Cooperative M-Learning with Nurse Practitioner Students

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New technologies give academics opportunities to incorporate innovative teaching-learning strategies into their curricula. While the value of handheld technology — personal digital assistants (PDAs), smartphones, and tablet computers — has been well documented in the clinical setting (Scordo & Yeager, 2003) and has considerable potential for the nursing classroom, mobile technology for learning lacks sufficient empirical evidence to support its use. This study, therefore, explores how mobile technology, or m-learning, influences nurse practitioner students.

The goals of this project, a multimethod educational research study conducted at two universities, were twofold: a) to explore how cooperative and interactive m-learning techniques enhanced classroom and clinical nursing education at multiple locations, and b) to determine the relationship between m-learning and students' learning styles. Two research questions were asked:

• Do cooperative and interactive m-learning techniques enhance classroom and clinical nursing education at multiple locations?
• Is there a relationship between m-learning and students' learning styles?

Abstract

New technologies give nurse academicians the opportunity to incorporate innovative teaching-learning strategies into the nursing curricula. Mobile technology for learning, or m-learning, has considerable potential for the nursing classroom but lacks sufficient empirical evidence to support its use. Based on Mayer’s multimedia learning theory, the effect of using cooperative and interactive m-learning techniques in enhancing classroom and clinical learning was explored. The relationship between m-learning and students’ learning styles was determined through a multimethod educational research study involving nurse practitioner students at two mid-Atlantic universities. During the 16-month period, nurse practitioner students and their faculty used personal digital assistants (PDAs) to participate in various m-learning activities. Findings from focus group and survey responses concluded that PDAs, specifically the Pocket PC, are useful reference tools in the clinical setting and that all students, regardless of learning style, benefited from using PDAs. It was also demonstrated that connecting students with classmates and other nurse practitioner students at distant universities created a cooperative learning community providing additional support and knowledge acquisition. The authors concluded that in order to successfully prepare nurse practitioner graduates with the skills necessary to function in the present and future health care system, nurse practitioner faculty must be creative and innovative, incorporating various revolutionary technologies into their nurse practitioner curricula.
**Literature Review** According to Mayer's multimedia learning theory (2001), methods that attend to all styles of learning — verbal, visual, and kinesthetic — may enhance the ability to solve problems. By providing content through text, images, audio, and video output, M-learning with PDAs can address all learning styles. PDAs can also promote cooperative learning. Pairing learners who possess varying degrees of knowledge allows them to gain information from one another and promotes academic achievement, critical thinking, retention, and enhanced oral communication skills (Gokhale, 1995; Johnson, Johnson, & Stanne, 2000).

PDAs can be used to access the Internet, retrieve data from servers, and connect callers using Voice over Internet Protocol (VoIP). Running classroom software, PDAs can connect learners to learners, teachers, and instructional material. Wake Forest University developed ClasslnHand™, a free PDA tool that supports presentations, web browsing, and polling (Bishop, Dininks, & Dominick, 2003). Students at the University of Texas at Brownsville and Texas Southmost College used Skype™, a cooperative PDA tool, to speak to other students and instructors in real time using chat sessions (Pan & Sullivan, 2005).

In general, medical faculty and students use the PDA only as a clinical resource, not for cooperative group learning. For example, Drexel and Vanderbilt University students use PDAs as a reference tool (Tyler, 2006), while Huffsstutter, Wyatt, and Wright (2002) integrated PDAs into a graduate nursing pharmacology course, also as a reference tool.

Most studies measure students' satisfaction with PDAs. Overwhelmingly, researchers report that students believe PDAs improve the quality of care given to patients by allowing access to drug information and lab values; however, few studies reported integrating the technology into the curriculum (Altmann & Brady, 2005; Koeniger-Donohue, 2008; Williams & Dittmer, 2009).

**Method**

**SUBJECTS** This education action and survey research project was conducted at two mid-Atlantic universities after institutional review board approval. Students in the family nurse practitioner (FNP) track at one university and the pediatric nurse practitioner (PNP) track at another university were asked to participate; 22 students consented. All participants were female; 21 (95 percent) were Caucasian, and one student was African American. Fourteen students (64 percent) were less than 40 years of age, and eight (36 percent) were over 40. Eight participants who were enrolled in more than one course of study.

