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Margaret M. Hansen EdD, MSN, RN
University of San Francisco, mhansen@usfca.edu

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Nursing Students' Attitudes Toward Technology: A National Study

Maag, Margaret M. EdD, RN

Author Information

Author Affiliation: Assistant Professor, School of Nursing, University of San Francisco, San Francisco, Calif.

Correspondence: College of Nursing, University of San Francisco, San Francisco, CA 94117

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Abstract

Nursing students' predispositions toward technology may be a factor affecting their use of technology in educational and clinical settings. A national survey was conducted to collect attitudinal measures toward technology and data on technology instruction to assist educators with developing information technology curricula. Outcomes indicate an overall positive attitude toward technology; however, participants reports of formal education in the use of technology applications are low. This shortcoming should be addressed through enhancement of nursing core curriculum.

Nursing students' attitudes toward technology (ATT) may influence their successful adoption of information competencies, willingness to learn computer systems, and ultimately, the use of technology to improve patient safety.¹⁻³ Nurse educators are in a position to develop curricula that include information technology (IT) solutions that will prepare the nurse for meeting the Institute of Medicine's core competencies and the Joint Commission on Accreditation of Healthcare Organization's national patient safety goals.^{4,5}

Research findings indicate that an individual's attitude is an integral part in the successful use of IT, computer systems, and computer-based instruction.⁶⁻⁸ Nursing graduates possessing a good sense of technology will be better prepared to interact with clinical information systems and clinical decision support systems. Tanner et al⁹ found that nursing information literacy plays a critical role in the implementation of evidence-based practice in different healthcare settings. However, current research regarding nursing students attitudes relative to the use of technology is lacking.

Attitudes

Research literature reflecting nurses' attitudes toward computers and IT has assessed nurses' individual characteristics, satisfaction with the use of computer technology, and overall dispositions.^{8,10-14} In 1999, Sinclair and Gardner¹⁵ reported nursing students' dispositions toward working with computers shortly after their entrance to a nursing program in Northern Ireland. Participants (N = 734) in this study with no previous computer training scored significantly lower on confidence ($P < .000$) and motivation factors ($P < .01$) in the use of IT. However, participants who were older than 22, men, and had "no degree" reported "greater knowledge of computers" when compared with the other groups that were 21 or younger, women, and held a degree. Dillon et al⁸ found that nurses' overall attitude toward a newly implemented electronic patient record system was favorable. Their findings identified a nurse's age as playing a significant role ($P = .05$) when interacting with the electronic system,⁸ with the older participants achieving higher mean attitudinal scores.

Grady and Schlachta-Fairchild¹⁶ report on telehealth nurses (N = 1,500) job satisfaction. Of the 1,500 nurses representing 36 countries, 59% of the telehealth nurses' reported being happier caring for patients via e-mail, videoconferencing, or telephone connections versus in-person care. Eighty-nine percent of this sample agreed that telehealth applications should be included in the nursing education curricula and 75% requested a certification in telehealth nursing. The results from this telehealth nursing survey indicate that telenursing will become more prevalent due to the increase in the aging and chronically ill population, therefore indicating more of a need for telehealth education.

Bandura¹⁷ stated a person's belief or confidence in their ability to be successful for any given behavior or task has a direct influence on their performance, persistence, and behavioral choices. This implies that having IT learning objectives for students will enhance their self-efficacy in using technology.

Technology Skills

Nursing students are requested to demonstrate technology skills and related knowledge of basic computer skills upon admission to schools of nursing (SONs). The use of a word processor (eg, Microsoft Word), presentation software (eg, PowerPoint and LiveSlideShow), Web-based search techniques (eg, Medline), spreadsheets (eg, Excel), databases (Access), e-learning software (eg, Blackboard), and statistical programs (eg, SPSS), as well as constructing and editing Web pages (eg, Dreamweaver), are common prerequisite skills.¹⁸

Some nursing students lack computer and IT skills due to a dearth of formal instruction. Leino-Kilpi et al 19 reported a paucity of computer-assisted instruction and formal education in IT (EIT) for nursing students. In addition, some hospital administrators restrict the use of computer information systems to only nursing staff. Therefore, nursing students' hands-on acquisition of computer information system skills before graduation is limited.

Tanner et al 9^(p937) stated "gaps in information literacy knowledge and skills of all groups of nurses, leading to the hypothesis that these limitations exist on a national level." The participants in their study reported a lack of expertise using electronic databases to conduct research. These same nurses admitted having "less than average" computer skills and very little time to search for electronically stored information. Seventy-three percent of the nurses enrolled in the national study conducted by Tanner et al 9 reported not receiving formal education in the use of electronic databases.

Methods

A primary aim of this study was to examine nursing students' attitudes relative to the use of technology as a guidepost for nurse educators. Because studies to date have focused primarily on nurses' and teachers' ATT, the author focused on questions pertaining to students' attitudes by exploring (1) confidence in using technology, (2) value of using technology, and (3) perceptions of technology and its usefulness in educational and professional settings. A second aim of this study was to determine if participants' demographic characteristics and self-reported formal EIT (eg, electronic databases, personal digital assistants [PDAs], Web site design) have a significant affect on nursing students' ATT. Furthermore, demographic characteristics were examined in relation to EIT scores.

