A mobile clinical e-portfolio for nursing and medical students, using wireless personal digital assistants (PDAs)

Bernard Mark Garrett a,*, Cathryn Jackson b

a School of Nursing, University of British Columbia, T201-2211 Wesbrook Mall, Vancouver, BC, Canada V6T 2B5
b Faculty of Applied Science, University of British Columbia, T201-2211 Wesbrook Mall, Vancouver, BC, Canada V6T 2B5

Accepted 20 July 2006

Summary This paper outlines the development and evaluation of a wireless personal digital assistant (PDA) based clinical learning tool designed to promote professional reflection for health professionals. The “Clinical e-portfolio” was developed at the University of British Columbia School of Nursing to enable students immediately to access clinical expertise and resources remotely, and record their clinical experiences in a variety of media (text, audio and images). The PDA e-portfolio tool was developed to demonstrate the potential use of mobile networked technologies to support and improve clinical learning; promote reflective learning in practice; engage students in the process of knowledge translation; help contextualize and embed clinical knowledge whilst in the workplace; and to help prevent the isolation of students whilst engaged in supervised clinical practice. The mobile e-portfolio was developed to synchronise wirelessly with a user’s personal Web based portfolio from any remote location where a cellular telephone signal or wireless (Wi-Fi) connection could be obtained. An evaluation of the tool was undertaken with nurse practitioner and medical students, revealing positive attitudes to the use of PDA based tools and portfolios, but limits to the use of the PDA portfolio due to the inherent interface restrictions of the PDA.

© 2006 Elsevier Ltd. All rights reserved.
This article appears in a joint issue of the journals Nurse Education Today Vol. 26, No. 8, pp. 647–654 and Nurse Education in Practice Vol. 6, No. 6, pp. 339–346.

KEYWORDS
PDA; e-Learning; Portfolio; Mobile-learning

Introduction

A key challenge for colleges involved in the delivery of professional health care education is the
successful integration of clinical practical experience into the curriculum. The School of Nursing at the University of British Columbia (UBC) has over 300 nursing students engaged in supervised clinical practice in hospital and community settings around Vancouver. Likewise the Faculty of Medicine has over 200 medical students undertaking supervised clinical experience locally and remotely. Students and faculty face the issue of limited resources in the practice setting that support clinical learning, and help to contextualize and embed clinical knowledge in the workplace. Nursing students whilst in practice are encouraged to record their clinical activities, and achievements, and reflect upon their experiences using models of clinical reflection in order to develop professional self-evaluation skills and consolidate their learning from practice (for example Johns’ (1995) model of experiential learning, Reid, 1993; Kolb, 1984). This reflective activity is facilitated by their clinical teachers.

The proliferation of technology and advanced computing has given rise to the availability of online and mobile technologies in the workplace. One technology commonly in use is the personal digital assistant or PDA. The PDA offers the health care practitioner a vast array of clinical resources at their fingertips when and where they are needed. A technological solution is described here, that provides educational tools using the new generation of networked PDAs. These included a mobile clinical portfolio that promoted professional reflection (Chasin, 2001; Hochschuler, 2001; Fischer et al., 2003), and also other mobile resources to enable students immediately to access clinical expertise and resources remotely.

Aims of the study

The aim of this project was to design, implement and evaluate a PDA based tool to support reflective learning in practice in a pilot study involving nursing and medical students during the academic year of 2005–2006. The project had the following objectives:

- Demonstrate the potential use of mobile networked technologies to support and improve clinical learning;
- Demonstrate the potential for a pedagogic tool to help contextualize and embed clinical knowledge whilst in the workplace;
- Evaluate the potential for a mobile PDA based portfolio tool to promote reflective learning in practice and engage students in the process of knowledge translation;
- Explore the value of networked PDA resources to help prevent the isolation of students whilst engaged in clinical practicum.