**PROCEDURE** To measure their previous PDA experiences and their perceptions about learning with the devices, students completed online pretest questionnaires. They also completed an online learning styles inventory created by Jester and Miller (2000). Both the pretest and the questionnaire were completed at the beginning of a student's course of study.

Students and faculty were registered on a SharePoint® collaborative m-learning website (hereafter referred to as "website") featuring PowerPoint guided tutorials that included instructions and screen shots for basic PDA functions and applications. Students were introduced to the PDAs gradually to lessen information overload; they had access to comprehensive technical support, including a help desk phone number, office hours, and periodic emails that reviewed available technical support and solicited reports of technical difficulties.

The Windows Mobile® operating system, configured on Pocket PCs, was selected because it supports both health care software and classroom tools. The following applications were purchased and/or downloaded for all students: ePocrates®, ClasslnHand, and Skype. In addition, the FNP students used Typhon Group Nurse Practitioner Student Tracking System™ (NPST) software, and the PNP students accessed the following applications: Bones, Harriet Lane 17th Edition™, Skyscape products (Artbeat™, The 5-Minute Pediatric Consult, ICD-9-CM, and Archimedes™), AAP Clinical Practice Guidelines, English Spanish Dictionary, and InfoRetriever®.

This study examined research questions in three phases over 16 months (four semesters). In the first phase, students were encouraged to use their PDAs whenever possible, especially in clinical settings. Students shared how they used their PDAs during three class discussions and a final focus group. In the second semester of the first phase, students used their PDAs with wireless classroom applications such as ClasslnHand and Skype. During class sessions, ClasslnHand was used to poll responses to multiple-choice questions. Skype was used to synchronously connect outside of class to analyze a case study. Students also used PDAs to share assignments and resources.

In phase 2, students completed m-learning assignments that promoted cooperative learning. (See Table I for assignments.) Interacting using the website and Skype, experienced NP students were paired with novice NP students. Activities employed text, sound, and images to appeal to varied learning styles congruent with Mayer's generative multimedia learning theory (2001). For example, the case study activity was presented in four video podcasts and posted on the website for discussion. In phase 3, participants repeated the phase 2 m-learning assignments and completed a learning style inventory.

At the end of each semester, students completed a posttest questionnaire and participated in a focus group. Examples of questions included: What was your best and worst m-learning experience? Did you learn from your partner in the cooperative learning assignments?

The principal investigators (Pis) and research assistant conducted focus groups and recorded extensive field notes. The co-principal investigators (Co-Pis) did not participate in the focus groups because they were also faculty of the students and wanted to avoid the perception of coercion. All data were kept confidential from the Co-Pis until final semester grades were submitted.
Focus group field notes were reviewed by the study team for completeness and accuracy. The PI and research assistant were debriefed immediately after each focus group to help identify preliminary themes. All data were analyzed by individual investigators and then collectively by the research team.

A multistep analysis plan was used. First, initial content analyses were performed to detect differences in members' responses within the groups by identifying, categorizing, and describing each group. Next, field notes from all groups were read to identify similarities and differences to reveal and refine categories and themes. The study team refined categories and themes after consulting with a content expert who validated the findings.

Pretest/posttest data and learning style inventory results were imported into Statistical Package for Social Sciences 15.0 for analysis. To compare students' pretest/posttest scores and learning styles, a non-parametric McNemar test was computed. The level of significance was set at .05.

**Results**

**PHASE 1**

The goal of this phase was to determine if interactive m-learning techniques promoted learning. Educators taught and role modeled using PDAs as organizers, reference tools, and to store data. Results showed that students significantly increased their use of their PDAs as clinical reference tools (p = .031), but not as note takers (p = .50) or as organizers (p = .50). There were no significant changes in the students' perceptions about the usefulness of PDAs in clinical practice (p = 1.0) or their opinion about incorporating PDAs into the curriculum (p = 1.0).

The number of students using a variety of resources increased, with ePocrates used most frequently and reported most helpful. Consistently, students felt that PDAs should be integrated into the graduate nursing curriculum because they are effective reference tools that prepare students to be NPs. One student described the PDA as "a way of life." Students confirmed that using interactive m-learning activities with the PDA facilitated both classroom and clinical learning.

