing expansion of wireless networks and improved capacity portable electronic devices, this mobility should not apply to learning. Keegan (2002, 2005) agrees that it should, declaring that the future of distance education is wireless and noting that there has never been a technology that has penetrated the world with the depth and rapidity of mobile telephony. He claims that the challenge for distance educators is to accept this fact and to now develop pedagogical environments for mobile devices.

What then do we mean by m-learning and what does it allow educators to do differently than other forms of teaching and learning? Keegan (2005) defined the term simply as the provision of education and training on PDAs¹ / palmtops / handhelds, smart phones and mobile phones. Trifonova and Ronchetti (2003) agreed, noting that m-learning is often defined as e-learning carried out by means of mobile computational devices and point out that this refers mainly to PDAs and digital cell phones. M-learning could “employ any device that is small,

¹ PDA refers to Personal Data Assistant. The term originated in reference to devices which provided features such as electronic calendars, organizers and task lists. PDAs typically now include mobile phones, digital camera and, in higher end devices, mobile computing capability.

autonomous and unobtrusive enough to accompany us in every moment of our everyday life” (p. 32). Kukulska-Hulme and Traxler (2005) view the most significant attributes of mobile technologies as their ability to support learning that is more situated, experiential and contextualized within specific domains and to support the creation and use of more up-to-date and authentic content.

The FRAME Model

In our study of m-learning in nursing education, we used the FRAME model (Framework for the Rational Analysis of Mobile Education), (Koole, 2005; Koole & Ally, 2006) to guide our understanding of m-learning, as well as to provide framework for our review of the literature on m-learning in health care, and more specifically, in nursing practice education.

In her model, Koole (2005; Koole & Ally, 2006) describes m-learning as a process resulting from the convergence of mobile technologies, human learning capacities, and social interaction. The FRAME model is represented as an intersecting set of three circles representing device usability, learner, and social aspects of learning (See Figure 1).

Device Usability Aspect

This describes the physical, technical, and functional components of mobile devices, the medium through which mobile learners and mobile community members interact. This interface is both enabled and constrained by the hardware and software design of the devices and can have a significant impact on the physical and psychological comfort levels of the users.

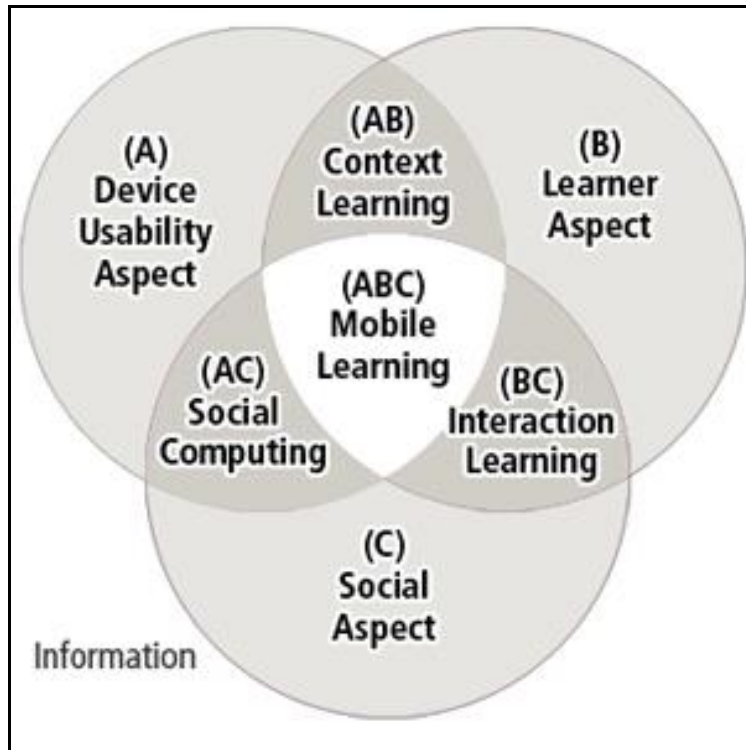


Figure 1. Koole's FRAME Model (reproduced with permission)

The Learner Aspect

This refers to the individual learner's cognitive abilities, memory, and prior knowledge and those situations and tasks in which a learner needs to succeed. It encompasses the wide range of theories of how learners learn (Driscoll, 2005; Mayes & de Freitas, 2004) and explains how mobile learning offers an extended environment where learners can interact within their physical and social environments.

The Social Aspect

This aspect refers to the processes of social interaction and cooperation and conveys an underlying thread of social constructivist philosophy. The way in which individuals exchange information affects how groups of people develop knowledge and sustain cultural practices.

Context Learning (AB)

This secondary intersection relates the characteristics of mobile devices to cognitive tasks and to the effective manipulation and storage of information. Highly portable devices permit learners to move with their mobile tools to more relevant or more comfortable locations and can affect the user's sense of psychological comfort and satisfaction by reducing cognitive load and increasing access to information.

The Social Computing Intersection (AC)

This secondary intersection describes how mobile devices enable users to communicate with each other and to gain access to other networked systems and information. When people are able to exchange relevant information at appropriate times, they can participate in collaborative situations that are normally difficult at a distance.