Background

Educational portfolios as a concept applied to health professionals’ education began to emerge in the literature in the late 1980s and early 1990s, although the origins were clearly described much earlier in education literature. Portfolios are increasingly valued in a number of health disciplines as evidence of attaining and maintaining competence (Ball et al., 2000; Crist et al., 1998; Grossman, 1998; McMullan et al., 2003; Youngstrom, 1998); to incorporate accreditation of prior learning into nursing and midwifery assessment (Ball et al., 2000); as a tool to support a self-directed, transitional process to professional roles for occupational therapists (Crist et al., 1998), and as a means for tracking continuing competency requirements of regulated health care professionals (Grossman, 1998). As the complexity of what health professionals are expected to do continues to increase there is a concurrent increase in the use of portfolios as a vehicle to facilitate personal reflection in practice and document professional development (Ball et al., 2000; Crist et al., 1998; Jensen and Saylor, 1994; McMullan et al., 2003; Parboosingh, 1996; Tracy et al., 2000).

Paper-based portfolios have been used with nursing students to encourage reflection on personal experiences in order to transform experience into tangible evidence of learning for some time. More recently electronic portfolios have also been used for this purpose (Krayer et al., 2003). The intent is to have prior learning identified, accomplishments validated and valued, and to motivate students to plan for continued learning (Ball et al., 2000). Portfolios have been described in the nursing literature as useful to evaluate several different learning outcomes at the same time such as nursing content knowledge, therapeutic interventions, communication proficiency, and critical thinking (Facione and Facione, 1996). Jensen and Saylor (1994) discuss portfolio use as one strategy to address the problem of a widening gap between thought and action in a complex practice setting in that it provides a structure and process to facilitate reflection in an active learning process. It is suggested that portfolios can be applied to document transitions in student growth and development, build student confidence and document evidence of personal achievement and professional growth.
It is also argued they promote self-directed learning and reflective practice central to the practitioner role (McMullan et al., 2003; Ryan and Carlton, 1997). The key features of the portfolio are carefully selected and produced examples of the achievement of learning outcomes that includes reflections on the items that demonstrates learning on the part of the student. The specific utility of portfolio use in nursing education is that it provides a highly individualized experience for the student which is an important component of an effective learning environment (Midgley, 2006). In using the portfolio approach the student collects the evidence that demonstrates their learning process, reviews and reflects on their learning in comparison to expected performance and is inspired to set goals for the future. Through this iterative process, the student continually evaluates what has been learned, and compares it to what is yet to be mastered and is then facilitated to develop a plan to bridge the gap between the two. In doing so, the student transforms prior knowledge and skills into a foundation for further growth and learning (McMullan et al., 2003). The ultimate goal of this process is that students will become more selective and self-directed in providing evidence of their learning development and achievement of outcomes and will demonstrate how they have developed personally and professionally and where further learning is needed (McMullan et al., 2003).

There has been an explosion of handheld digital devices in the past decade including digital media players, digital cameras, GPS systems and networked communication devices and they have inevitably merged with the power of computers. These handheld computers are small, portable devices that can store and manage data as small as an address book to large databases of information that can be easily accessed and retrieved when needed. The combination of wireless and internet technologies allows more complex tasks including access to email and to special PDA-formatted Web channels, browsing Web sites and the ability to synchronize data between the PDA and a computer via the internet (Erdley, 2006; Fontanelo et al., 2003; Thompson, 2005). Significant advantages of the handheld computer include its small size, mobility, flexibility, and ease of use (Altmann and Brady, 2005; Koblenztz, 2005; Tooey and Mayo, 2004).

Health care practitioners commonly use PDAs in practice to access information to support clinical decisions and evidence-based practice at the point of care (Honeybourne et al., 2006). They provide quick access to reference information and standard protocols or best practice guidelines, diagnostic and clinical references, as well as hospital information systems and patient records. The PDA provides a mass of critical information that is relevant and quickly accessible when it is needed that supports the clinician to make informed decisions that ultimately benefit safe patient care (Courtney et al., 2005; Erdley, 2006; Fischer et al., 2003; Newbold, 2004; Tooey and Mayo, 2004). With the significant growth in handheld technology, expanding health-care applications and ease of use the PDA is becoming an integral part of healthcare and the practice of professional nurses (Miller et al., 2005; Thompson, 2005). Given the advantages of handheld technologies, the exponential growth of its use in health care and the computing and data management capabilities of the PDA it would seem a logical and powerful tool to support the mobile use of portfolios in the clinical learning environment.

