Canadian Journal of Nursing Informatics (CJNI), Vol 4, No. 4, p. 3 to 34

An Evidence-Based Pilot Project: The Influence of Information-Laden Handheld Computers on Computer Competence, Information Sources, and Stress Levels of Nursing Students

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The authors would like to acknowledge financial support from St. F.X. University and Cape Breton University and Unbound Medicine for the donation of Nursing Central software licenses for the original study, http://www.unboundmedicine.com/store/nursing_central_pda_wireless

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Abstract

This quasi-experimental study examined whether the use of a personal digital assistant (PDA)-based, information management system called *Nursing Central* © would improve nursing students' computer attitudes and competence, stress levels, and use of clinical information. *Nursing Central* © contains electronic information commonly used by nursing students in clinical learning. A convenience sample of nursing students (N = 131; 24 intervention and 106 comparison) was recruited from two Eastern Canadian universities. The intervention students and clinical teachers used the PDA program during a six-week clinical rotation. Statistical tests were run to determine any mean variable differences between the intervention and comparison groups. No significant effects for the intervention were noted for stress, computer competence, or computer attitudes over the rotation. A potential intervention effect was evident for specific clinical information stress (CIS) and nursing information use (NIUS) as the intervention students reported significantly improved item means at post-test on four of the five CIS items (i.e. making a medication error, having clinical information, being prepared for clinical, and being evaluated unfairly) and one NIUS item (use of electronic drug resources). Future research is suggested with a larger and more diverse sample of nursing students, randomization to control bias, a longer intervention period, and a qualitative component to capture the lived experience of nursing students.

Key Words: PDA, computer competence scale, nursing informatics, clinical information stress (CIS), nursing information use (NIUS).

Introduction

Nursing informatics is the application of computer and information science to use information and/or knowledge to best support nursing practice (Hebert, 2000). Nurse experts have announced that informatics competence is required in order for nurses to provide high quality patient care within an information age (Canadian Nursing Informatics Association, 2002; Fetter, 2008; Hebert, 2000; McBride, 2005; Morgan, Fogel, Hicks, Wright and Tyler, 2007; and Thompson & Skiba, 2008). Recently acknowledged links between informatics, information, and evidence-based nursing (Courey, Benson-Soros, Deemer, and Zeller, 2006; and Levett-Jones, Kenny, Vander, Hazelton, Kable and Bourgeois, 2009) further highlights the vital role of informatics in nursing practice. Informatics competence enables nurses to search for the best available knowledge to support clinical decision making (Levett-Jones *et al.*, 2009). It is vitally important for nurse educators to collectively develop core informatics competencies and to ensure achievement of standard competencies before graduation (Canadian Nurses Association, 2006; Fetter, 2008; McBride, 2005). Student nurses can more easily achieve informatics competence if educators infuse the nursing curriculum with classroom and clinical informatics learning opportunities (McNeil, Elfrink, Bickford, Pierce, Bevea, Averill & Klappenbach, 2003; McNeil, Elfirink, Beyea, Pierce, & Bickford, 2006; Scott, Gilmour, & Fielden., 2008; Ward & Moule, 2007; and Willmer, 2005).

Achievement of informatics competence also requires that nurse educators, students, and practicing nurses overcome major barriers (Fetter, 2009; Ward & Moule, 2007). For nurses in practice, attainment of informatics competence has been affected by limited computer or information technology access, skill, and/or continuing education support for use of innovations in practice (Bickford *et al.*, 2008; Estabrooks *et al.*, 2003; McBride, 2005; Wilbright *et al.*, 2006). Practicing nurses have been reported to have limited Internet

expertise (Bickford, Smith, Ball, Frantz, Panniers, Newbold, Knecht, Farish-Hunt, & Cortes-Comerer, 2008; Gilmour, 2007; Gilmour, Scott & Huntington, 2008) and little time to access computers or the internet on the unit (Gilmour et al., 2008; Van Patter, Gale & Schaffer, 2009). Furthermore, negative computer attitudes of practicing nurses (Alquraini, Alhashem, Shah & Chowdhury, 2007; Timmons, 2003) must be overcome in order to promote adoption of informatics tools and techniques. Some of the negative computer attitudes among practicing nurses have been attributed to poor access or availability of information technology on clinical units (Canadian Nurses Association, 2006; McBride, 2005) and computer systems or program communication failure issues (McKnight, 2006).

While few researchers have studied informatics skill and/or information use patterns of nursing students (Levett-Jones et al., 2009), similar barriers to technology and informatics tools have been reported. Limited computer skills have been reported for both student nurses (Moule, 2003) and faculty (Fetter, 2009). Furthermore, like practicing nurses, students have reported limited access to computers in clinical settings (Bogossian *et al.*, 2009; Ward & Moule, 2007), limited support, and variability in hardware and software (Fetter, 2009). Limited Internet access in clinical practice settings means that nursing students are unable to provide patients advice on Internet-based information as they are unable to search for, and/or validate, clients' health information (Scott et al., 2008). Wide variation in technology resources and computer access across different nursing programs (Bogossian, Kellett & Mason., 2009; Scott, Gilmour & Fielden, 2008) underscore the need for standards in informatics education.

