Tracking Pharmacy Students' Use of Personal Digital Assistants (PDAs) in a Clinical Simulation Laboratory Course

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Abstract:

Objectives: To determine the role and value of personal digital assistants (PDAs) with the *ePocrates*® software program in pharmacy education.

Setting: A standardized-patient driven clinical simulation course for 4th year (senior level) pharmacy students, over a two-year period with 2 different classes (n = 237).

Methods: Students were provided with a standard library of pharmacy reference textbooks in addition to a Palm Pilot® with *ePocrates* (freeware version) software. As part of the clinical simulation course, students interviewed standardized patients (actors trained to portray patients with medical conditions), and were expected to consult tertiary references to assist them in their interviewing, problem solving, and patient management activities. Students were asked to self-report utilization of PDAs (Personal Data Assistants) vs. text-based resources. Following completion of the course, focus groups of students were convened to discuss the study, and different methods they had selected to access information during the clinical simulation activities.

Results: Students demonstrated purposeful selective use of PDAs, but more frequently and more consistently preferred using text-based references. The exception to this was in circumstances in which they believed text references would be out of date or they clearly identified their own information need. In situations of greater ambiguity regarding the information need, students preferred to access the textbooks, since these provided an opportunity for visual scanning that appeared to assist them in problem-identification and problem-solving.

Conclusions: PDAs may complement textbooks within a clinical simulation environment, but do not appear to replace them. Since the small screen limits text-scanning ability, students (who are in a high knowledge-uptake stage of their professional development) found greater utility in use of textbooks, despite comfort, familiarity and general liking of PDAs.

Keywords: Pharmacy Education, Personal Digital Assistants, PDAs, Learning Styles, Educational Technology

Background

The use of technology to optimize student learning is ubiquitous in post-secondary education in North America.[1] Advances in technological prowess, coupled with steadily declining costs, have allowed students in many disciplines to benefit from the processing power and memory capacity of a variety of electronic devices, including personal computers (PCs) and personal digital assistants (PDAs). Widespread availability of Internet-based resources, and an increasingly computer-savvy student body have resulted in changes to academic programs and curricula.[2]

Pharmacy education and practice have traditionally been on the leading edge of incorporating technologies.[3] As health care professionals, pharmacists have been among the first to routinely use (and rely upon) computers as part of professional practice. Today, few clinicians could function without access to electronic pharmacy records, databases, and other computer-based applications. As a profession, pharmacy is frequently seen as a leader within health care regarding the introduction of new technologies. Within education, pharmacy was one of the first health professions to integrate computers into academic programming in the 1970s and 1980s. During this time, use of efficiency optimizing database programs (such as dispensing or patient record-keeping software) was emphasized.

Today, within the academic pharmacy literature, there have been numerous case reports detailing varying degrees of success with implementation of computer-assisted or technologically mediated teaching-and-learning tools.[4,5,6,7,8,9,10] For example, use of Web-based course notes to complement or supplement in-class presentations is now a routine expectation for many students and faculty. With growing availability of band-width, increasing ease of transmission through high-speed Internet services, and a more sophisticated end-user, video-streaming and other functionalities have also become more commonplace.

A key area of discussion and debate in the academic computing literature revolves around the balance between technologies which enhance connectivity and those which enable access to content. Proponents of connectivity-enhancing technology describe the value of creating virtual communities of learners and practitioners, so individuals may engage in interactive, social learning environments. From this perspective, the value of technology may be seen as allowing individuals to form relationships despite geographic or temporal distances or barriers. The value of these relationships is to facilitate deep learning, rather than superficial acquisition of facts. Alternatively, proponents of content-accessing technology describe the value of unfettered access to a large (and ever-growing) database of relevant facts and knowledge. Through the use of sophisticated search engines, point-and-click technologies, and memory media, it is possible to access vast amounts of information in a relatively easy manner. Advocates suggest that it is now possible to create entirely virtual libraries, completely free of written text-based references (such as textbooks), and that this is a desirable end-point given the limitations of paper-based materials. Such limitations include cost, the need to constantly update editions, size and bulkiness of texts, the lack of customizable searching facilities, and the need to “wade” through a mass of printed material in order to find a specific, desired piece of information.