Interaction Learning (BC)

This secondary intersection (BC) focuses on social interaction. Participation in learning communities and cognitive apprenticeships can provide socially based learning environments in which learners can acquire information and negotiate meaning.

The Mobile Learning Process (ABC).

All three aspects overlap at the primary intersection (ABC), which represents a convergence of all three aspects and defines the m-learning process. As such, m-learning can

afford learners access to a variety of human, system, and data resources, as well as to assist them to assess and select relevant information and redefine their goals (Koole, 2005). M-learning is, however, also constrained by the mobile device hardware and software configurations and dependent upon adjustments in teaching and learning strategies.

The Use of Mobile Learning in Health Care and Nursing: Review of the Literature

Mobile Learning in Health Care Education

The education of health care professionals in the context of a rapidly changing health care system is a prime example of how the mobility of learners within a variety of real life learning environments has posed increasing challenges and where mobile technologies have the potential to support and enhance teaching and learning. The high acuity and pace of practice in institutional environments, combined with an explosion of knowledge and technology, increasingly requires practitioners to access and process clinical data efficiently by drawing on current resources to support safe care and evidence-informed practice at the point-of-care. Moreover, the shift of client care to the community requires that the education of health care professionals take place increasingly in this more autonomous and diverse practice environment where resources are not readily accessible, where client acuity is increasing, and where more traditional methods of directly observing and working with students are not as feasible. These shifts in practice, along with more limited education and practice resources to support students' practice, raise concern for the quality of their education and the safety of their practice. This is particularly significant for rural practice education where resources are limited and geography poses additional challenges. Addressing these "new age" challenges requires "new age" approaches and tools to support the teaching and learning of health care professionals.

Experiences with Mobile Learning in Nursing

Rosenthal (2003) outlines a number of useful functions identified by nurses using PDAs: address book, "to do" lists; date book; memo pad; expense tracking; "find" functions; diagnostic tools; patient, student and staff management programs; clinical guidelines; medical dictionaries; and lab values . She categorizes these as tools that enhance productivity, promote risk management/error reduction, and through their rapid access to critical information lead to stress reduction.

Cahoon (2002) groups the functions into five categories: clinical services, calculators, data collection, medical record system and content tools. Newbold (2003) notes that if the PDA is also a wireless device, the uses increase in both number and complexity. She lists potential applications such as: interdisciplinary consultations, electronic ordering and test results, patient histories, progress notes and assessments, references, protocols, and prescription information. Increased PDA wireless capacity to include phone and camera capabilities permits rapid chart access, improved workflow, increased time for patients, cost savings, enhanced productivity and, therefore, boosts professional satisfaction.

The utilization of PDAs in nursing practice has not been confined to acute care settings. George and Davidson (2005) note that in both long term care and community-based sites, nurses are utilizing the new technology to enhance their practices. Community based nurses are using PDAs to provide patient teaching information and to track patient progress.

Several authors have outlined benefits and barriers to PDA use. Davenport (2004) identified 38 barriers and 68 benefits to PDA use and, based on a survey completed by nurses,

she produced six themes in each category, ranked in priority order. The benefits were: a) quick access to current drug database and nursing reference books (highest ranking), b) the ability to manage patients and procedure information, bedside data entry, and data collection for research and teaching (tied for the 2nd, 3rd, and 4th rankings) c) patient health management (ranked 5th), and d) improved team communication (ranked 6th).

Davenport also found the following barriers, ranked by priority: a) the risks of storing confidential patient information; b) the cost of PDAs and ease of loss or damage; c) not enough research on PDA use in nursing; d) difficult to read, e) slow data entry; and f) difficult to understand. These barriers were rated as modest to moderate.

Experiences with Mobile Learning in Nursing Education

Lehman (2003) identified challenges faced by nursing instructors in the practice setting. She reported using PDAs to keep records of student assignments, checklists for completing physical assessments and as a source of point-of-care reference (drug software). This eliminates the need for carrying hardcopy drug references. Lehman also used the PDA to document student progress on-the-spot. It was reported that previous studies found electronic data to be more accurate than paper documentation.

Miller et al. (2005) conducted a pre-post and comparative study to identify nursing “students’ information seeking behaviours and the effectiveness and cost of innovation strategies associated with incorporation of PDAs into students’ clinical practice” (p.19). Due to limitations of the study, authors note that differences among the two groups in seeking information cannot be attributed to PDA use. It was however determined that students utilizing PDAs had increasing

numbers of questions when in the practice setting, as well as a greater recognition of the need to use current resources.

Goldsworthy, Lawrence and Goodman (2006) examined the relationships between the use of personal digital assistants, self-efficacy and the preparation for medication administration. Thirty six second-year baccalaureate nursing students were randomly assigned to either a PDA or control group. The authors reported that the PDA group showed a significant increase in self-efficacy.

Stroud, Erkel, and Smith (2005) reported on the patterns of use and demographics of users within nurse practitioner (NP) programs. A 20 item questionnaire was sent to students and faculty in 150 organizations across the US. The 227 returned questionnaires represented 27% of the sample. A high percentage, 67% of those returning the questionnaire, used PDAs, generally to "support clinical decision-making" (p.67). The list of uses and frequency cited is reported in Table 1.

