Metacognitive Factors that Impact Student Nurse Use of Point of Care Technology in Clinical Settings

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Abstract

The utility of personal digital assistants (PDA) as a point of care resource in health care practice and education presents new challenges for nursing faculty. While there is a plethora of PDA resources available, little is known about the variables that effect student learning and technology adoption. In this study nursing students used PDA software programs which included a drug guide, medical dictionary, laboratory manual and nursing diagnosis manual during acute care clinical experiences. Analysis of student journals comparative reflective statements about the PDA as an adjunct to other available resources in clinical practice are presented. The benefits of having a PDA included readily available data, validation of thinking processes, and facilitation of care plan re-evaluation. Students reported increased frequency of use and independence. Significant correlations between user perceptions and computer self-efficacy suggested greater confidence in abilities with technology resulting in increased self-awareness and achievement of learning outcomes.

KEYWORDS: metacognition, self-regulated learning, point-of-care, healthcare technology
Having access to evidence based information at the point of care is an accepted standard in the current health care environment. This demand is related to the vast amount of knowledge nurses need to have and which requires competence and independence in data collection, resource use, information prioritization, and decision making (Huffstutler, Wyatt, & Wright 2002). One of the primary reasons for encouraging access to point of care resources is linked to recent research that shows a decrease in medical errors and improvements in the quality of care (Robinson & Burk, 2004; Yu, Houston, Ray, Garner, & Berner, 2007). Personal digital assistant (PDA) technology can provide the support needed to achieve these competencies which would influence patient health outcomes such as cost reduction and demands for care (Rempher, Lasome, & Lasome, 2003; Scordo, Yeager, & Young, 2003; Sloan & Delahoussaye, 2003; Tooey & Mayo, 2003; Yeager & Young, 2003). Using a PDA allows an efficient workflow so nurses can spend time improving health care delivery (Tooey & Mayo, 2003).

The driving forces behind improving clinical technical competence in nursing are the International Medical Informatics Association – Nursing Informatics working group (IMIA-NI), American Association of Colleges of Nursing (AACN), and National League for Nursing (NLN). The IMIA-NI (2009) supports the development of nursing informatics in member countries and promotes nursing informatics worldwide by promoting linkages and collaborative activities with national and international nursing and health care informatics groups and nursing and health care organizations globally. They strive to develop recommendations, guidelines, tools and courses related to nursing informatics for publication, and dissemination of research and development materials. The AACN advocates for incorporating technological advancements in nursing education curricula. The NLN Board of Governors issued a position statement in 2008 which mandates “Preparing the Next Generation of Nurses to Practice in a Technology-Rich Environment”.

An NLN survey of nursing faculty and administrators on informatics content in curricula resulted in some recommendations such as faculty development in informatics competency, informatics integration into courses, and informatics use in clinical agencies for students (Thompson & Skiba, 2008). The charge to faculty in nursing programs is to prepare nurse graduates in the 21st century to have competence in clinical reasoning skills and computer technology. The PDA technology provides instant access to clinical data and treatment options that may be in textbooks, medical records, or on the Internet. Information stored on a PDA provides access to databases at the bedside which benefits productivity (McCord, 2003; McCreadie, Stevenson, Sweet, & Kramer, 2002; Scordo et al.,
2003; Thompson & Skiba, 2008). Teaching students diagnostic reasoning and decision making based on research generated evidence can be supported with interactive PDA technology (Rempher et al., 2003).

The major premise of this study was that education and health care technology outcomes could be achieved using PDA’s to guide nursing practice as students build cognitive and metacognitive awareness, knowledge, and skill over time to foster critical thinking and clinical reasoning (Gravill, Compeau, & Mardolin, 2002). Specifically, the purpose of this research was to describe the relationships between student characteristics, PDA use, computer user perceptions, computer self-efficacy and self-regulation of learning. It was hypothesized that training and use of PDA devices would improve confidence in computer ability, computer self-efficacy, and clinical reasoning skills.