Over the past decade, significant advances have been made in creating smaller, more portable content-accessing technologies. As costs for memory have declined significantly over time, the widespread availability of such devices has increased. A key feature of such devices is their ability to capture and store a large amount of data, and provide the end-user with the capacity to customize personal databases and portals of entry. Major advantages of such devices are their relative portability and ease of use.

Among the more popular of such content-accessing technologies, Personal Digital Assistants (PDAs) have become commonplace. First introduced in the late 1980s, PDAs were initially somewhat bulky and awkward, and were limited in portability and utility due to memory constraints. Advances in technology have now resulted in development of sophisticated hand-writing translation platforms (such as Graffiti), larger and expandable memory, user-friendly colour interfaces, and longer battery life to enhance portability.

As content-accessing technologies, PDAs possess remarkable potential within health care education and practice, particularly within an information-intensive profession such as pharmacy.[11] Most pharmacists are familiar with the need to consult references to verify important facts and salient details; indeed, as a professional group, it may be argued that pharmacists demonstrate a unique reliance on tertiary reference sources to support professional practice. With the emergence of personal computers, an increasing number of formerly text-based tertiary references (eg, *Physician’s Desk Reference* and *Remingtons: The Science and Practice of Pharmacy*) have become more widely available in

electronic/digital formats, replacing the need for expensive, space-consuming textbooks. However, personal computers occupy space, require electricity and are generally a non-mobile technology.

Over the past 5 years, there have been significant advances in the number and quality of PDA-based clinical references that have been developed and marketed to pharmacists. These references provide the same high-quality information as tertiary textbooks, but with the advantage of portability and search engines to facilitate information retrieval. Currently, many clinicians rely heavily on their PDAs to provide up-to-date information that formerly would have required greater time and effort to locate using textbooks. The availability of PDA readers, more comfortable and user-friendly colour interfaces, and improved fonts have all contributed to greater acceptability of this technology within professional practice.

As a result of changes to the way pharmacists access information in practice, there have been increasing calls to ensure that pharmacy students are well-prepared for the technologically intensive nature of professional work. As a group, pharmacy students demonstrate a relatively high degree of computer literacy and are generally open to the use of technology. Particularly for those students who have received secondary education in North America over the past decade, the presence of computers in the classroom and at home has resulted in a high degree of acceptance of the role of technology in enhancing the quality of patient care.

Nonetheless, the role and value of content-accessing technology in pharmacy education has not been adequately assessed. While there have been case reports outlining the use of PDAs in courses and development of specific, customized PDA-based platforms and programs for pharmacy students, the way in which PDAs actually improve the efficiency and/or effectiveness of learning and clinical skills development has not been described.

Objective

The objective of this study was to determine the role and value of personal digital assistants with the *ePocrates* software system in pharmacy education. For the purposes of this study, the PDA was used as a content-accessing technology only; although PDAs may also be used as connectivity-enhancing technologies, this was not a focus of this study because such applications are currently somewhat limited in practice.

Setting

This study was undertaken with 2 cohorts of senior-level (year IV) pharmacy students in the undergraduate (BScPhm, the entry-level degree) program at the University of Toronto. Students in this program are all required to take a professional practice laboratory course in their senior year, Pharmacy Practice Laboratories IV (PPL). The PPL course consists of a 10-week series of clinical simulations involving standardized patients (actors trained to portray patients with simulated medical conditions).[12] Students are divided into laboratory groups of 8-10, and placed under the tutelage of a pharmacist teaching assistant. At the beginning of the course, students are introduced to a fictional, multi-generational “family.” Over the 10-weeks of the course, family members (portrayed by standardized patients) visit the simulated pharmacy setting, interacting with the pharmacist. In certain weeks, standardized patients return for follow-up visits, in order to model disease progression and to emphasize continuity of care. In addition, the course has been mapped out to emphasize connectivity among different family members; for example, in week 3, a teenage girl visits the pharmacy to have a prescription for oral contraceptives filled, and to receive counseling on safer sex; in week 7, her irate father appears insisting on speaking with the pharmacist who dispensed these medications without his knowledge.

PPL attempts to recreate the environment of a typical community pharmacy through the innovative use of clinical simulations involving standardized patients. Each case within the course is designed to portray complex clinical and psycho-social issues, and since patients may re-appear in future sessions, students are required to maintain clinical records and notes, engage in monitoring and follow-up, and provide

pharmaceutical care. A global assessment system is used in this course, in which integration of students' clinical knowledge and communication skills is required in order to successfully address critical issues in the case.