In June 2006, a Western Canadian University's Centre for Nursing and Health Studies polled their nurse practitioner students on PDA use. Students were asked to respond to one of two anonymous surveys: "I use a PDA" and "I don't use a PDA". One hundred and fifty students responded: 64 (42.6%) in the "use" category and 86 (57.3%) in the "do not use" category (Park, 2006). The respondents had a wide range of perceptions of reasons to recommend PDAs to other nurse practitioners, as well as of the barriers to use (Table 1).

Table 1

Nurse Practitioner Insights – Park (2006)

Reasons to recommend	Barriers to use
1. Valuable with right software	1. Cost
2. Lighter to carry than textbooks	2. Lack of knowledge about technology and software
3. Decrease in medication errors, safer than memory	3. Difficult to set up
4. Convenient, useful tool	4. No time to learn
5. Information available is immense and valuable	5. Confidentiality issues
6. Back-up quick reference, security blanket	6. Technology failures (batteries die)
7. Concise and easy to transport	7. Loss of personal touch
8. The way of the future	8. They aren't necessary
9. Looks professional	9. They don't teach you to be a Nurse Practitioner
10. Can edit & highlight the most important information & add personal notes	
11. You can use it to explore options with client	
12. Organizational benefits	
13. Up-to-date information	
14. Aids mobility	

The Relationship between FRAME Model and Research on Mobile Learning in Nursing

Effective mobile learning is defined by the convergence of the device usability, learner, and social aspects to extend their impact beyond their natural boundaries. Mobile learning affords enhanced collaboration among learners, ready access to information, and a deeper contextualization of learning. Mobile learning can help learners gain immediate and ongoing access to information, peers, and experts who can help them determine the value of information found on both the Internet and in their real-world environments (Koole & Ally, 2006). The

relationship between the FRAME Model and the themes reported in the research literature are shown in Table 2.

A number of research articles relating to health care professionals use as PDAs focus on the aspect of device usability (e.g., Cahoon, 2002; Newbolt, 2003; Rosenthal, 2003). Health care professionals have traditionally carried small booklets and index cards in their pockets, so they are natural early adopters for PDAs as content providers. Students are always in the market for the latest and best, so new innovation permeates the field.

The learner aspect of Koole's FRAME theory is demonstrated by the health care professional/students' experience and interaction within the clinical setting, which includes the clients/patients, the facility or home and multiple caregivers. Besides reference content, many existing tasks such as sending pharmacy and laboratory requisitions have translated to PDAs easily. The ongoing recording of patient information is also facilitated. These activities are documented in the research (Cacace, Cinque, Crudele, Iannello & Venditti, 2004; Thomas, Coppola & Feldman, 2001).

Table 2

The correspondence between PDA uses and Koole's FRAME model.

Cahoon (2002)	Stroud et. al. (2005)	Park (2006)	FRAME Model
Clinical services	To do list; Memo pad	Pharmacy; lab uses	Device Usability
Calculators	Calculator: Expense tracker	Calculator	Device Usability
Data collection		Keeping up-to-date	Learner Aspect Context learning
Medical record tools	Calendar/date book	Calendar	Device Usability
Content tools	Patient management tools; Clinical reference materials; Address/phone book	Referring to texts & guidelines; Studying	Learner Aspect
Communication tools	Information exchange via beaming (Bluetooth)		Social Computing
Interaction tools	Games; Recreational reading		Context learning
Communication tools	E-mail; Internet access	E-mail	Social Computing

Less, however, is reported on the psychological comfort of the user when carrying out this research using mobile devices. The Western Canadian University Nurse Practitioner students used the term “security blanket” and “safer than memory” in their list of reasons to recommend the use of PDAs (Park, 2006). The use of PDAs in medication error research also exemplifies this comfort (Rothschild, Lee, Bae, & Bates, 2002; Galt et al., 2002). Conversely, a few students

felt that a PDA might come between them and the patient/client and lead to the loss of personal touch (Park, 2006).

The Social Computing Intersection is the least explored component. Local Area Networks (LANs) and free or inexpensive wireless connectivity address the physical part of this intersection. Students in both the studies of Stroud, Erkel, and Smith (2005) and Park (2006) mention email as the only interactional use of the PDAs. We are now interested in the use of PDAs to help to form a learning community. The connectivity potential of these devices for practice and teaching/learning has not been fully explored.

We conclude from this review, that there has been little research on interactional use of PDAs by health care professionals. As well, further research and exploration is required relating to confidentiality and security of data with PDA use. The final issue, cost, will most likely decrease with increased demand and increased wireless capacity.

The Use of Mobile Technologies to Address Challenges in Nursing Practice Education

Changes in health care delivery have impacted nursing practice education and as a result created ideal conditions for the implementation of m-learning approaches. More specifically, care is moving to the community where client complexity and acuity is increasing and where up-to-date information at the point-of-care is critically needed to support practice. This means that care delivery requires physical mobility throughout the community which does not lend itself to more traditional direct teaching supervision models. The instructor is removed from instruction at the point-of-care and the real-time responsibility for instruction falls on practitioners whose focus is necessarily on service delivery rather than pedagogy.