Few researchers have examined whether lack of informatics skills and tools affects stress levels of nursing students. Limited informatics skill may be a source for stress as clinical teachers expect nursing students to arrive prepared with information required to

provide safe, competent patient care and be able to give rationale for nursing care and clinical decisions.

Access to quality clinical information may reduce stress as students feel prepared with the knowledge required for patient care at their finger tips. Researchers have reported that nursing students (Lindop, 1999) and practicing nurses (Jones & Johnston, 2000b) commonly experience stress in clinical practice. Some of the factors that have been associated with student nurse stress have included a) lack of free time, b) fear of failure, c) inadequate response of the educational facility to student needs, d) poor library facilities (Kanj, White & Ernst, 2006), e) fear of making a mistake or f) failing in clinical practice (Lindop, 1999). One researcher warned that academic stress was the greatest kind of stress source among nursing students, followed by stress related to financial, family and health issues (Lo, 2002). Although clinical learning in the current high tech, rapidly changing health care setting is likely stressful for nursing students (Goldsworthy, Lawrence & Goldman, 2006), few researchers have studied this relationship.

The PDA has been described as an innovative technology that is increasingly used by nurses to improve workflow, provide access to drug and patient care information, facilitate calculation of doses, and provide access to clinical references at the point of care or the patient's bedside (Tooley & Mayo, 2003; White *et al.*, 2005). PDA's have been described as having a transformational effect on nursing practice (Thompson, 2005) and they are now required in some undergraduate nursing programs (White, Allen, Goodwin, Breckinridge, Dowell & Garvey, 2005). The transformation or decentralization of nursing information from traditional sources such tas extbooks and manuals to the nurses' handheld computer is likely empowering. With little direction on best approaches, nurse educators are faced with the decisions and challenges of selecting best ways to integrate informatics learning tools within the nursing curriculum (Elfrink, Davis, Fitzwater, Castleman, Burley, Gorney-Moreno, Sullivan, Nichols, Hall, Queen, Johnson, & Martin, 2000; Smith & Pattillo, 2006; Wilson,

n.d.). Although there has been limited research on the role of handheld computers or personal data assistant's (PDA's) in nursing education (George & Davidson, 2005; Smith & Pattillo, 2006), some benefits that have been reported include improved access to information, fewer medication errors, and decisional support at the point of care (Bates & Gawande, 2003; Jones & Johnston, 2000a, 2000b). The PDA provides nursing students with access to information (e.g., electronic textbooks, drugs and lab manuals, disease information, etc) at the point of care.

While several researchers have noted the benefits of PDA's in nursing education (George & Davidson, 2005), findings have only recently emerged on the role of PDA's in clinical teaching and learning. Greater understanding is needed on whether PDA's are effective and useful teaching tools that bring information to the point of care. This pilot study aims to determine whether providing access to PDA technology will improve nursing students' (1) stress and clinical information stress levels, (2) computer attitudes and competence, and (3) use of information in clinical practice learning.

Conceptual Model

The study was guided by a conceptual model comprised of four interrelated concepts:

- information source
- level of evidence
- computer competence
- informatics competence

(illustrated in Figure 1 on next page).