Study design and sample

A wireless, cell phone/General Packet Radio Service (GPRS), and digital camera equipped PDA device was selected for the delivery platform for the project and the UBC Clinical e-portfolio tool was developed. The Microsoft Pocket PC/Windows Mobile platform was selected for delivery as this offered the required wireless, and multimedia capabilities required (see Fig. 1). This application was developed to facilitate access to clinical placement information (contact information, shift times, learning opportunities and resources) and the recording of experiences from clinical practice, including a quick menu of medical/nursing categories and a reflective cycle wizard to guide students through a cycle of structured reflection on their clinical practice. Johns’ (1995) model of experiential learning was selected for this purpose for its simplicity. The PDA application also provided a secure (128 bit encrypted) wireless synchronization and storage of portfolio data with a secure Web server based portfolio (see http://clinical.nursing.ubc.ca/ username TestStudent and password test123 for a live example on the Web). The Web based interface was designed so that students could access the Web-based portfolio to edit their portfolios and teachers could access their student’s portfolios and add commentary. A range of other applications and clinical tools were also selected and pre-loaded onto the PDA (see Table 1 for a summary).

The study set out to answer the question “What are student's perceptions of a PDA based clinical e-portfolio, and PDA based reference tools in supporting their clinical learning?” The evaluation
study design was based upon the assumption that the phenomenon was best understood through the lived experiences of the participants (Walsham, 1995). An interpretive phenomenological approach (Koch, 1995; Heidegger, 1962) is appropriate here as it is concerned with exploring the individual’s experiences and perceptions of the phenomenon concerned. A sample of volunteer students was recruited to participate in a qualitative evaluation of the tools consisting of six final year Nurse Practitioner Students and four final year Medical Students at UBC undertaking community based practicum’s in January 2006. These students would be in practice for an average of three days each week during this period. This sample population was selected as it was considered likely that these practitioners could make good use of the tools at this stage of their programs. A small sample size was only possible because of the limited number of devices available to the project team. Each student was given a PDA pre-loaded and configured with the clinical software to use for a period of three months and 2 h of initial PDA training on how to use the devices and the applications.

Students completed a log of activities using the PDA clinical software over the three month period of use. This included records of the applications used, and time taken in use, number of times the portfolio data were entered, number of full reflective entries made, number of times new protocols and research data were accessed, number of times clinical reference data were accessed, and number of times the devices malfunctioned. Following the three month period a post exposure questionnaire was used in order to establish their perceptions of and views on the potential uses of the e-portfolio and clinical PDA based tools they used. They also participated in a focus group interview to explore these issues further. A content analysis of these data were performed using Open Coding (Polit et al., 2001) and Ethnograph qualitative data analysis software (Qualis Research, 2003).