As outlined in the FRAME model (Koole, 2005; Koole & Ally, 2006), the social environment is an essential component to the construction of knowledge by the learner. Mobile learning that provides opportunities for connectivity and interaction has the potential to provide the learner with a meaningful learning environment, one in which the learning is situated in a real life context. Timely and rapid access to practice resources (e.g., instructor, peers, information / reference materials, agency information), may better support teaching and learning, particularly when practice takes place in the community where the instructor is further removed from the point-of-care and where opportunities for student-to-student interactions are more limited.

The requirement to provide theory and evidence-informed care to clients (College of Registered Nurses Association of British Columbia [CRNBC], 2000) is also challenging in the context of more isolated care in the community and of a rapidly expanding body of knowledge. Access to current knowledge can be problematic for students in the practice setting because of limited access to text resources, computers and connectivity to the internet and library data bases and even more challenging for students whose access is further removed from the point- of- care.

In keeping with Koole's (2005) FRAME model, access to and usability of mobile learning devices is critical to supporting the context of learning and learning interactions. Carefully planned selection of hardware, software (such as decision-making and drug reference programs), and connectivity options that meets the learner's cognitive, physical and psychological needs in the context of their learning environment is critical in supporting theory and evidenced-informed practice. Together, the resulting educational challenges to changes in health care delivery have created an ideal environment for mobile technologies that provide

resources for students at the point-of-care and which enable instruction to be re-introduced in real time.

Guided by the FRAME model (Koole, 2005; Koole & Ally, 2006), we designed a pilot project and a formative evaluation study to help us to begin to address the gaps in the literature and the challenges in nursing practice education outlined above. This study was exploratory and descriptive in nature and was structured as a two-stage formative evaluation of the use of specific mobile devices, Hewlett Packard iPAQ© PDAs, in nursing practice education. Stage 1 consisted of one-on-one trials with 4th year nursing students and instructors, while Stage 2 was a full field trial in a one month long 3rd year nursing practice course. In the remainder of this chapter, we report of the results of Stage 1 of this study.

Methodology

Research Setting

Stage 1 of the study was designed to test the feasibility of the use of the iPAQs with nursing students before their introduction into a real life nursing class. Two instructors and three volunteer students in the final year of a 4 year Baccalaureate Nursing Program at a Western Canadian Community College participated in this part of the study. The mobile device, the HP iPAQ Model 6955, they used was a full fledged Pocket PC computer combined with a mobile telephone and a digital camera and provided for both WiFi and GPRS wireless capability. The participants were supplied with selected software programs. These included both those programs built in to the iPAQs (Microsoft Office Mobile©, Internet Explorer© and Pocket MSN Messenger©) and additional software provided by the research team, including nursing support software (the 2007 Lippincott's Nursing Drug Guide©, and Davis' Lab and Diagnostic Tests©),

the Skype© audio conferencing program, and Acrobat Reader Mobile© , which were loaded onto the devices in advance.

Research Questions

This stage of the study was designed to answer the following questions:

1. Can PDA use be implemented and sustained in independent nursing practice education settings?
2. Are PDAs useful in nursing practice education settings?
3. What is the appeal of / comfort with PDAs for nursing students and instructors in real life instructional settings?

Study Design – Stage 1

Stage 1 consisted of one-on-one trials. Tessmer (1993) indicates that a one-on-one trial involves the evaluator working with one learner / instructor at a time, e.g., doing “walkthroughs”. The two faculty members assisted the lead author in setting up the mobile devices and testing them for use. These three researchers then met with the student participants for Stage 1 to provide a two hour initial training session in the use of the devices. The students were then asked to try out specific features of the devices around campus and the community for a two week period, that is, to make use of the devices in a variety of possible ways in order to first test out whether or not the mobile devices can be used effectively and efficiently for the purposes planned for the real-life instructional setting of Stage 2.

Several forms of evaluation data were collected in Stage 1:

- The researcher's written comments during one-on-one observations of student use of the mobile devices and any specific comments directed to them.
- A pre-study demographics survey.
- Semi-structured interviews with the course faculty members and 4th year students, conducted by the lead author.
- Reflective logs kept by faculty and students.

Analysis

The pre-study demographic survey was tallied and descriptive statistics compiled. The interviews were transcribed and coded using AtlasTi© software. Each interview was coded by two research team members independently and then the codes were merged. The code were then discussed by the research team and examined in relation to the FRAME model.

Findings

Prior Knowledge of Mobile Devices

The data and the interviews revealed that, with the exception of one of the instructors (both research team members), this group were novices in m-learning and had had no prior direct experience with PDA use. They had ample experience with mobile (cell) phones and four of five owned one (See Table 3). For most of the participants, this was their first experience with a PDA – style pocket computer. They were all familiar with, and had used, MS Windows, MSOffice, Hotmail, and Skype on desktop or laptop computers, but not on PDA style devices. They were also aware that there was nursing software for PDAs, but had not used it (except for the one instructor).