PDA RESOURCES AT THE POINT OF CARE

The PDA makes it possible for the nurse to access large volumes of regularly updated clinical information in practice. This is essential since information systems are becoming ever more essential to quality practice (Huffstutler et al., 2002; Rothwell, 2002). The user can store data and access it later with the use of a modem for synchronization with home computers (McCord, 2003; Tooey & Mayo, 2003). Many subscribers to PDA technology believe it will not only increase efficiency, but will also help to reduce medication errors and reduce costs (Tooey & Mayo, 2003; McCreadie et al., 2002; Rothwell, 2004). A few comprehensive surveys conducted by EPocrates TM (2007), solicited information from 558 nurse users and showed that respondents believed the new technologies such as electronic medical records (EMRs) and clinical information on mobile devices (PDAs and smartphones) may have a positive impact on the quality of health care. In addition, a survey of 3,828 physicians revealed that more than half report avoiding at least one medication error per week with technology resources (EPocrates).

It is estimated that PDAs could save up to one hour per shift of nursing time which could be devoted to direct patient care rather than charting, waiting to chart, or waiting for access to the computer (Eastes, 2001; McCord, 2003; Meyer, Sedlmeyer, Carlson, & Modlin, 2003; Rempher, et al., 2003; Rothwell, 2004; Tooey & Mayo, 2003). In addition, the PDA is less intrusive or threatening to patients due to their smaller size compared with larger computers (Tooey & Mayo, 2003). Personal digital assistant software has been successfully tested as an electronic collection device to track, monitor and investigate outcomes of
associated services provided by an infusion therapy team (Goss & Carrico, 2002), and for peri-operative staff to easily and efficiently access surgical procedural requirements, make clinical notes and move collected data to peri-operative databases for storage (McCord, 2003).

Despite the many advantages of PDAs, not all nurses are comfortable with the technology nor can they afford the devices (Scordo et al., 2003; Yeager & Young, 2003). Other disadvantages are the issues of theft and losing the device in the clinical area. Privacy concerns are an issue with current privacy regulations (Health Insurance Portability and Accountability Act of 1996) (HIPAA) which will impact the use of portable electronic devices and/or if they are lost or stolen (Goss & Carrico, 2002; Scordo et al., 2003). This is being addressed using software that provides data encryption and identification locks for device access. Other limitations include the small size of the PDA screens (Garrett & Jackson, 2006; Tooey & Mayo, 2003), software programs which may not undergo peer review or be written by experts in the field (Scordo et al., 2003; Yeager & Young, 2003) and limited memory space (Tooey & Mayo, 2003).

**Integrating Point of Care Technology into Nursing Curricula**

Computer technology is an essential tool that has influenced the professional practice of nursing. It is imperative that faculty provide integration into clinical instruction for access to data that supports patient care and informs decision making for students (Meyer et al., 2003; Sloan & Delahoussaye, 2003). It is hypothesized that nursing students introduced to PDA technology early in their career may be more accepting of other technologies or be a change agent to support PDA use in workplace (Meyer et al., 2003).

There is a growing body of research on nursing student use of PDA technology. In an Australian program, a quasi-experimental, non-equivalent experimental group design was used to measure PDA effectiveness in promoting pharmacologic knowledge and decision support in clinical practice. Focus group discussions with the 41 students in the PDA group stated that the PDA improved their pharmacology knowledge acquisition, found the device easy to use, and beneficial to their learning (Farrell & Rose, 2008). In a descriptive survey of 190 undergraduate nursing students who used PDAs in clinical practice, it was shown that they were most likely to use clinical drug guides than other programs (Altman & Brady, 2005). Other recent studies have found enhanced drug knowledge and self-efficacy in medication administration with PDA use (Garrett & Jackson, 2006; Altman & Brady, 2005; Greenfield, 2007; Pattillo, Brewer, & Smith, 2007).
An evaluation of technology integration in a community health course used wireless PDA technology with a sample of 30 students to send home visit reports to faculty. They were compared to 24 students who used traditional methods of reporting (Sloan & Delahoussaye, 2003). The purpose of this non-experimental study was to show that new graduates could be prepared to use technology skills.