### Table 1  PDA applications used

<table>
<thead>
<tr>
<th>Application</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>UBC clinical e-portfolio</td>
<td>A mobile clinical e-portfolio</td>
</tr>
<tr>
<td>Epocrates Rx</td>
<td>Drug reference software (a complete formulary)</td>
</tr>
<tr>
<td>Epocrates Dx and Sx</td>
<td>Disease reference and symptom assessment tools</td>
</tr>
<tr>
<td>Epocrates labs</td>
<td>A laboratory test reference</td>
</tr>
<tr>
<td>Epocrates ID</td>
<td>An infectious diseases reference</td>
</tr>
<tr>
<td>Epocrates tables</td>
<td>A clinical tables reference tool</td>
</tr>
<tr>
<td>PDA contacts</td>
<td>A personal information contacts database</td>
</tr>
<tr>
<td>PDA calendar</td>
<td>A personal information calendar/schedule</td>
</tr>
<tr>
<td>PDA e-mail</td>
<td>An e-mail client</td>
</tr>
<tr>
<td>Cell-phone</td>
<td>Cellular telephone</td>
</tr>
<tr>
<td>SMS text messaging</td>
<td>Text message client</td>
</tr>
<tr>
<td>SMS picture messaging</td>
<td>A picture messaging client</td>
</tr>
<tr>
<td>Griffiths five minute medical consult</td>
<td>A diagnostic assistant tool (PDA version of the text)</td>
</tr>
<tr>
<td>Pocket internet explorer</td>
<td>A mobile web browser</td>
</tr>
<tr>
<td>Pocket word and excel</td>
<td>Word-processing/spreadsheet</td>
</tr>
<tr>
<td>Pocketfeed RSS newsreader</td>
<td>A really simple syndication (RSS) news reader (synchronised with medscape headlines, family medicine notes and medicenet.com)</td>
</tr>
</tbody>
</table>
Ethical considerations

Ethical considerations were met by gaining informed consent, ensuring the dignity, confidentiality and prevention of harm to students, and giving assurance that their participation would have no impact on the grades awarded or relationships with the institution. The unequal power relationship between students and teachers was given due care by ensuring that the individuals conducting the research were not involved in teaching in those programs of study. No personal identifiable patient information was allowed to be recorded by students during their clinical experience, and where pictures of patients were used the students were required to get written consent of the patient, and not show the identity of the person in the image. All fees incurred in the use of the devices were covered by the University. The study methodology was subject to independent review by the University Behavioral Ethics Review Board before any students were engaged in the work.

Findings

The logs of application use demonstrated that students made considerable use of the tools during the three month period. A summary of the number of times the applications were used is presented in Fig. 2. The quick reference tools were seen as particularly valuable, especially the Epocrates drug reference and the diagnostic reference tools. The e-portfolio tool was not used as frequently as the stand alone reference tools and was generally used once per week to record all of their clinical reflections in a single activity. On average the students used the applications (including cell phone use) for a total of 68 min per week. There were no obvious differences between the usage patterns of the medical and nurse practitioner students, although with the small sample used no significant trends can be implied here.

Electronic reference vs. Interactive communication

The PDAs were mainly used as electronic reference tools rather than data recording and communications devices. The cell phone function was used infrequently by the group, but all but one of the students noted they retained their regular cell phones as they only had the PDA temporarily. However, most identified that the integrated wireless and cell-phone and camera was a considerable benefit. No students used the audio memo functional-

![Figure 2](image-url)
ity and several expressed that they were not comfortable to "talk into the box" but the camera was seen as a more useful tool. Mobile Web-browsing was also seen as a great benefit, but regarded as expensive with current GPRS fees. One participant noted that:

"The drug and disease reference stuff was great, and it was good to be able to have your phone and e-mail all on one thing. It was cool to be able to send pictures, and it worked really well."

These findings would seem to indicate a consistent view of the PDA as a reference tool rather than a multimedia communications medium. When this was explored further in the focus group interviews it became evident that the students valued the inherent interactivity of the applications (such as the daily updating of the drug formulary and the ability to enter search queries in applications), but still viewed the device as a stand alone PDA and did not make full use of the communications functions.

"I didn't really use all of the functions. I kept forgetting it had a phone, camera and the Web and e-mail even though I knew it! I guess I didn't really look at it like that, because I wasn’t used to having that”

Interface limitations

The handwriting user interface put the students off entering data; the screen was seen as too small requiring too much time to enter data quickly. The use of thumb keyboards was an option but students demonstrated a preference for not entering text using these formats. Students wanted more pick and choose menu items rather than inputting text. One student noted:

"I preferred working on the e-portfolio and entering data via computer as the screen was too small on the PDA to be practical and efficient.”

The use of wireless synchronization was seen as very useful but its value was again seen as limited by the PDA user interface. Likewise the access to clinical guidelines on the PDA was valued highly but seen as somewhat limited by the screen size. However, the students expressed considerable interest and use of the multimedia capabilities of the PDA interface, particularly the camera functionality.