Table 3

Level of Mobile Device Ownership

Own mobile device	Stage 1
Cell Phone	4
PDA	2
None	1

Stage 1: N = 5

Despite their lack of direct experience with PDAs, all five participants reported that they were very comfortable with these devices. This was a somewhat curious self rating since their prior experience clearly was only with mobile telephones and, to a lesser extent, digital cameras (presumably built into their mobile phones). Table 4 details the participants' prior experience with the functions and software provided in the HP iPAQs. The interviews, however, revealed that this comfort was based on their experience with computing in general and with observations of others using PDAs for some of these functions.

Table 4

Prior Expertise with Mobile Devices

Feature / Experience	None	Beginner	Competent	Experienced
Telephone	0	0	1	4
Photography	2	1	0	2
Email	2	1	1	1
Internet	2	2	0	1
Text Messaging	3	1	0	1
Audio Messaging	4	0	0	1
Word Processing	2	1	1	1
Spreadsheet	3	0	1	1
Database	3	0	1	1
Nursing Software	2	1	1	2

Stage 1: N = 5

Learning the Mobile Device Features

It was not a simple task for our participants to learn to use all the features available on these devices. As reported above, the PDAs provided to the participants were loaded with a relatively wide range of software. The HP iPAQs also provide users with a number of built-in features, including both a touch screen (with stylus) and a thumbing keyboard (See Figure 1) and the capability to transcribe hand writing using the stylus to text. In addition, when appropriate service is available, iPAQ 6955 users can use either WiFi hotspots or GPRS (cell phone and data) wireless connectivity to send email, browse the Internet or use an audio conferencing program such as Pocket MSN Messenger or Skype. Participants were provided with both types of connectivity. For the study, the iPAQs were set up with local service GPRS connectivity and WiFi was available both on campus and in spots around the community (e.g., coffee shops) as well as the home networks of some participants.



Figure 1. The HP iPAQ 6955

The two instructors received their devices two months before Stage 1 of the study began. They were oriented to some of the features of the device by the lead author and learned others

through reading the manual and exploration. One of the instructors already owned a similar model of PDA and used that in her practice.

The three students were provided with a two hour orientation. In order to allow them to effectively use these devices, we decided that it was necessary to directly introduce the students to a number of these features and provide them with time to practice under supervisions. Features taught during the orientation were: a) use of both the touch and thumbing keyboards, b) cursive to text transcription, c) how to enable wireless connectivity (WiFi and GPRS) for email and Internet browsing, d) use of the nursing drug and lab values software, and e) use of text and audio messaging (e.g., Skype).

Ease of Use

Despite the apparent complexity of the devices, especially the number of features to learn, our participants uniformly claimed that these devices were easy to learn and easy to master overall. While they found that the two orientation sessions were not sufficient to allow them to achieve full mastery, our respondents found that they only required an additional 1 to 3 hours learning on their own afterwards to become comfortable with the use of the iPAQs. In particular, they found that much of their knowledge with desktop computing (e.g., Windows and MS Word) was transferable. In the interview, Jane², who regarded herself as a complete novice with PDAs, noted that:

Uh... I think that it's a very easy device to use. Um... you can kind of fumble your way through it and find things and kind of work through. Um... I think that has something to do with how comfortable you feel on a... on a main computer, as to how comfortable you can come and use one of these. Because a lot of the knowledge is kind of um...

² Pseudonyms are used in place of participants' actual names.

transferable. Um... I think personally if I had.. um... a longer time with the device I would come... become more comfortable with the internet and accessing stuff over the internet.

More specifically, our respondents even found some of the more unusual features simple to use. Referring to the transcriber (touch hand writing to text), Jane commented that:

I found that to be just amazing, you could write in anything and it.... and I have pretty messy hand-writing and I could handwrite words in and it would come up and you know, it would print them on the Word document, it was amazing. I found that to be very... kind of fun to use, you know.

Of the various programs on the PDAs, our participants found the nursing software (2007 Lippincott's Nursing Drug Guide and Davis's Lab and Diagnostic Tests) to be user friendly and reported it to be the feature they used most in the trial. Jane also commented on these programs:

Yes, and I used them probably ten times a day on a daily basis, every time I was in the hospital. I used them a lot, eve... whenever I needed to look up a medication or cross-reference a lab test or even um... looking up the... um... the isolation precautions for Meningitis, it was all right there I could just go in and put in the word, it was easy to find um... and it comes right up. Um... You put in a few letters and it comes up with a bunch of options...

Barriers to Use

The feature that posed the most difficulty for participants was wireless connectivity. Despite orientation to this feature, none of our student participants were able to make the GPRS

data connection work when using the devices on their own. In one case, the student successfully used the WiFi connectivity with her home wireless system, but did not try the GPRS connectivity. The other two appeared to confuse the two features. Sally, for instance, when asked about using GRPS stated:

I tried that in the um office at Home Community Care, but it wasn't working for me. But I, I was just... trying to see if I could pick out the signal, but I... I didn't really try and... you know, really hard to figure it out or anything.

[and then]

I tried the... I turned on the cell phone feature and the Wi-Fi. ... and it... it... the cell phone, um, lit up, but the Wi-Fi didn't light up.

Our participants also talked about their inability to use wireless connectivity in the hospital. This was a combination of the local hospitals' policies not to allow the use of wireless devices for fear of causing medical equipment to malfunction and the consequent lack of WIFI connectivity. These policies are under debate in the health care community and, in fact, one local hospital modified its policy during the period of our study, so this may become less a barrier to mobile learning in nursing in future.