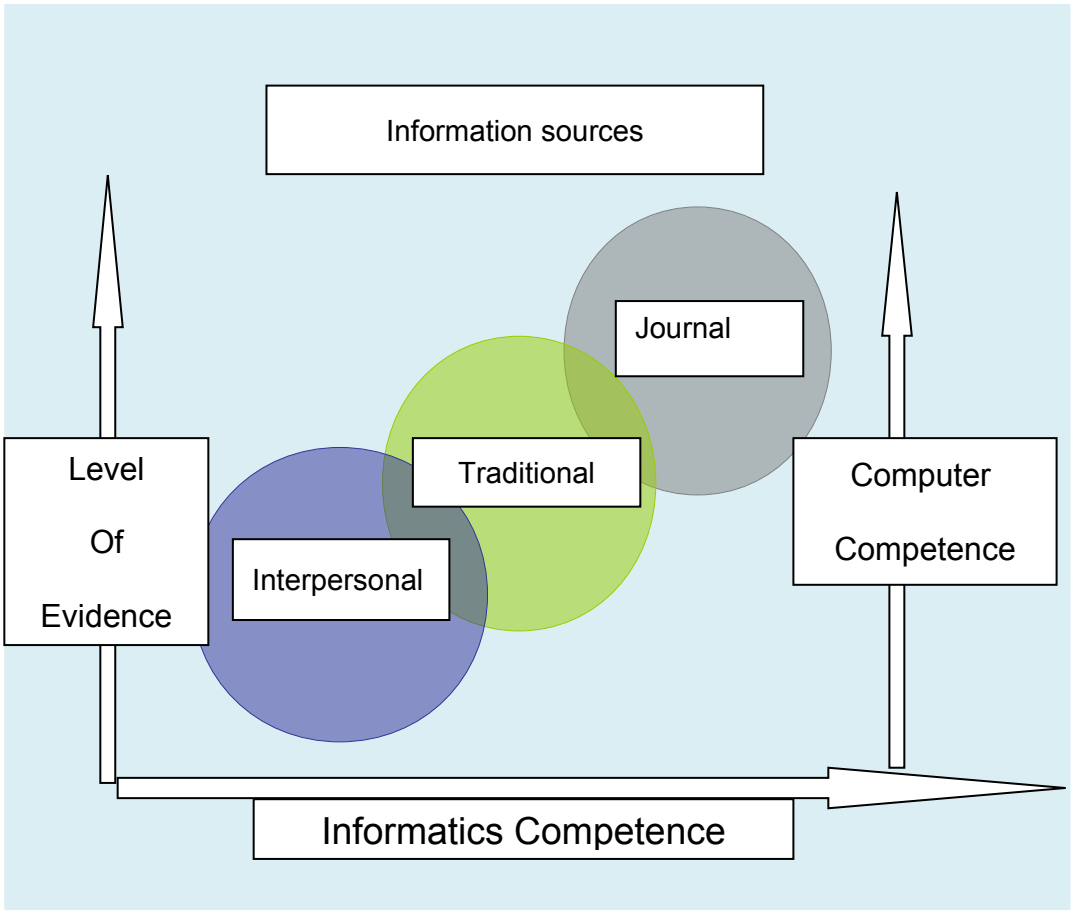


Figure 1. Information Use Model (adapted from Secco, Woodgate, Hodgson, Kowalski, Plouffe, & Rothney, Sawatzky-Dickson & Suderman, 2006)

Informatics and *computer competence* enable nurses to access information sources (Hobbs, 2002) and to apply information in patient care (Staggers, Gassert & Curran, 2002). Student nurses with informatics competence are likely to experience lower stress related to acquisition of information to support practice and clinical decisions. Undergraduate nursing students learn to support nursing practice via acquisition of information from many sources: *interpersonal, computer, and non-computer sources. Interpersonal information* is gathered via interactions with clinical teachers, fellow students, and practicing nurses. Computer access is needed to access electronic information sources

in literature repositories, electronic journals, Internet websites, e-mail and chat rooms (Secco et al, Jamieson, Profit, Bailey & Whtty-Rogers, n.d.). Since one basic premise of evidence-based health care is the application of the most current evidence or information when making decisions for and with clients (Guyatt et al, 2000), lack of computer access and informatics competence is a barrier to best practice. Informatics competence enables the nurse to access electronic health systems, diagnostic information, to chart, and to search for the best available evidence or research findings to inform patient care (Levett-Jones et al., 2009).

Design

The study design was quasi-experimental with an intervention and non-equivalent comparison group of nursing students who voluntarily participated. The convenience sample of nursing students completed the same demographic questions and research scales both before and at the end of the six week clinical rotation.

Procedures

Nursing students were recruited from two universities, St Francis Xavier (St FX) in Antigonish and Cape Breton University (CBU) in Sydney, Nova Scotia. The nursing programs were similar as the program was jointly offered at the time of the study. Student recruitment into the study began after receipt of ethical approval from both universities. Intervention students were recruited from only CBU while comparison students were recruited from both CBU and St FX. Intervention students were recruited from clinical courses and volunteered to use the PDA and software program; all students were provided with a study explanation (verbal and written) and signed an informed consent form.

Intervention

Intervention nursing students and their clinical teacher were given a PDA loaded with the *Nursing Central* © software program for a six week clinical rotation. *Nursing Central* © (created by Unbound Medicine) provides access to searchable information sources typically used by student nurses and clinical teachers in practice rotations. The *Nursing Central* © software provided electronic access to the following resources:

- Taber's, 20th Ed. Medical Dictionary
- Davis's Drug Guide
- Davis's Lab & Diagnostic tests, 2e
- Diseases and Disorders
- Medline Journal searching capability (Unbound Medicine).

An orientation workshop on the use of Nursing Central was provided for participating clinical teachers and nursing students.

Instruments

The *Nursing Information Use Scale (NIUS)* was initially used in a study with pediatric nurses (Secco et al., 2006). The NIUS consists of 15, 5-point Likert items with anchors that range from "strongly agree" to "strongly disagree". Factor analysis identified three subscales (Secco et al.) that measure use of various types of information sources:

- Interpersonal (II),
- Journal (JI), and
- Traditional Information (TI),

and the extent the computers will improve nursing and practice Computer Expectations (CE). Cronbach alpha coefficients of internal consistency were strong for the total NIUS

(.71) and CE (.86) and weaker for the shorter TI, JI, and II (.47). Validity evidence for the NIUS includes significant, moderate to low strength, correlations with both computer attitudes, r = .23, p = .01, and computer competence, r = .26, p = .003 (Secco et al.).