Students in the program take the PPL course during their final year, along with several other courses, including advanced pharmacotherapeutics. The sequence of cases was designed to complement the course schedule in pharmacotherapeutics and to provide reinforcement and clinical application of material learned in this course. This means that students may attend a case-based lecture in a certain therapeutic area at the end of one week, and then be required to apply this information in a clinical simulation the next week. Thus, students in this course (who were participants in this study) are learners and novices without significant clinical experience or expertise, who have an on-going need for reinforcement of their learning.

Methods

Students in PPL were provided with training in use of a PDA device (Palm Pilot Vx®) and a free-ware program (*ePocrates*). The *ePocrates* program is freely available and downloadable from the Internet (www.epocrates.com) and may be used by clinicians, students, or the general public at no cost. An enhanced version of this program is also available for cost. *ePocrates* was selected for this study since it is also frequently used by pharmacists due to its ease of access, relatively rapid updating of information, ease of use, and lack of subscription or on-going costs. As part of this study, a one-hour tutorial was provided to all students on the use of this program.

Following this training session, students began the PPL (clinical simulation) course described previously. For each simulation, students were provided with both the PDA (loaded with *ePocrates*) as well as standard pharmacy reference textbooks. The reference textbooks sources were made available to students should they require them as part of their role-playing in the clinical simulation. Students were not required to utilize either the PDA or the textbook based references; these were simply made available to students to more realistically simulate a clinical setting and to provide them with support as learners.

Following each clinical simulation role play, students reported the number of times they utilized either print-based textbooks or the PDA, and the nature of this utilization (ie, reason for "looking up" information). These reports were collected and analyzed. At the end of the course, two focus groups with randomly selected students were convened to discuss results and guide data interpretation.

This study was undertaken over a two-year period with 2 consecutive senior level classes. The class of 2000 consisted of 117 students and the class of 2001 consisted of 120 students.

Results

No statistically significant differences were noted between the class of 2000 and the class of 2001, or between male and female students in their utilization of the PDA or text-based references during clinical simulations. Consequently, for convenience, data are reported and analyzed for a single cohort of 237 students, rather than two different cohorts.

Figure 1 illustrates the frequency of use of text-based references and the PDA across the 10-weeks of the clinical simulation course. Each time a reference book was consulted or the PDA utilized during the simulation, it was counted as an independent event (eg, if a student consulted a reference to verify a dose on a prescription at the beginning of the simulation, then consulted the same [or a different] reference later in the simulation to learn about side effects, this counted as two events). In some weeks the total number of consultations was less than 237, since not all students consulted a reference (PDA or text) during the course of a simulation.

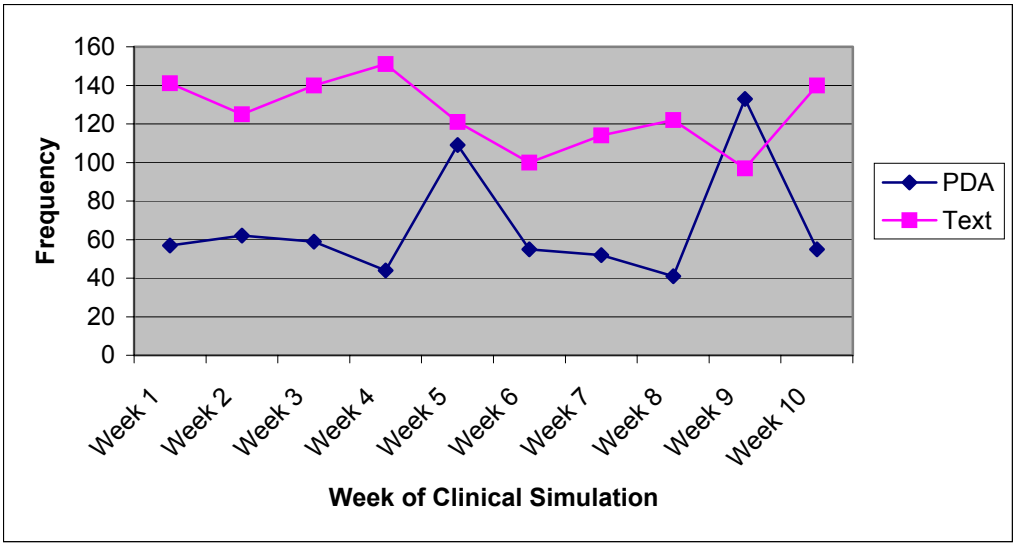

Figure 1. Frequency of Use of Textbooks or PDA

Figures 2a and 2b illustrate the reasons for consulting references and a comparison of type or references used (textbooks or PDA), based on category. Table 1 provides demographic and background information about student-participants in this study, including sex, age, previous experience with computers and PDAs, and previous clinical experience.