In a study of 6 nurse practitioner students who used PDAs during a clinical experience as an alternative to bringing multiple textbooks to clinical sites, researchers found that PDAs permitted more time with patients, improved learning with information at the point of care, and personalized the physical examination of patients (Koeniger-Donohue, 2008). Another survey of nurse practitioner students found that 67% of faculty and students used PDAs and reported the device supported clinical decision making (96%) (Stoud, Erkel, & Smith, 2005). The gap in this body of research is the relationship between computer use, computer self-efficacy, and the PDA influence on metacognitive thinking for clinical reasoning.

CONCEPTUAL FRAMEWORK

Metacognition and Information Technology

Metacognition refers to the individual’s ability to self-monitor and self-regulate learning. This is influenced by self-efficacy, or the belief that one can do a task, and self-awareness, or the ability to compare current behavior to internal standards and values. Research with information technology has found that greater confidence in computer ability resulted in increased self-awareness and improved learning outcomes (Gravill et al., 2002). One method to measure metacognition is with the Self-regulated Learning Model (SRLM). This model was operationalized through journal prompts to support the conceptual relationships of metacognitive processes, behavioral processes and environmental structuring in educational settings (Bandura, 1997). For example, self-observation of behaviors using technology may lead to thinking about patient reactions to the device and discretion about appropriate environmental manipulation.

Technology Acceptance Model

A force that drives the self-efficacy or belief that one can use a computer is whether technology is accepted by the user. The Technology Acceptance Model (TAM) based on the “Theory of Reasoned Action” (Fishbein & Ajzen, 1975) was developed after it was discovered that the major factors of perceived usefulness
and ease of use, highly impacted the acceptance of computers (Venkatesh, Morris, Davis, & Davis, 2003). In other words, people would use computers if they perceived benefits from that use, and that behavioral intentions to use computers were influenced by attitudes toward using technology.

The Computer User Perceptions questionnaire, based on the TAM, has items of perceived usefulness, perceived ease of use, attitude toward using, and behavioral intentions to use. It has a Cronbach’s alpha reliability for the four constructs that exceeds 0.80, with all factors loading in excess of 0.7 (Morris & Dillon, 1997). It was concluded that intentions are the strongest predictor of future behavior and gathering user perceptions of usefulness and ease of use accurately assesses whether that system device will ultimately be accepted. It has been argued that there are other influencing variables for computer use such as self-efficacy, which is the belief that one can do a task, and self-monitoring the behavioral intentions for that task. Conclusions drawn from this research based on Social Cognitive Theory, were that computer self-efficacy refers to judgments of ones capability to use a computer (Morris & Dillon, 1997).

Another instrument used with the TAM is the Computer Self-Efficacy Measure based on Social Cognitive Theory (Compeau & Higgins, 1995). Internal consistency reliability exceeds 0.80 with all factors meeting the 0.70 criteria for loading. Testing with a random sample of 2000 business community members revealed that individuals with high self-efficacy used computers more, enjoyed their use, and experienced less anxiety. These measurements were used in the current study to test PDA technology use in a group of senior nursing students.

**METHODS**

**Design**

A repeated measures design was used to describe the metacognitive strategies, computer perceptions and computer self-efficacy of students who used a PDA for 8 weeks of an acute care clinical experience. It was hypothesized that repeating the measures would show changes in computer self-efficacy over time and assist future educators in timing the support students would need to adopt technology in clinical settings.
Setting and Sample

Clinical experiences took place in a tertiary level 2 trauma facility and a community hospital from the southeastern region of the United States. Twenty-six baccalaureate student nurses in a senior level medical/surgical course volunteered to participate during two separate academic semesters. All students were English speaking and reflective of regional admission criteria. The mean age was 23.42 years (20-33), 88% (n=23) were female, and 11% (n=3) were male. All students were Caucasian and 73% (n=19) were unmarried. The majority, 82%, had worked in health care for a mean of 2.91 years (0-16). The mean course load was 14.54 credit hours (12-17) and the mean GPA was 3.36 (2.3-3.9).