A revised Computer Competence Scale (CCS) (Kaminski) was used as a measure of computer and informatics competence using a number of computer soft- and hardware applications. A five-point, Likert response was added as a rating scheme for each item to permit scoring and data analysis. The internal consistency Cronbach coefficient for the CCS was strong, .91 for this sample of nursing students.

The Attitudes Toward Computers scale (ATC) (Nickell & Pinto, 1986) contains 20, five-point Likert items that measure attitudes toward computers. The Likert responses ranged from strongly disagree (1) to strongly agree (5). Items in the ATC are designed to measure perspectives on the value and utility of computers. The internal consistency Cronbach coefficient for the ATC was strong, .84 for this sample of nursing students.

Stress was measured with the Student Nurse Stress Index (SNSI) (Jones & Johnston, 1999) which contains 22 items, 5-point Likert items comprised of four subscales. Strong internal consistency Cronbach alpha coefficients have been reported for subscales, Academic Load (.71 - .82), Clinical Concerns (.76 - .85), Personal Problems (.63 - .72), and Interface Worries (.75 - .83) (Jones & Johnston, 2006). The internal consistency reliability, Chronbach alpha coefficient for the CIS with this sample of nursing students was very good (.83).

The newly developed Clinical Information Stress (CIS) scale consists of 5 Likert response items that measure amount of stress experienced as a result of lack of, or barriers to, needed information. An example item is the amount of stress related to ‘not having

clinical information'. The internal consistency Chronbach alpha coefficient for the CIS with this sample was high (.89).

Analysis

The data were entered into a database and analysed using SPSS version 16 (SPSS, 2008). Characteristics of the total sample and the intervention and comparison groups were determined using descriptive statistical analysis, including means and frequencies. Differences between intervention and comparison groups were tested using analysis of variance, independent and dependant t tests. The aim of the analysis was to address whether use of a PDA-based nursing information software would positively affect student nurses: (1) stress and clinical information stress, (2) computer attitudes and competence, and (3) information use during a clinical rotation.

Results

Sample

A convenience sample of 2nd, 3rd, and 4th year nursing students (N = 131) was recruited from CBU (64.1%; n = 84) and St. FX (35.4%; n = 47) (see Table 1 on next page).

The average age of the final sample was 25.2 years and more than 90% of participating students were female (93.1%; n = 121). Almost 40% (38.7%) of nursing students worked an average of 11.05 hours per week outside of university in a health or related setting. Close to 20% of the study participants had a previously earned university degree (n =25) and were in nursing as a 2nd degree student.

		N	%	Total %
Gender	*Male*	9	6.9	
	Female	122	93.1	100
University	*CBU*	84	64.1	
	St FX	47	35.9	100
Previous degree	*yes*	25	19.5	
	no	105	80.5	100
Program Year	*2nd*	43	33.1	
	3rd	43	33.1	
	4th	44	33.8	100

Table 1. Sample Characteristics

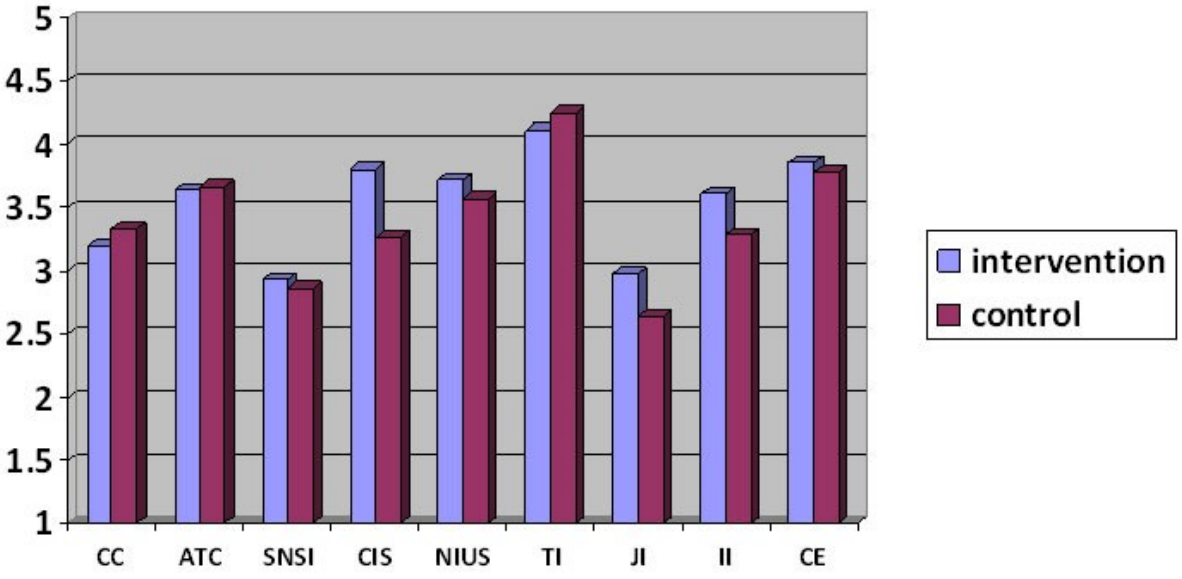
Equality of Comparison and Intervention Group