Testing the PDAs during the first two semesters resolved technology issues and identified support needs. Although comprehensive assistance was available, students still used class time to ask questions and wanted class extended 10 minutes to resolve technical issues. Some students needed additional technology instruction to complete the m-learning assignments, which caused anxiety as assignments were awarded credit. During phase 1, students also discovered that PDA multitasking was difficult due to the limitations of Windows Mobile.

During phase 1 focus groups, students evaluated m-learning classroom strategies and identified ways to support clinical learning using PDAs. Classmates taught each other about the PDA features and health care applications. As one preceptor did not allow a student to use the PDA in the clinical setting, it was concluded that the environment must be conducive to PDA use for it to be an effective clinical tool.

PDAs were used as clinical resources, for example, to verify but not to make a diagnosis. Students used PDAs instead of textbooks to access

### Table 1. Research Process

<table>
<thead>
<tr>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
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<tbody>
<tr>
<td><strong>Semester</strong></td>
<td>Spring '06</td>
<td>Fall '06</td>
</tr>
<tr>
<td><strong>Subjects</strong></td>
<td>n=4</td>
<td>n=12</td>
</tr>
<tr>
<td><strong>Research Question</strong></td>
<td>Do interactive m-learning techniques promote learning?</td>
<td>Do cooperative m-learning techniques promote learning?</td>
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</tbody>
</table>
| **Assignments** | • Students given PDAs with health care and classroom learning applications and were encouraged to use in clinical (spring) and classroom (summer) settings  
• Class discussions and final focus group discussions regarding applications used and valued by students | • Students interacted using the m-learning site and Skype  
• Experienced NP students paired with novice NP students  
• Assignments  
1) Create a biography on the m-learning website  
2) Interview another student via Skype and add information to their biography  
3) Submit two monthly journal entries  
4) Participate in a synchronous case study via Skype with another student  
• Complete an asynchronous case study discussion with a group of students led by a faculty member (Spring 2007 only)  
• Learning Style Inventory completed by students (Spring 2007 only) | |
information and supplement reading assignments in classroom and clinical settings. Overall, students stated that PDAs should be used earlier in the program and recommended using them with classroom case studies. Students reported that the interaction between classmates and faculty was the most valuable m-learning experience because it encouraged the sharing of knowledge and resources.

PDAs also promoted learning by presenting information in short, bulleted segments rather than long, narrative text. One student stated, "The bullets stick in your brain." An important finding was that with PDAs, students found the classroom setting to be a less competitive and more cooperative learning environment. They shared resources in class and discussed class activities outside the classroom.

**PHASE 2** The goal of this phase was to determine if cooperative m-learning techniques promoted learning. During this phase, students continued to value the overall experience but expressed concerns about the technology. They used PDA tutorial documents only for reference and still wanted additional class time for instruction. They reported difficulty accessing the website due to browser incompatibility with BlackBoard, which forced students to use two content sites, as well as security issues. Asked to evaluate the ease of use of their PDA applications, students reported that ePocrates was the most user friendly, while Harriet Lane was the most difficult. Students preferred PDA person-to-person calls to the Skype conference feature.

The pairing of FNP/PNP students was reported positively. Distance was not a barrier because the technology allowed students to communicate easily. However, knowledge differences were barriers. As anticipated, less experienced NP students perceived more benefits from the pairing, while more experienced students reported that pairing was not beneficial. Students reported difficulty scheduling with their partners, and the challenge increased exponentially with multiple partners.

Some students recommended using the PDA to reference a dermatology library; PDAs with digital cameras could allow students to use clinical images to supplement content. One group used dictation with PDAs but was challenged because the record feature does not allow the user to pause during recording. Students desired more faculty role modeling of PDA use, but overall, they described PDAs as integral to the learning environment.

The pretest and posttest survey was not administered during phase 2 in order to reduce the testing threat to internal validity. Many participants would likely be included in phase 3 and complete the survey at that time.