While the student participants were not concerned with it, during Stage 1 trials, the instructors and research team discovered one other barrier that promised to seriously impact Stage 2 of our study. This was the inability to access the WebCT course website that would be used for communications and for sharing of resources in the nursing course to be used in the field trial. We were able to access the log in screen but not log in to the course. The issue appears to be with Java scripting and, at the time of writing, has not yet been resolved. This highlights

the need for the use of learning management systems and web sites that have been designed specifically for mobile use (e.g., Google Mobile).

Portability

One of the most pervasive arguments for mobile learning is the perceived ready portability of PDAs and like devices. Our participants generally agreed that the iPAQs were portable, but they had somewhat varying opinions on the degree of this. They agreed that they were suitable to carry in purse or pocket or clipped to a belt whenever this was feasible. Two respondents, for instance, carried the iPAQ in uniform pants (leg) pocket in hospital. Alice reported this to be quite useful:

Alice: It was in my pants pocket down on the side by my knee, right side always 'cause I'm right handed, and I had no issue with it, it was accessible. There was one time where I was on break, reclined and I guess it slipped out of my pocket. So, an 800 dollar device is sitting in your pocket and you think you're going to lose it, you keep a really close eye on it.

Interviewer: <laughs> yeah. Even if it's yours. Yeah. So you found it comfortable?

Alice: Yeah. Yeah it didn't bother... I never noticed it was there, when it was in my pocket. It wasn't bulky, it wasn't clunky. It was clipped right on, I wasn't worried about it just accidentally slipping out.

Jane, however, found the presence of the device in the uniform pocket to be somewhat annoying and chose to place it nearby instead:

No I had it in a leg pocket. Um... I found it quite heavy actually. Um... walking around after a twelve hour shift you really started to feel it there and a couple of days I actually took it off and put it in the um... narcotics drawer of the med cart, because it was just too heavy and it kind of rubs on your leg a little bit and... it was kind of uncomfortable that way.

Visibility

Kukulska-Hulme and Traxler (2005) considered one of the most significant attributes of mobile technologies to be their ability to support learning that is more situated. This implies that mobile devices might be used in a variety of lighting situations, including outdoors or in automobiles. One of the advantages of the iPAQ 6955 is that the brightness of the screen is easily adjustable using a slider on the home screen. Our participants found that the screens were sufficiently bright and that the colour and type size of the text displayed allowed it to be clearly read. Sally, for instance, commented in response to a question about screen visibility:

Interviewer: Right? In sunny conditions. So in... how did you react to the visibility of this device in different situations and conditions?

Sally: Um... I didn't have an issue with them; I didn't really use them outside. I used them in the vehicle and had no problem with them. You can change the lighting of the screen to lighter or darker. Right now at the angle I'm looking at it, it looks dark, but as soon as I pick it up the glare's gone and it's not an issue.

Our respondents also felt that the screen size of the devices was suitable and pointed out that bigger screens also meant heavier, less portable devices. Alice, for example, commented:

I'd stay that size because... I don't think it's too big or too small, and... um, it was easy to carry around and um, you know, easy to handle and easy to carry around, I'd probably keep it the way that it is.

Usefulness in Nursing Practice Education

The option to reference nursing software at the bedside was cited as the most useful feature of the mobile devices in nursing practice experiences. All the participants found the devices to be convenient for immediate reference and easy to access when needed. They also noted that the programs allowed them to remain current via software updates and found that they aided in patient teaching by using "layman's" language. For instance, when asked to comment on the usefulness of the Lippincott drug reference program, Sally noted that:

If there was a question, if I wasn't sure about something I'd have to actually go back to the office and find out more information and you know, either next visit or I could call the person and.. um.. call them back and give them the information. But it was really handy to have it right there so I could um, you know, talk to the patient about it. It was probably like a different... a different drug they had been on and they didn't really understand what it was for and... and what not. So I found it was really great to be able to do that and be able to use it as a reference tool.

Our respondents also commented on the availability on the iPQs of the option to use either telephone or email to contact their instructors and on the potential of the devices to allow private communications via mobility. Sally, for example, stated:

Yeah. Well I like it because.. um because you have the options of connecting to the internet or the phone, uh... you could use it to talk with your instructor if you needed to... and, um, it... you know, options. You have lots of questions as students...

[and]

Oh there was one situation in my clinical setting where I had to get a hold of my instructor and get a hold of them now. And so a matter of finding a private telephone in the hospital... It's pretty much near impossible. If you had at least one of these, you could step outside, you could... you could make yourself in a private situation to speak to somebody, and have access to the telephone.

Our participants also thought that the mobile devices were useful for seeking information and for document storage and access. Sally again noted that:

... and uh, you know, you always want to look something up or a reference... you know, referencing so... I like that option of having different programs on there you can refer to. Um, of course the internet or different sources you can use to connect to. And you know, storing... storing documents on there and um, assignments... if you were gonna send something to your instructor. It saves a lot of time... my time, 'cause ordinarily if I were gonna do something I'd have to either find a computer somewhere, or go home or I'd... I'd have to find a way of getting to a computer to do something.