While the mean age of the intervention group nursing students was higher, 27.18, than the comparison group, 24.82, the difference was not significant, t = 1.56, p = .12. Also, intervention nursing students reported significantly higher Clinical Information Stress compared with those in the control group, $p < .05$ (Table 2). Whether study variables differed for students in 2nd, 3rd, and 4th year was tested with analysis of variance, F tests. A significant linear increase in Attitudes Toward Computers (ATC) was seen for each increase in year in the nursing program (i.e., 2nd year = 3.55; 3rd year = 3.66, and 4th year = 3.76; F = 4.57, p = .034). None of the other study variables was significantly different by year in program.

	Intervention (n = 22)	Control (n = 106)
CC	3.19	3.33
ATC	3.64	3.66
SNSI	2.93	2.86
CIS	**3.80**	**3.26***
NIUS	3.72	3.57
TI	4.11	4.25
JI	2.98	2.64
II	3.61	3.29
CE	3.86	3.78

*$p < .05$

Table 2. Independent t Tests for Group Differences Pretest



Research Question 1: Student Nurse Stress

The mean score on the Brief Student Nurse Stress Index (SNSI) for the whole sample of student nurses was 2.78 (Figure 2 on next page). Among the SNSI subscales, mean Academic Load (AL) stress was the highest 4.01. Other stress source means, such as Personal Problems, 2.09, and Interface Worries, 2.89, were somewhat lower.

A look at the changes in stress over the clinical rotation indicated that, for the control group only, SNSI significantly decreased from the beginning to the end of the clinical rotation, t = 2.38, p = .02 (Table 3 on paper page 16).

Although the same decrease was seen among the intervention students, it only approached significance, t = 1.97, p = .064. A significant decrease was seen in SNSI for the whole sample from pretest, 2.86, to posttest, 2.65, p = 003 (see Table 4 on paper page 17) suggesting that stress release was likely due to a factor that affected all students. This significant lowering of stress for the whole sample provides little evidence of an intervention effect for the PDA intervention.