"Entering text on the PC, fine, but not really the PDA. If we had codes that you could cover everything instead of typing everything in, or more drop-down menus.”

This area of technological development remains highly competitive and the current user interfaces for these devices have improved rapidly to fulfill the portable design brief, including the use of pen-based data input and small LCD displays. It appears the remaining interface restrictions need to be addressed to maximise the value of these mobile devices for clinical practice.

Preparation and skill level

Several of the students needed repeat training to use the basic PDA functions (charging, synchronizing, and installing applications). Students with more limited technical knowledge/skills were more restricted in their use of additional functionality of the device. For example, only three students used the remote PDA e-mail application. Students found the applications fairly easy to use once they had been trained to use them. The more technically competent users made good use of the wireless features such as e-mail and Web, but the students did express difficulties in understanding the differences between data and voice services on their cell-phone service plans. It was clearly identified that ongoing training and support was valued, as one student remarked:

"I would like to see follow-up during the term for education in regards to the operation of the PDA, especially for first time users.”

Reflection on practice

Several students felt that documenting clinical reflection was not feasible "on the job" as they were "too busy", and it was not seen as a priority in their overall daily activities. Although they acknowledged the value of professional reflection, the use of the guided reflection process was not regarded as a useful tool by the students, who expressed a preference for logging events in a more open format. The ability to make entries in practice and wirelessly synchronize was seen as useful and overall the students liked the electronic format, and ability for teachers to comment on their activities. However, desktop computer based Web access was preferred to record entries and the PDA used for capturing images or recording critical event reminders rather than full blown portfolio entries. In general students liked the ability to be able to send multimedia remotely to the e-portfolio, and upload files attached to their records.
Clinical learning and isolation

The value of the PDA to help prevent clinical isolation and support clinical learning was viewed positively, with all the students making favorable observations on the PDAs ability to "keep you connected." Some comments reflecting the student’s views on this were:

"For sure, yes, the wireless connection was good. Depends on the place you were for a signal, but the way it continually updates is itself is better than a book about 5 years old."

"A real bonus when you are in the middle of nowhere, it was great to have the Web and e-mail on tap."

"It's a great support tool, like a friend in my pocket!"

"It really helped my learning in my area."

The RSS applications were not widely used by students, and only used by the medical students in the study. However, on exploration this appeared mainly due to unfamiliarity with the RSS medium by the participants. Overall there were clear indications of perceived value in the wireless and wired connectivity of these devices, and particularly in the "smart" functionality of the applications to synchronize and update their content.

Conclusions

It would seem that mobile e-portfolios can facilitate a persistent, integrated framework where students can store digital artefacts, add reflections, demonstrate their competency with particular learning outcomes, invite commentary and assessment, and selectively publish components online to document how they are achieving clinical competency with careful planning and support. However, engendering an ethos of recording professional reflection whilst in the practice setting may be difficult to achieve, even with effective tools. Using an electronic portfolio to help contextualize and embed clinical knowledge whilst in the workplace may not be achievable within current structures due to the clinical workload, and the time required for this process to be completed.

As a multifunctional computing and communications platform it appears that the wireless PDA can support and improve clinical learning, and at this point the clinical reference and the communication tools seem to provide optimum value to the student’s learning. Wireless networked PDA resources can help prevent the isolation of students whilst engaged in clinical practicum. Professional analytical processes and knowledge translation were also encouraged by the process of using the PDA to support the student’s personal clinical learning (Chasin, 2001). This pilot project revealed some of the value and limitations of handheld computers to nursing education for the opportunity it provided nursing students to utilize tools and resources to support their learning in practice. Further work to explore these issues and teachers perceptions of their value is required to better understand their contribution to clinical educational practice.

Acknowledgement

The authors gratefully acknowledge the funding of this project by the University of British Columbia Teaching and Learning Enhancement Fund.

References