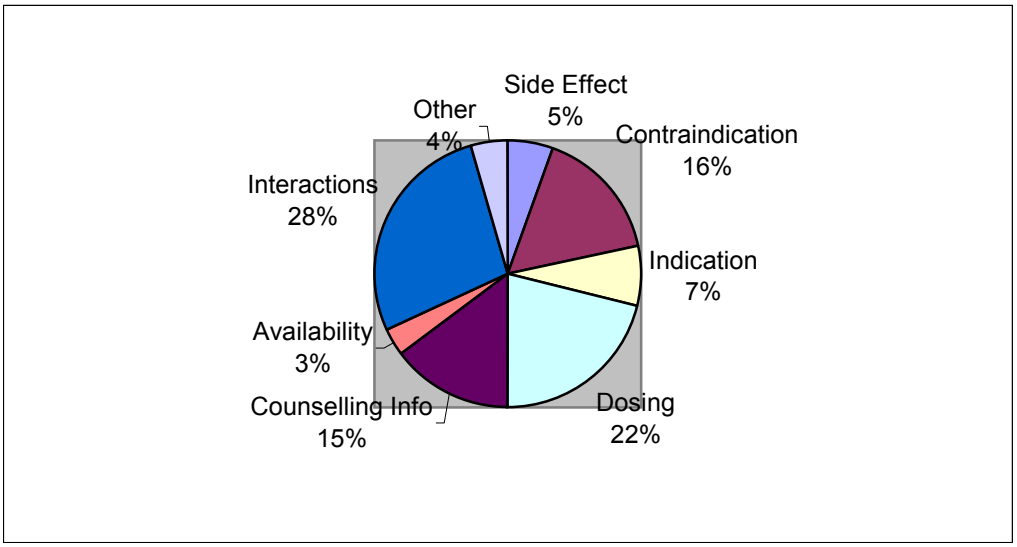

Figure 2a. Reasons for consulting PDA or Textbooks

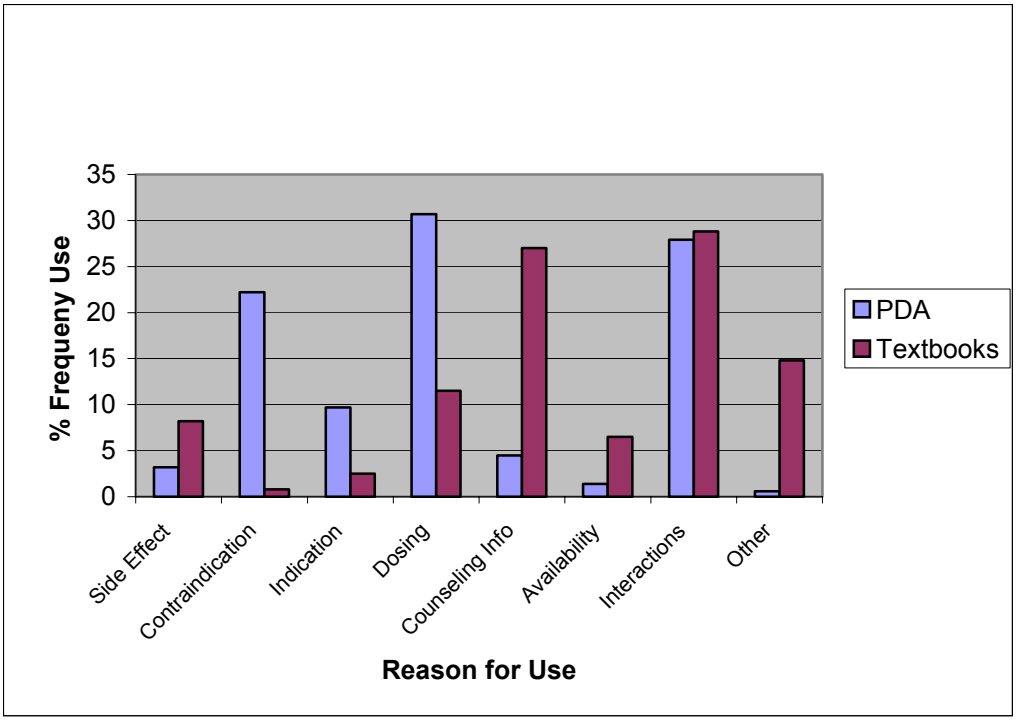

Figure 2b. Comparison of use of PDA vs. Textbooks

Table 1. Demographic profile of students (n=237)