**PHASE 3 AND PRETEST/POSTTEST RESULTS FOR ALL PHASES** The goals of phase 3 were to continue evaluating the effectiveness of cooperative m-learning and to determine if learning styles influenced students’ preferences for technology-based learning. Eighty-eight percent of students (n = 16) responded that PDAs facilitated classroom learning as opposed to 66 percent at pretest (n = 12). One of the students, who initially felt the PDA would enhance learning, found it distracting. McNemar test confirms that differences between pretest and posttest responses were insignificant (p = .109). Ninety-four percent (n = 17) felt the PDA enhanced clinical learning with no change in pretest and posttest responses (p = 1.0). According to McNemar tests, use of a PDA in this study did not significantly change the way students used their PDAs or how often they used them (p = .031). There was no significant difference in the number of students using PDAs in clinical practice (p = .008), as organizers (p = .625), and as note takers (p = .625). In addition, use of a PDA did not significantly influence whether participants felt PDAs should be integrated into the curriculum (p = .50) or if students should be required to purchase one (p = .656).

The most positive remarks were given about the asynchronous case study using the podcast and the synchronous case studies by student colleagues. Less experienced students particularly appreciated the synchronous case study and reported the cooperative learning as valuable. Students reviewed materials on the PDA when the synchronous case studies were being presented via Skype. Some students

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**Table 2. Effects of Students’ Learning Style on M-learning Preferences**

<table>
<thead>
<tr>
<th>POSITIVE STUDENT RESPONSES</th>
<th>VISUAL/VERBAL LEARNER</th>
<th>VISUAL/NONVERBAL LEARNER</th>
<th>TACTILE/KINESTHETIC LEARNER</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDA enhanced clinical learning</td>
<td>n = 3 (100%)</td>
<td>n = 3 (100%)</td>
<td>n = 1 (50%)</td>
<td>n = 7</td>
</tr>
<tr>
<td>PDA enhanced classroom learning</td>
<td>n = 2 (66%)</td>
<td>n = 3 (100%)</td>
<td>n = 2 (100%)</td>
<td>n = 7</td>
</tr>
<tr>
<td>PDA should be integrated into curriculum</td>
<td>n = 2 (66%)</td>
<td>n = 3 (100%)</td>
<td>n = 1 (50%)</td>
<td>n = 6</td>
</tr>
</tbody>
</table>
reported, however, that Skype was not useful unless one was without cell phone access. One student stated that PDAs should be optional as not all students learn with this modality: "It can be a reference tool but may not be a first choice for everyone if reference books are available."

Students found the learning styles inventory useful because it identified their style and offered strategies to improve their academic success based on that style. Of the eight students who took the inventory, three had visual/verbal style, three had visual/nonverbal style, and two had tactile/kinesthetic style. All visual/nonverbal and tactile/kinesthetic participants stated that the PDA enhanced classroom learning, in contrast to 66 percent of the visual/verbal learners. See Table 2 for the effects of students' learning style on m-learning preferences.

Discussion There was minimal change in students' perceptions during the study because many had used PDAs prior to the pretest. This study reinforced that PDAs, specifically the Pocket PC, are useful reference tools in the clinical setting. It also demonstrated that connecting students with classmates and other NP students at distant universities creates a cooperative learning community providing additional support and knowledge acquisition. Focus group and survey responses showed that all students, regardless of learning style, benefited from using PDAs.

While the cooperative learning model was most valued by novice NP students, this finding does not discount the benefits for experienced NP students. Faculty who use cooperative learning must reinforce the value of mentoring for professional development and work to enhance learning for all participants.

In future studies of PDAs and m-learning techniques, faculty should role model PDA use while allocating training time for the devices. Preceptors should also be included in future studies as they are responsible for students' educational experiences and may benefit from a technology that can enhance patient care. Research should extend beyond the classroom to clinical settings where the impact of using technology can be measured in health outcomes.

Conclusion The importance of technology in health care continues to grow with the advent of electronic records, revolutionary equipment, and innovative interventions. Educators can help graduates function in this environment by providing access to technologies now available at the point of care. Current literature supports the use of PDAs in the clinical setting, but does not address their use in the nursing classroom. This study examined how PDAs and m-learning techniques can augment clinical learning as well as enhance classroom and cooperative learning. Clearly, the successful NP graduate possesses a variety of technological skills before entering today's workforce.

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Key Words Graduate Nursing Education – M-Learning – PDAs – Nurse Practitioner – Technology – Cooperative Learning

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