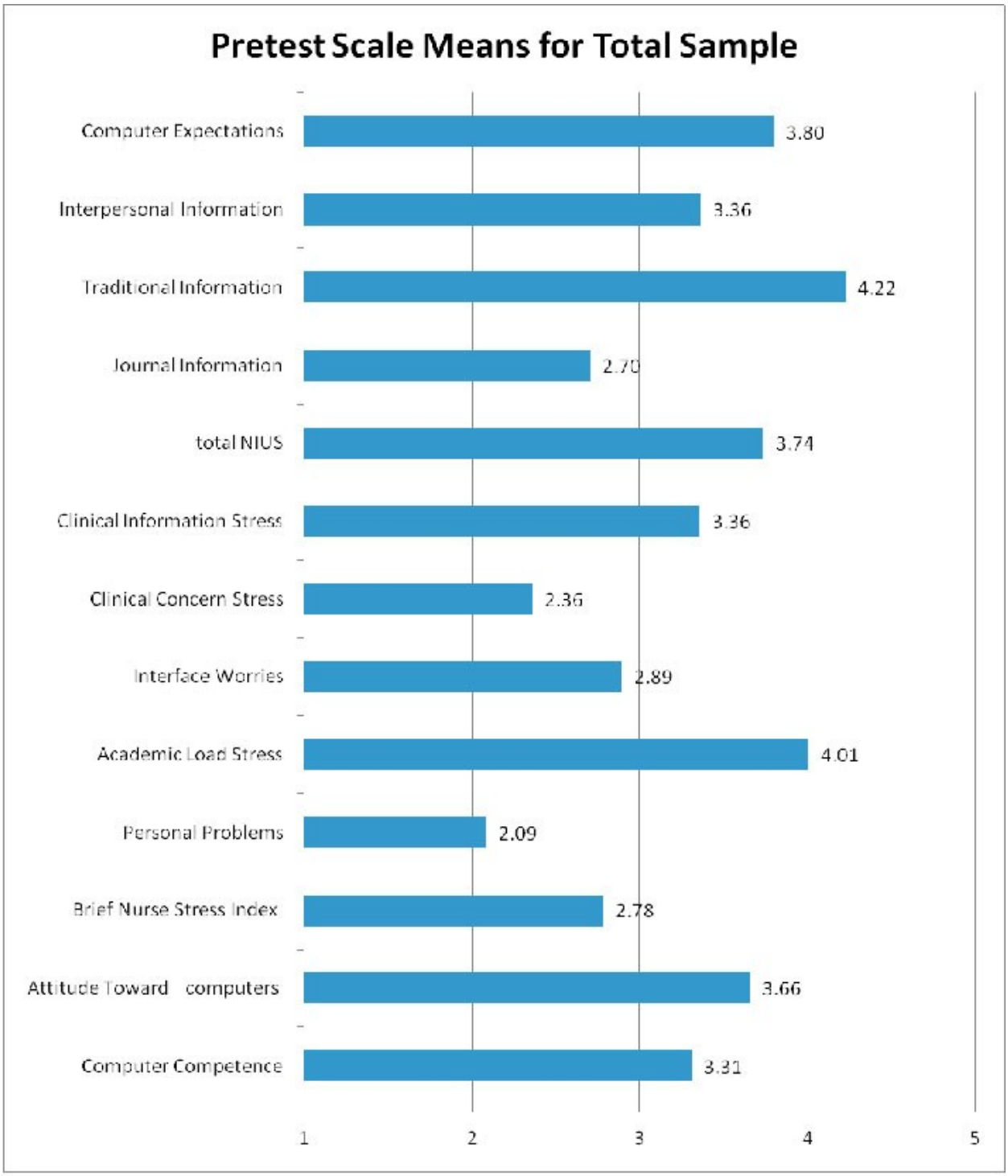


Figure 2. Mean Scores for the Total Sample

	Intervention (N = 20)				Control (N = 40)			
	Pretest	Posttest	*t*	*p*	Pretest	Posttest	*t*	*p*
CC	**3.15**	**3.52**	**-2.19**	**.009**	**3.32**	**3.51**	**-2.70**	**.01**
ATC	3.62	3.70			3.63	3.69		
SNSI	2.94	2.74	1.97	.064	**2.80**	**2.61**	**2.38**	**.020**
CIS	**3.85**	**3.19**	**3.18**	**.005**	3.24	3.31		
NIUS	**3.81**	**3.31**	**3.61**	**.002**	3.70	3.57		
TI	4.11	4.13			4.29	4.25		
JI	3.15	2.98			**2.71**	**3.13**	**-2.09**	**.043**
II	3.65	3.45			3.14	3.41		
CE	**3.83**	**2.70**	**3.89**	**.001**	**3.73**	**3.20**	**3.04**	**.004**

Table 3. Dependent t tests of Mean Changes in Time by Group

LEGEND

CIS = Clinical Information Stress

CC = Computer Competence

ATC = Attitudes Toward Computers

SNSI = Student Nurse Stress Index

NIUS = Nursing Information Use Scale

TI = Traditional Information

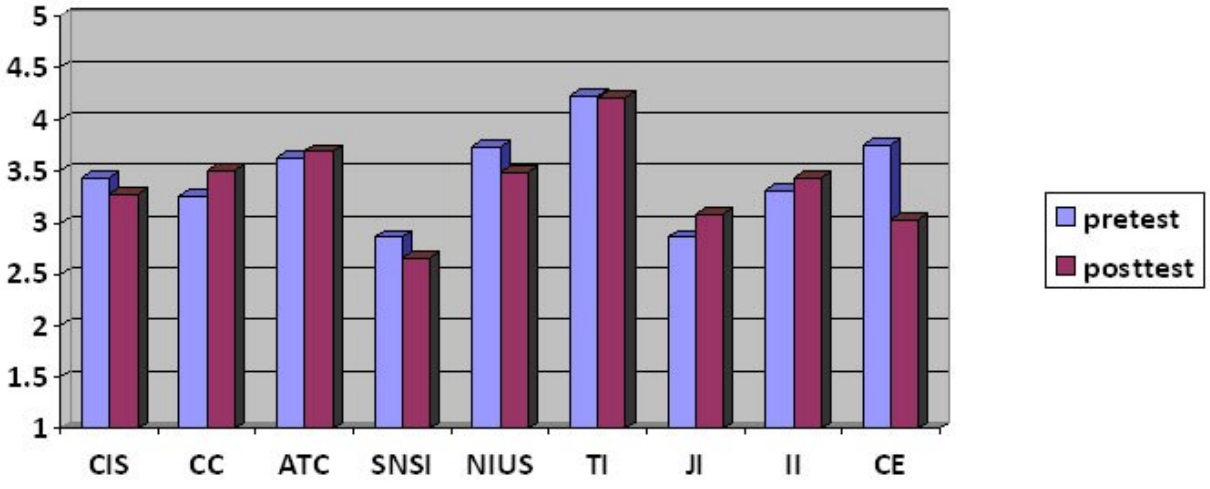
JI = Journal Information

II – Interpersonal Information

CE = Computer Expectation

	Mean		t	p
	pretest	*posttest*		
CIS	3.44	3.27	1.37	.177
CC	3.26	3.51	-3.93	.000
ATC	3.63	3.69	-1.68	.098
SNSI	2.86	2.65	4.77	.003
Total NIUS	3.74	3.48	3.44	.001
TI	4.23	4.21	.28	.784
JI	2.86	3.08	-1.32	.192
II	3.31	3.43	-.97	.340
CE	3.76	3.03	4.73	.000