Conclusions

In this chapter, we reviewed the extensive research literature on the use of m-learning in nursing education and reported on Stage 1 of an exploratory evaluation study of m-learning in a nursing practice education setting. We concluded from the literature review that there has been little research to date on the interactional application of m-learning by nursing educators and that this should be the focus of our inquiry. We noted that nursing care is moving to the community where client complexity and acuity is increasing and where up-to-date information at the point-

of-care is critically needed to support practice. As a result, we argued that the delivery of nursing education requires physical mobility throughout the community and does not lend itself to more traditional direct teaching supervision models. Instead, guided by Koole's (2005) FRAME model of m-learning, we judged that access to and usability of mobile learning devices is critical to supporting the context of learning and learning interactions.

The purpose of Stage 1 of the study was to test the feasibility of the use of the iPAQs with nursing students before their introduction in Stage 2 into a real life nursing education class. In this stage, therefore, we asked a number of questions.

First, we asked if the use of mobile devices such as PDAs can be implemented and sustained in independent nursing practice education settings. Our participants felt that this was indeed the case. They uniformly reported that they were comfortable with mobile devices in general and that, despite the number of features required to use the iPAQs effectively, these devices were easy to learn and easy to master overall. In particular, they found the nursing software (drug reference and lab values) supplied on the iPAQs simple to learn and to use at the point- of-care. They also indicated that they found the devices to be readily portable and the screen sufficiently visible in a variety of settings.

Our respondents did, however, point out barriers to the use of the devices in nursing practice education. The availability and use of wireless connectivity is critical for communications with instructors and other students. Despite orientation, none of our student participants were able to make the GPRS data connection work when using the devices on their own. In one case, the student successfully used the WiFi connectivity with her home wireless system, but did not try the GPRS connectivity. It is likely that a more thorough orientation and

more practice of these features will be needed before students will feel comfortable with the interactional uses of mobile devices.

Second, we wished to determine if PDAs were useful in nursing practice education settings. Our participants cited the option of referencing nursing software at the bedside as the most useful feature of the mobile devices in nursing practice experiences. They found the devices convenient for immediate reference and easy to access when needed. They also found that they aided in patient teaching. Our respondents also thought it was potentially useful to use the iPAQs for either telephone or email to contact their instructors and, further, because the devices were mobile, to allow such communications to be more readily private. The results of Stage 1, however, do point to the need for further validation of the interactivity and communications aspects of mobile devices in nursing practice education.

Finally, we wished to assess whether mobile devices such as PDAs appealed to, and were comfortable to use by, nursing students and instructors in real life instructional settings. This again relates closely to ease of use of the devices. Our respondents all reported that they were comfortable with mobile devices in general and that the iPAQs specifically were easy to learn and easy to master overall. They did, however, experience some difficulties using the PDAs – particularly the connectivity – and these difficulties appeared more pronounced for those with less successful past experience with mobile devices and even computers in general. Stage 1 results then indicate that nursing students and faculty are attracted to the use of mobile devices in practice education but that sound prior instruction in their use is important.

In conclusion, Stage 1 of our study confirmed that the use of m-learning, at least with the HP iPAQ PDAs, is feasible in actual nursing practice education settings and that this use has the potential to be very effective at least in affording students and instructors with ready access to

resources at the point-of-care. Our results indicate that the interactive uses of mobile devices are also potentially very useful, but this aspect needs to be more thoroughly investigated in the second stage of our study.

Implications for Practice

The focus of this was on the use of mobile learning in Nursing practice education. During Stage 1 of our study, we worked with a small group of 5 participants and, therefore, cannot with any confidence generalize our conclusions to nursing students in general. However, our data does point to some initial, tentative, implications for the use of mobile devices in this instructional context:

1. Prior knowledge: Students' previous experience with computing is likely a significant factor in their learning to use mobile devices. There may be a need for some level of differentiated instruction (novice and experienced groups) about, and orientation to, the specific mobile devices to be used in a class or program.
2. Time to learn: 3G mobile devices like the HP iPAQ are generally easy to learn, but they are also complex technologies with many features. Despite our participants' claims that they can be learned quickly, some features – especially those associated with wireless connectivity – may take students time and additional instruction to learn to use effectively and completely.
3. Ease of use: Our participants reported that the mobile devices were both readily portable and provided clear visibility in a variety of situations. While battery life may be an issue, it appears that such devices can be readily and comfortably used in nursing practice contexts.

4. Immediate access to information: Our participants uniformly reported how convenient it was to have immediate access at the bedside to reference information such as drug interactions and lab values. It seems likely that, in this way, mobile learning can add to student nurses' level of confidence in their practice and, therefore, to their safety of practice.
5. Improved communications with instructors: Our instructors commented on the difficulties that they experience staying in touch with their students on a regular basis once these students are out in practice experiences. While policies concerning the use of wireless devices in hospital settings are currently a barrier, mobile devices provide a number of options for connectivity that may lead to more flexibility for instructors to contact students and vice versa.

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References

Cacace, F., Cinque, M., Crudele, M., Iannello, G., & Venditti, M. (2004). *The impact of innovation in medical and nursing training: A hospital information system for students accessible through mobile devices*. Proceedings of mLearn 2004, the 3rd World Conference on Mobile Learning. Rome, Italy.