Instruments

The journal prompts were developed and based on the SRLM and validated by experts (inter-rater reliability coefficient .7 to.9) to determine consistency to reflect the self-regulated learning processes. Each participant completed weekly journals as an independent activity, were instructed to think and write about whatever came to mind as they read the prompts and reflected on clinical experiences. Confidentiality was maintained by assuring the students that journals would not be evaluated as course work and would have no impact on course grades. The researcher who was not the clinical instructor reviewed the journals weekly for verbal content and transcribed the narratives into word processing files as a separate clinical assignment for research purposes only.

The Computer User Perceptions Questionnaire was revised to capture perceptions of PDA usefulness, ease of use, attitude toward using, and behavioral intentions to use. The Computer Self-Efficacy Measure was administered to capture the self-efficacy construct and serve as convergent validity with self-regulated learning strategies to determine metacognitive activities surrounding PDA use. The PDA clinical log was developed to measure the actual real time use of PDA software and as a record of critical incidents requiring technical support.

Procedures

Prior to starting the clinical practicum, ethics board approval was obtained, the study was explained to the students and clinical faculty, voluntary informed consent was obtained, and the research instruments were administered. The students completed the demographic questionnaire and the Computer User Perception Questionnaire at week one of the study, and the Computer Self-
Efficacy Measure at weeks 2 and 8 of the study. The PDA Clinical Log was kept by the students to record any technology issues during the course of the semester. Prior to all clinical experiences, the students were oriented to the PDA mechanical functions, technological accessories, and software operations. Students were supplied with contact information to reach technical support in the event any technical problems arose. All completed instruments, PDA logs, and reflective journals were coded with a number to protect student identity, and were kept in locked files in the researcher’s office for security.

DATA ANALYSIS

Qualitative Analysis

Metacognitive strategies were determined with content analysis by the use of retrospective verbal protocol analysis (RVPA) which is a framework to focus on written or verbal data to reveal the sequence of cognitive events that occur between the introduction of information stimuli and the decision outcomes (Ericsson & Simon, 1993). If the data satisfy the criterion of relevance, consistency and memory, it can be used to denote underlying cognitive processes. The three progressive steps to protocol technique are referring phrase analysis to identify the vocabulary and focus of concepts, assertional phrase analysis to identify the relationships between concepts that make up the epistemology for the domain being studied, and script analysis to identify the themes and strategies used during reflection. Research has shown that RVPA is suitable for data that focuses on the decision outcome of tasks (Kuusela & Paul, 2000). The outcome of this content analysis will show the extent that metacognitive self-regulated learning is used by students with PDAs.

The analysis of the journals revealed that the primary referring phrases were linked to time related issues searching for data or carrying out interventions, thinking strategies including the use of PDA resources, clinical situations using the PDA, interactions with personnel as an adjunct to PDA resources, and environmental circumstances, approximating 58% of the words in the narratives (Figure 1). Figure 2 shows the assertion phrase analysis revealing that comparative thinking statements were used the majority of the time (38 – 47%). The specific script analysis, as it relates to PDA use, reveals that the students relied on different resources for point of care activities and clinical assignments. The PDA was included in the repertoire of available resources along with colleagues, faculty, staff, the medical record, library, and the Internet. Some of the students found that data were “more readily available” and “easier to find” on the
PDA and did rely on it in the clinical area. The PDA was also “better than carrying around textbooks” and “validated thinking processes”. One student returned to the PDA to re-evaluate care plans; “When I use the PDA, I feel confident about actions, interventions, and return to the PDA for re-evaluating”. A primary advantage of having the PDA in the clinical area is “to try looking up answers myself in the PDA and then ask for explanations from the nurse.”