Table 4. Total Sample Dependent t tests of Change (N = 60)



Mean Clinical Information Stress (CIS) for the whole sample was relatively high, 3.36, and suggested that nursing students experienced a fair level of stress related to clinical information (Table 1). Intervention nursing students demonstrated significantly lower CIS at posttest, 3.19, compared with pretest, 3.85, p = .005 (Table 3) which suggests an intervention effect. However, a closer look reveals that intervention students had higher CIS at pretest suggesting that learning to use the PDA may have contributed to greater CIS. Item level analysis revealed that intervention nursing students reported lower means on four of the five CIS items, i.e., making a medication error, not having clinical information, not being prepared for clinical and being evaluated unfairly (Table 6). The mean stress was lower for intervention students on one CIS item means, not having correct information, but only approached significance, p <.077.

Research Question 2: Computer Attitudes and Competence

The entire sample of nursing students displayed relatively positive Attitudes Toward Computers (ATC), 3.66, although mean Computer Competence (CC), 3.31, was somewhat lower (Figure 2). A significant increase in student nurses' CC was seen over the 6-week rotation for both the intervention and comparison groups (Table 3). The significant increase in mean CC for the total sample (post-test, 3.51; pretest, 3.26, p = .000) (Table 4) suggests all nursing students from both nursing programs experienced learning opportunities that enhanced their computer competence. Student nurses' ATC were relatively stable with no significant change over the clinical rotation when the means are examined by group (Table 3) or with the entire sample of students combined (Table 4). The high mean ATC and relative stability of scores suggest the nursing students in the study had a preset level of computer attitudes upon which the study intervention had little impact.

Research Question 3: Nursing Information Use

The pretest Nursing Information Use Scale (NIUS) mean for the total sample of nursing students was 3.74 and indicated relatively high use of nursing information sources. The student nurses most often used Traditional (TI), 4.22, followed by Interpersonal (II), 3.36, and Journal (JI), 2.7 information sources (Figure 2). The high reported use of TI sources, likely reflects the common use of nursing textbooks as information sources in the undergraduate nursing program. This likely reflects the fact that all nursing students are assigned course textbooks to support information for clinical practice.

	Intervention (N = 20)				Control (N = 40)			
	Pretest	**Posttest**	***t***	***p***	**Pretest**	**Posttest**	***t***	***p***
Traditional texts	4.60	4.70			4.78	4.68		
Quick reference guide	3.65	3.90			4.28	4.23		
email	3.80	3.90			4.12	*3.85*		
Electronic drug	**2.45**	**3.75**	**-4.33**	**.000**	2.73	2.63		
Journal review papers	2.95	3.20			**2.73**	**3.28**	**-2.22**	**.032**
Structured abstracts	3.21	3.16			2.70	3.00		
Nurses	3.75	3.80			3.48	3.70		
Phone or ask professional	3.55	3.1			2.80	3.13		

Table 5. Dependent Paired t Tests of NIUS Items

The NIUS mean was significantly lower at the end of the clinical rotation, t = 3.44, p = .001. Group analysis revealed that nursing students in the control group demonstrated significantly higher use of JI at posttest compared with pretest, *p* = .04 (Table 3). No significant changes for JI, TI, or II for the whole sample (Table 4) provided little evidence of a treatment effect for the PDA intervention. However, NIUS item level comparisons of

specific sources of information revealed interest differences (Table 5). For example, the comparison group reported significantly greater use of journal review papers compared with the intervention nursing students, p <.032. Furthermore, significantly higher use of electronic drug references among the intervention nursing students, p = .000, suggested an intervention effect as one of the e-resources on the PDA was a drug guide.