Male	95/237 (=40.1%)
Female	142/237 (=59.9%)
Age (mean ± S.D. and range)	24.8 ± 2.9 (range: 22 – 57)
Own PC	Male: 89/95 (93.6%) Female: 127/142 (89.4%)
Own PDA	Male: 41/95 (43.2%) Female: 55/142 (38.7%)
Previously Used PC in Pharmacy	237/237 (100%)
Previously Used PDA in Pharmacy	Male: 12/95 (12.6%) Female: 6/142 (4.2%)

Discussion

Demographic information regarding students' familiarity and comfort with use of technology was confirmed through focus group discussions. In general, participants demonstrated a relatively high degree of comfort with PDA technology, and many (40.5%) owned their own PDA (usually a Palm Pilot) prior to involvement in this study. All students surveyed indicated they had used computers in the past within a pharmacy practice setting and the vast majority (91.1%) indicated they owned a personal computer. In focus group discussions, students indicated a high degree of comfort with use of technology in pharmacy education and practice, and an expectation that they would be required to access technology and electronic databases as part of their undergraduate education and post-graduate training and practice. Male students reported greater ownership and familiarity with computers and PDAs.

Analysis of data from this study illustrates differential utilization of textbook references and the PDA-based *ePocrates.* For this study, commonly occurring textbooks in Canadian pharmacy practice were made available to students, including the *Compendium of Pharmaceuticals and Specialties* (CPS, a compilation of drug-specific monographs similar to the *Physicians' Desk Reference* in the US),

Therapeutic Choices (a standard reference providing algorithms for treatment of commonly occurring medical conditions), *Martindales (The Extra Pharmacopoeia),* as well as a commonly-used pharmacotherapeutics textbook, such as DiPiro's *Pharmacotherapy).*

As illustrated in the data, students generally preferred use of the print-based textbooks over use of the PDA, despite expressing general comfort and familiarity with use of the PDA device. Over the 10 weeks of the course, textbooks were consistently used more frequently than the PDA, with the exception of week 9. The difference in utilization frequency narrowed somewhat over the course of 10 weeks, but not in any statistically significant manner. Interestly, frequency of PDA use also spiked at week 5.

Focus group discussions with students provided insight into the spiked frequencies at weeks 5 and 9. In both of these sessions, clinical simulations involved complex disease states (HIV/AIDs in week 5 and cancer chemotherapy in week 9). Students indicated that they switched to use of PDAs for these sessions simply because they believed that information in the printed textbooks would not be as up-to-date as what they could find in the PDAs, which were updated off the *ePocrates* website on a monthly basis. However, students also reported first seeking information in the textbook, then moving to the PDA only when they believed the textbook was inadequate for their information needs. This propensity to first access written textbooks, then move to the PDA was confirmed over the course of the 10-weeks, and was consistent between the two cohorts studied.

Data regarding reasons for use of PDAs vs. textbooks similarly illustrates significant differences. In focus group discussions, students were asked to reflect upon their experiences during the study and provide reasons for these findings. There was broad agreement that one key reason for differences in utilization of PDAs vs textbooks related to the way in which data was presented in these different media. Students indicated that with a textbook, it is possible to scan multiple sections of a drug monograph or a chapter in a quick and efficient manner. Students found this to be a particularly useful feature of textbooks in situations in which they were not certain of which specific piece of information they required. For such ambiguous information, the ability to scan a broader array of information was an important problem-solving strategy for students.