Figure 2. Percent of assertion statements used in weekly reflective journals (N=26).
Quantitative Analysis

Table 1 shows the analysis of the PDA clinical log. The mean clinical use was 1.55 hours, at home on weekdays 1.64 hours, and at home on weekends 1.24. The programs with the greatest use were the drug guide, medical dictionary, and nursing diagnosis program. Issues related to technical support were insignificant.

Table 1
PDA log entries (N = 26)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean Hours</th>
<th>Range in Hours</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of use in clinical</td>
<td>1.55</td>
<td>0-30</td>
<td>3.06</td>
</tr>
<tr>
<td>Duration of use at home on</td>
<td>1.24</td>
<td>0-8</td>
<td>1.41</td>
</tr>
<tr>
<td>weekends</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of use at home on</td>
<td>1.64</td>
<td>0-35</td>
<td>3.03</td>
</tr>
<tr>
<td>weekdays</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean Incidents</th>
<th>Incident Range</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific software use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drug guide</td>
<td>4.59</td>
<td>0-25</td>
<td>4.75</td>
</tr>
<tr>
<td>Medical dictionary</td>
<td>2.76</td>
<td>0-30</td>
<td>5.21</td>
</tr>
<tr>
<td>Nursing diagnosis</td>
<td>2.40</td>
<td>0-15</td>
<td>2.85</td>
</tr>
<tr>
<td>Word program</td>
<td>2.07</td>
<td>0-20</td>
<td>3.66</td>
</tr>
<tr>
<td>Laboratory manual</td>
<td>1.57</td>
<td>0-11</td>
<td>1.96</td>
</tr>
<tr>
<td>IV drug guide</td>
<td>.86</td>
<td>0-20</td>
<td>2.24</td>
</tr>
<tr>
<td>Other software</td>
<td>.74</td>
<td>0-22</td>
<td>2.63</td>
</tr>
<tr>
<td>Hardware problems</td>
<td>.09</td>
<td>0-5</td>
<td>.59</td>
</tr>
<tr>
<td>Software problems</td>
<td>.27</td>
<td>0-3</td>
<td>.61</td>
</tr>
<tr>
<td>Correct problems yourself</td>
<td>.03</td>
<td>0-1</td>
<td>.19</td>
</tr>
<tr>
<td>Asked for help for problems</td>
<td>.04</td>
<td>0-4</td>
<td>.34</td>
</tr>
</tbody>
</table>

Table 2 shows the results of the cross-tabs and chi-square tests to compare pre to post tests on the Computer Self-efficacy Measure. The acceptable level of error was set at ≤.05 considering the study procedures and sample size. A significant improvement in confidence was revealed from the second to the eighth week for completing assignments using PDA software independently and completing assignments using PDA software with the built-in help feature. The students tended to strongly disagree that the PDA was frustrating to use, worrying about losing data on the PDA, and that the PDA was intimidating. They tended to strongly agree with frequently using the PDA in the clinical setting. A weak significant correlation was found for use of the laboratory manual and the item on the Computer Self-efficacy Measure (I could complete assignments using the PDA if I had a lot of time to use the software) ($r = -.42$, $p = .009$).
Table 2
 Pre to Post Test Scores for items on the Computer Self-Efficacy Measure (N=26).