- Cahoon, J. (2002, April). Handhelds in health care: Benefits of content at the point of care. *Advances in Clinical Knowledge Management*, 5. Retrieved Sept 16, 2005 from <http://www.openclinical.org/docs/ext/workshops/ackm5/absCahoon.pdf>
- Davenport, C. (2004). *Analysis of PDAs in Nursing: Benefits and barriers*. Retrieved Sept 16, 2005 from www.pdacortex.com/Analysis_PDAs_Nursing.htm
- Driscoll, M.P. (2005). *Psychology of learning for instruction (3rd Ed.)*. Boston, MA: Pearson – Allyn and Bacon.
- Galt, K.A., Rich, E.C., Young, W.W., Markert, R.J., Barr, C., Houghton, B, et al. (2002). Impact of hand-held technologies on medication errors in primary care [Electronic version]. *Topics in Health Information Management*, 23(2), 71-81.
- George, L., & Davidson, L. (June, 2005). PDA use in nursing education: Prepared for today, poised for tomorrow. *Online Journal of Nursing Informatics*, 9(2). Retrieved Sept 16, 2005 from http://eaa-knowledge.com/ojni/ni/9_2/george.htm
- Goldsworthy, S., Lawrence, N., & Goodman, W. (2006). The use of Personal Digital Assistants at the point of care in an undergraduate nursing program [Electronic version]. *CIN*, 24(3), 138-143.
- Hill, T. R., & Roldan, M. (2005). Toward third generation threaded discussions for mobile learning: Opportunities and challenges for ubiquitous collaborative learning environments. *Information Systems Frontiers*, 7(1), 55-70.
- Keegan, D. (2002). *The future of learning: From eLearning to mLearning*. Ericsson.

- Keegan, D. (2005, October). *The incorporation of mobile learning into mainstream education and training*. Paper presented at mLearn 2005, the 4th World Conference on Mobile Learning. Cape Town, South Africa.
- Koole, M. L. (2005). *The framework for the rational analysis of mobile education (FRAME) model: An evaluation of mobile devices for distance education*. Unpublished master's thesis. Athabasca University, Alberta. Retrieved September 21, 2006, from <http://library.athabascau.ca/drr/viewdtr.php?course=thes&id=205>
- Koole, M. L., & Ally, M. (2006, April). *Framework for the rational analysis of mobile education (FRAME) model: Revising the ABCs of educational practices*. Networking International Conference on Systems and International Conference on Mobile Communications and Learning Technologies, 216.
- Kukulska-Hulme, A. & Traxler, J (2005). *Mobile learning: A handbook for educators and trainers*. London: Routledge.
- Lehman, K. (2003). Clinical nursing instructors' use of handheld computers for student recordkeeping [Electronic version]. *Journal of Nursing Education*, 42(10), 41-42.
- Mayes, T., & de Freitas, S. (2004). *Review of e-learning theories, frameworks and models*. Joint Information Systems Committee (JISC) E-Learning Models Desk Study. Retrieved September 21, 2006, from [http://www.jisc.ac.uk/uploaded_documents/Stage%20%20Learning%20Models%20\(Version%201\).pdf#search=%22JISC%20Mayes%22](http://www.jisc.ac.uk/uploaded_documents/Stage%20%20Learning%20Models%20(Version%201).pdf#search=%22JISC%20Mayes%22)
- Miller, J., Shaw-Kokot, J. R., Arnold, M. S., Boggin, T., Crowell, K. E., Allehri, F., Blue, J. H., & Berrier, S. B. (2005). A study of personal digital assistants to enhance undergraduate clinical nursing education. *Journal of Nursing Education*, 44, 19-26.

- Newbolt, S. K. (2003, October). New uses for wireless technology. *Nursing Management*, 22, 22-32.
- Park, C. (2006). [Survey data on mobile use by Nurse Practitioner students]. Unpublished raw data.
- Rosenthal, K. (2003). "Touch" vs. "tech": Valuing nursing specific PDA software. *Nursing Management*, 34(7), 58.
- Rothschild, J.M., Lee, T.H., Bae, T., & Bates, D.W. (2002). Clinician use of a palmtop drug reference guide [Electronic version]. *Journal of the American Medical Informatics Association*, 9(3), 223-229.
- Stroud, S.D., Erkel, E.A., & Smith, C.A. (2005). The use of Personal Digital Assistants by Nurse Practitioner students and faculty [Electronic version]. *Journal of the American Academy of Nurse Practitioners*, 17(2), 67-75.
- Tessmer, M. (1993). Planning and conducting formative evaluations: Improving the quality of education and training. London: Kogan page.
- Thomas, B. A., Coppola, J. F., & Feldman, H. (2001). Adopting handheld computers for community-based curriculum: Case study. *Journal of the New York State Nurses Association*, 32, 4-6.
- Trifonova, A., & Ronchetti M. (2003). A general architecture for M-Learning. *Journal of Digital Contents*, 2(1), 31-36.
- Wagner, E. D. (2005). Enabling mobile learning. *Educause Review*, 40(3), 40-53.