One student provided an example related to side effects. During the clinical simulation, the patient reported feeling "tense" and "tight" muscles and wanted advice regarding appropriate analgesia. The student had previously identified that the patient had recently started on a statin for hyperlipidemia and the student suspected that this temporal link was important. Having only recently completed a lecture in pharmacotherapeutics of hyperlipidemia, the student's knowledge base was somewhat weak and he needed to confirm his suspicion:

"*That's the problem with the [PDA]. It's great if you know exactly what you need – like the dose of the drug, or a drug interaction. But if you're trying to figure something out – like this side effect – well, it's not going to list tense or tight muscles like that. But when I checked [the reference text] and did a quick read of the side effects section [of the drug monograph], there it was."*

As this student's experience suggests, participants' perception of the utility of the PDA appeared to be a function of the specific circumstance in which information was required. In circumstances in which students felt confidence in knowing what piece of information was required, the PDA was accessed preferentially over textbooks. Examples of such situations included verification of dosing, identification of specific drug-drug or drug-food interactions, or identification of contraindications. In other circumstances, where the information need was somewhat less defined, more ambiguous, or where the problem was not entirely clear to the student, preference appears to have been given to use of textbooks. Examples of such situations included providing general counseling information, identifying mechanism of action/pharmacological activity of a medicine (categorized under "Other" in Figures 2a and 2b), or trying to establish a causal link between emergence of a side effect and initiation of a new drug.

In focus group discussions, students identified the value associated with scanning a drug monograph for information, particularly when they were unsure as to how best to proceed. On many occasions, they described how scanning for information in a textbook appeared to provide important cues to them for further information gathering or questioning of the patient and suggested potential solutions to problems. In contrast, the small size of the PDA screen, coupled with its inherent text limitations and somewhat awkward scanning facilities, limited the utility of the PDA in such circumstances.

Interestly, students themselves identified how each type of resource (eg, PDA or textbook) could be most efficiently and effectively used. During clinical simulations, the students acted in a consistent and predictable manner, regardless of their underlying propensity towards use of technology, previous experience with PDAs, or previous clinical experience. Despite lack of formal instruction regarding optimal circumstances for use of textbooks vs. use of PDAs, students appeared to develop and use a series of informal rules governing how to optimize success in clinical simulations and information acquisition.

Limitations

A major limitation of this study is the use of only one PDA-based platform, *ePocrates.* Currently, there are many different software programs available. *ePocrates* was selected because it was freely available, had no cost, and was generally well recognized within the pharmacist community. However, its interface may not be as sophisticated as other programs, consequently limiting students' ability to scan. Thus, conclusions of this study may not necessarily apply to PDAs in general, or other PDA-based programs (including the for-pay version of *ePocrates*) specifically.

Methodologically, this study relied upon self-reporting and self-reflection by students regarding their performance in clinical simulations. Such methods may be imprecise and suffer from time-linked memory deterioration. Alternative methods for tracking utilization on the PDA could be used that do not rely upon self-reporting and observers could also be used to track utilization of textbooks to improve accuracy of reporting.

Conclusions

While there appears to be little doubt that technology is an important facilitative tool for pharmacy education, this study has illustrated both important strengths and limitations of a specific technology and software platform. Students in this study appeared to generate a series of tacit, consistent rules to assist them in identifying circumstances, in which accessing textbooks would be more strategically advantageous than using a PDA and vice-versa. Students' information-seeking behaviours illustrate the importance of visual scanning of information (such as a drug monographs) in helping them to identify, frame and solve certain kinds of clinical problems. The nature of printed textbooks facilitates such scanning and allowed students an opportunity to make connections between clinical cases and drug information resources. Though seemingly time-inefficient, the act of flipping through a textbook appears to be an important step in problem solving for some students. When confronted with an unfamiliar situation, students appear to be able to derive cues from textbooks in a more meaningful way than from the PDA. Conversely, in situations where students are more certain of their information need, the PDA appears to be a more useful and efficient resource. Features such as pull-down menus facilitate access to specific facts without the distraction of scanning text.

Despite comfort with the technology platform, students' learning needs are such that textbooks still appear to be an important tool for development. While it may be argued that some digital media (such as PC Pads) can recreate the scanning facility afforded by textbooks, further research will be required to confirm whether such technology will actually change students' information-seeking behaviours.

It appears that PDAs are an important complement to, but not a replacement for, textbooks in pharmacy education. Students in this study self-adapted to the differing strengths and limitations of each media,

and appeared to evolve a self-regulating system for optimizing use of resources within the context of a clinical simulation. Further research in information seeking behaviours of students is required to understand this important skill; in the mean time, it appears that print-based textbooks will continue to have an important role in pharmacy education.

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