<table>
<thead>
<tr>
<th>Variable</th>
<th>X^2</th>
<th>df</th>
<th>p</th>
<th>Kappa</th>
<th>ASE</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I could complete the assignments using the software on the PDA, if there was no one around to tell me what to do. (very confident)</td>
<td>11.26</td>
<td>1</td>
<td>.000</td>
<td>-.02</td>
<td>.09</td>
<td>-.20, .162</td>
</tr>
<tr>
<td>8. I could complete the assignments using the software on the PDA, if I had the built-in help feature for assistance. (very confident)</td>
<td>5.4</td>
<td>1</td>
<td>.020</td>
<td>-.10</td>
<td>.14</td>
<td>-.39, .19</td>
</tr>
<tr>
<td>24. Using the PDA is frustrating for me. (disagree)</td>
<td>6.4</td>
<td>1</td>
<td>.01</td>
<td>.24</td>
<td>.14</td>
<td>-.04, .54</td>
</tr>
<tr>
<td>27. It scares me to think that I could lose a large amount of information by making the wrong selection on the PDA. (disagree)</td>
<td>8.66</td>
<td>3</td>
<td>.03</td>
<td>.28</td>
<td>.14</td>
<td>-.00, .57</td>
</tr>
<tr>
<td>29. PDA’s are somewhat intimidating to me. (disagree)</td>
<td>12.0</td>
<td>3</td>
<td>.00</td>
<td>.18</td>
<td>.09</td>
<td>.00, .37</td>
</tr>
<tr>
<td>30. I used the PDA frequently in the clinical setting (agree)</td>
<td>14.0</td>
<td>3</td>
<td>.00</td>
<td>.11</td>
<td>.06</td>
<td>-.01, .24</td>
</tr>
</tbody>
</table>

* p ≤ .05

Significant moderate correlations existed between items on the Computer User Perception Questionnaire and the Computer Self-Efficacy Measure pre-test. Students perceived that operating the PDA would be easy if software manuals were available as a reference (r = -.49, p < .05). The PDA would improve clinical performance if there was confidence that the PDA would assist with organization (r = -.59, p < .05), and would increase chances of doing a better job on assignments (r = -.49, p < .05). It was likely that effective use would be associated with less apprehension with the device (r = -.58, p < .05), and the less the PDA intimidated them (r = -.63, p < .05). The PDA would enhance clinical effectiveness if students received orientation first (r = -.55, p < .05).

Students who felt ease of use were also confident that it would probably increase the quantity of work output (r = -.60, p < .05), if they were not apprehensive (r = -.52, p < .05), were not fearful of making mistakes (r = -.54, p < .05), and were not intimidated by the device (r = -.63, p < .05). If they thought influential people promoted PDA use, they were confident that colleagues would perceive them competent (r = -.53, p < .05) and it would increase the chances of doing better on assignments (r = -.50, p < .05). Students intended to use the PDA frequently if there was confidence with software programs (r = -1.0, p < .05).
Significant correlations between some items on the Computer User Perception Questionnaire and the Computer Self-Efficacy Measure post-test reveal that it was likely that the PDA would improve clinical performance if students were confident that it would increase work effectiveness \( (r = -.51, p < .05) \), increase the quantity of output \( (r = -.51, p < .05) \), and increase the sense of accomplishment \( (r = -.45, p < .05) \). The PDA would most likely increase productivity in clinical if students were confident that it would increase effectiveness in clinical \( (r = -.67, p < .05) \), increase the quantity of output \( (r = -.67, p < .05) \), less reliance on support persons \( (r = -.52, p < .05) \), and looked forward to having to use the PDA \( (r = -.59, p < .05) \). Finally, using the PDA was perceived as being positive if someone was available for help \( (r = -.69, p < .05) \) and if there was orientation to the device \( (r = -.69, p < .05) \).

**LIMITATIONS**

The greatest limitations to the study were the sample size, voluntary participation and selection from a singular area of the Southeastern USA which affects transferability of findings to other educational environments. Some other effects that may have impacted the findings were prior use of self-regulated learning strategies for journals and prior use of PDA’s. Reliability of the content analysis was accomplished by providing an audit trail for points of agreement and disagreement for the retrospective verbal protocol analysis.