	Intervention (N = 20)				Control (N = 40)*	
	Pretest	**Posttest**	***t***	***p***	**Pretest**	**Posttest**
Making Med error	**4.35**	**3.70**	**2.9**	**.008**	3.53	3.78
Not having Clinical information	**3.85**	**3.05**	**2.9**	**.009**	3.25	3.33
Not Having correct information	3.80	3.25	1.87	.077	3.25	*3.15*
Not prepared for clinical	**3.95**	**3.25**	**2.41**	**.027**	3.18	3.05
Being evaluated unfairly	**3.30**	**2.70**	**2.35**	**.030**	3.00	3.23

*No significant differences for Control group means

Table 6. Dependent Paired t Tests of Mean Item CIS Differences

Discussion

Stress and Nursing Students

The lower stress level for all nursing students at posttest suggested that completion of the clinical practice rotation, rather than the intervention, was the likely stress-lowering factor. Higher clinical information stress at pretest for the intervention students and the significant lowering over the clinical rotation suggested the initial learning to use the PDA software may have provoked stress or frustration. This finding suggests the need for more extensive orientation to the PDA before its use in clinical practice. Furthermore, a

longer intervention period might have resulted in significant intervention effect. It is recommended that future researchers measure and/or control for other factors that may affect stress, such as the acuity and type of unit where the student practiced the clinical rotation (Escot, Artero, Gandubert, Boulenger & Ritchie, 2001; Jones & Johnston, 1997), level of social support (Gammon & Morgan-Samuel, 2005; Lo, 2002), coping skills (Tully, 2004), and type of nursing program (Pryjmachuk & Richards, 2006).

Use of nursing Information

The high use of traditional information sources such as textbooks and reference guides compared with journal information by students in this study is consistent with findings from the lresearch literature about practicing nurses who rely on textbook resources weekly and journal articles only monthly (Royle, Blythe & Potvin, 2000). Lower use of journals may be explained by limited access to computers (Levett-Jones *et al.*, 2009), lack of database searching skill, and/or lack of understanding of research terminology or the academic writing style commonly used in published articles (Brown, Wickline, Ecoff & Glaser, 2008; Van Patter Gale & Schaffer, 2009). Like practicing nurses, nursing students in this study also seemed to prefer practical types of information (i.e., drugs, intravenous medications, drug compatibility) often found in textbooks and quick resources (Doran, 2009). The potential intervention effect for electronic drug references suggests that the PDA access to the Drug Guide improved student nurses use of information. The lack of any other significant differences in information used by student nurses suggests either the intervention had limited effect on the study variables or that greater time with the PDA intervention may have been needed to alter information use patterns of the nursing students.

The unexpected finding of lower expectations of computers among the intervention students at post-test may be explained by a realization that while the PDA is a 'backup brain' (Stern, 2007) and information source at the point of care (Doran, 2009), it can never replace sound nursing clinical judgement. Access to technology and information is not sufficient to promote evidence-based nursing practice (Doran, 2009). Student nurses, like practicing nurses, may benefit from having PDA access to the best information and use of a 'pull' strategy, or automatic delivery of relevant information alerts and reminders (Doran, 2009).

Computer Attitudes and Competence

Student nurses in this study had positive, stable attitudes toward computers and computer competence improved over a six-week rotation. These positive findings suggest that theoretical, practice and lab courses provide appropriate learning experiences. The high level of computer competence suggests that nursing faculty are acting as positive role models to promote acceptance and use of technologies as information tools (Hebert, 2000). A recent US survey of nursing informatics requirements in nursing programs noted that less than 25% of courses used handheld computers, or PDA's, as a means to retrieve information or evidence to support nursing practice (Thompson & Skiba, 2008). Use of PDA's as information tools may potentially help practicing nurses solve information problems and learn more effectively (Doran, 2009) and the same is likely true for nursing students.

Some limitations of this study included a relatively small sample size (especially the intervention group), convenience sampling, a non-equivalent comparison group, and lack of random assignment of students to groups. A social response set bias, where students wanted to impress their faculty, may have resulted in more favourable responses on nursing

information use, computer attitudes and competence. A non-equivalent comparison group likely increased bias and confounders as the students from the two university sites may have differed in ways not measured in this study. These limitations diminish the confidence and the conclusiveness on the true impact of the PDA nursing information management system on nursing students' use of information sources, stress levels, and computer competence and attitudes. Recommendations for future research include a larger sample, use of random assignment, and careful timing of measurement of outcomes. Future research could include a longer orientation period for students to learn to use the information management intervention before stress level is measured and a longer intervention period to ensure students have full opportunity to apply the system within their clinical learning.

Conclusions

Although the nursing students in this study reported positive computer attitudes and high computer competence, they reported more frequent use of traditional textbooks and reference guides as information sources. Despite this high use of textbooks as information sources, the intervention students reported a significant increase in use of electronic drug resources by the end of the six week rotation. While this pilot project shed some light on the stress levels, computer competence and attitudes, and sources of information used by nursing students, further research is needed to determine best teaching approaches and tools to promote informatics competence. There is a need for more extensive planning and integration of informatics learning and tools within the curriculum such as that described by a group of nurse educators who integrated PDA's into each year and course of their nursing curriculum with connections among the classroom, lab and clinical learning strategies (Bauldoff, Kirkpatrick, Sheets, Mays & Curran, 2009).

A planned, comprehensive approach that includes collaboration with the university librarian and information technology systems would more likely improve student nurse use of information sources while lowering stress and enhancing computer attitudes and competence.

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