**DISCUSSION**

The training and use of PDA devices and software did improve confidence in computer ability, computer self-efficacy, and clinical reasoning skills as measured in this study. Content analysis of journals based on the SRLM model revealed the ability to self-monitor and self-regulate surrounding PDA use in clinical practice. For some students the PDA was very significant as a data repository, while for others it became a help aid for thinking and validating and re-evaluating clinical work. The PDA was helpful in reducing the time related to search for data to carrying out interventions, and as a thinking strategy resource in clinical situations. Similar to other research, the PDA improved access to drug knowledge, was easy to use, and was beneficial to learning (Altman & Brady, 2005; Farrell & Rose, 2008; Garrett & Jackson, 2006; Greenfield, 2007; Pattillo, Brewer & Smith, 2007). One theme that was evident in the journals and significant on the surveys was instruction and orientation to the device. The significance of training for successful adoption is a recurring theme in the literature. Students have to be motivated to learn and practice with the device to
master its use (Hedman & Sharafi, 2004). While the barriers of screen size, information privacy, and lack of familiarity with technology has been identified by other authors, they were not issues with this sample of senior nursing students.

Correlating student demographic characteristics with the computer user, computer self-efficacy, and PDA log measurements did not reveal any significant relationships, which has also been previously reported. The significant use of the drug resource has been reported with medical residents, nurse practitioner students and other undergraduate students (Yu et al., 2007). However, this sample also used the medical dictionary and the nursing care planning reference which may be related to specific clinical assignments. The programs with the greatest use were the drug guide, medical dictionary, and the nursing diagnosis program.

The acceptance of PDA technology by these students was a mitigating factor in enhancing the self-efficacy or belief that the computer was useful. The increased ease of use led to lessened anxiety and greater self-efficacy with the PDA as a point of care reference. Students perceived ease of use with available software manuals, improved self-efficacy and confidence due to better organization because of the PDA, and ultimately better outcomes of their work. The practice with the device decreased anxiety and enhanced thinking effectiveness. These findings were substantiated by other researchers who concluded that individuals with high computer self-efficacy used them more, enjoyed their use, and experienced less anxiety (Compeau & Higgins, 1995; Gravill et al., 2002; Morris & Dillon, 1997; Venkatesh et al., 2003). Significant correlations between computer user measures and computer self-efficacy revealed that the PDA improved clinical performance if there was confidence that it would increase work effectiveness, output, and increase the sense of accomplishment. While it was perceived that there still needs to be a support person available for help in this study, greater confidence in computer ability could result in increased self-awareness and learning outcomes as noted by Gravill et al., (2002).

**IMPLICATIONS**

Through this research, best pedagogical practices in nursing education can be determined with regard to maintaining PDA technology as a clinical resource for all students as part of current standard practices. Students are still dependent on other resources which may be appropriate in some situations, but as technology advances, faculty can help the nurses of the future adjust and desire to participate in developing new technology that emerges in the work world. If student confidence and self-efficacy in using computer technology can be increased
during educational experiences, perhaps so can the life-long self-managed learning habits as these relate to changes in health care technology.

The characteristics of PDA users have been described over the last decade. Future research should be directed at evaluating the metacognitive and cognitive processes at the point of care with technology use. This could easily be evaluated with verbal protocol technique to discover the nuances of nurse interaction with technology at the bedside for the purpose of streamlining and fine tuning devices and software that permit the most efficient use of time and resources. If there remains a need for conventional resources, then what are they and how can technology be an adjunct? In summary, computer adoption is not just impressing people with the benefits but also about coaching, teaching and encouragement.

CONCLUSION

The outcomes of this study show that it is meaningful to educate nursing students with technology to prepare them to practice in a technology-rich environment. While some of the variables have been identified for ease of use and self-efficacy, further investigation is needed to evaluate metacognition related to impact technology makes on clinical decisions at the point-of-care. The evidence from this study strengthens support for using PDA resources across nursing education programs. Further research is needed with larger numbers of students and in a variety of clinical settings to determine the effects on learning nursing practice.

REFERENCES