Setting

Fifty-two SONs (17 private, 17 public, and 18 religious) located in 4 regions (16 East Coast, 15 Midwest, 15 West Coast, 5 offshore, and 1 distance education) were invited to participate in the study. Of these, 28 contacts (10 private, 9 public, and 9 religious) located in 3 regions (Alaska and Hawaii were collapsed into the West Coast region) agreed to participate. Data were collected from 21 (7 private, 7 public, 7 religious) SONs (7 East Coast, 6 Midwest, and 8 West Coast) accredited by the Commission on Collegiate Nursing Education. Inclusion criteria included undergraduate and graduate students currently enrolled in a university baccalaureate or higher-degree

program. The study was conducted at the 21 universities after approval from each SON and ethical review board(s).

Participants

The findings are based on a convenience sample of 743 participants, with women constituting 89.5% ($n = 665$) of the sample and men 9.8% ($n = 73$), with less than 1% or 5 participants not reporting their gender. The percentage of men (9.8%) participating in the study is higher than the reported percentage of men (8.4%) enrolled in SONs in the United States during the fall 2004 academic semester.²⁰ The age of the students ranged from 17 to 65 years ($M = 29.10$, $SD = 11.16$), with 1.5% not reporting age. The participants' demographic information according to academic level and region is presented in Table 1. A subset of the schools ($n = 6$) provided demographic enrollment data for the fall 2004 academic year, and these data indicate approximately a 7% participant rate of the eligible nursing students.

Table 1

Data Collection Procedures

A questionnaire comprised 3 sections: (1) demographic details, (2) self-assessment of formal instruction in the use of 8 ubiquitous technological tools, and (3) the Technology Attitude Scale (TAS),²¹ which was mailed to the deans/directors of SONs. A link was provided for the same information in a Web-based format. Although Internet usage is high among college-age students,²² I gave the participants the option to complete the questionnaire in a paper-based format that included a postage-paid return addressed envelope. The dean/director of the SON provided the student participants the paper-based questionnaire or the link to the Web-based questionnaire via a mass e-mail to the students. Both formats included participants' instructions and consent forms. One hundred five (14%) student participants completed the paper-based questionnaire. The number of student participants ($n = 630$; 86%) completing the Web-based questionnaire supports the idea that Web-based surveys may offer high-quality samples from populations who frequently use the Internet.²³

The Instrument

To predict factors that may affect nursing students' overall ATT, the questionnaire asked the participant to lend information about age, gender, academic level, and the name of the university/college the student was currently attending. After the demographic section, the participant was asked to indicate the formal education in technology received during nursing school. The 8 technological tools listed in the questionnaire were (1) word processing (eg, Word), (2) Internet browsers (eg, Internet

Explorer), (3) use of software (eg, graphics, financial, project management), (4) use of hardware (eg, computers, projectors, cameras), (5) Web-design programs (eg, Dreamweaver or Front Page), (6) Databases (eg, Oracle, MySQL), (7) e-mail clients (eg, Eudora, Outlook), and (8) PDA (eg, Palm Pilot).

McFarlane et al 21 originally designed the TAS to determine teachers' ATT. After the evaluation of the original 20-item TAS,²¹ the TAS item statements were modified to fit a student population by removing terms directed at teachers, and the modified 15-item TAS comprises the third section of the current study's questionnaire. The TAS statements are illustrated in Table 2 and explore positive and negative ATT. For the analyses, the rating scales of the negatively worded statements were reversed. The mean score obtained from the 15 typical 6-point Likert rating scales (range: 1 = strongly disagree to 6 = strongly agree) was used to measure participants' ATT. The term "technology," for purposes of this study, means computers, databases, e-mail, PDAs, software, hardware, and use of the Internet.

Table 2

Validity and Reliability of the TAS

McFarlane et al 21 tested the reliability of the original 20-item TAS that includes 7-point Likert rating scales, ranging from "Not True" to "Very True," by administering the scale to a small sample of foreign language teachers (N = 17) before and after a pilot teacher-training program, and the TAS scores had a Cronbach [*alpha*] of .92 and .95. The aforementioned researchers found the TAS scores of 86 foreign language teachers participating in their full experimental study as having a Cronbach [*alpha*] of .92 and .85, respectively.

Content validity was determined by reviewing the research conducted by McFarlane et al 21 and the original 20-item TAS statements. A pilot group of students (N = 193) attending a West Coast university filled out the revised paper-based 15-item TAS. The value for the reliability coefficient was .88 (significant at the .05 level) indicating satisfactory reliability.

Statistical Analysis

The data gleaned from the TAS were analyzed using the independent-samples *t* test for gender, and analysis of variance (ANOVA) was conducted to determine mean differences for age, academic level, type of university/ college attending, and self-reported EIT and student participants' TAS scores. Factor scores from the TAS were obtained by conducting a factor analysis. All statistical evaluations were conducted using SPSS 11.0 statistical software.

Results

Demographics and Technology Attitudes

When creating course design and interacting with learners, it is an educator's primary goal to understand who comprises the audience of learners. Therefore, gender and age are important factors to consider when evaluating students' IT learning needs. As displayed in Table 2, TAS item responses 1, 4, 6, and 8 gathered similar mean scores indicating participants agreeing that learning about technology and knowledge of technology is important during academic and professional careers. Of the 743 student participants, 688 (93%) "moderately" to "strongly" agreed that it was "important to know about technology for a future career." Whereas the participants' views about the "benefits of technology" and "confidence in their ability to learn about technology" during their career as a student were illustrated in TAS item responses 3, 10, 11, 13, and 15.

Overall, the participants "moderately" agreed "liking to use technology" ($M = 5.24$, $SD = 0.97$). Factor 2 response items illustrate participants' "lack of self-efficacy" in using technology. The TAS item responses 7, 9, 12, and 14 portray student participants' comfort level associated with using technology. Overall, the participants' mean scores for factor 2 statements had the widest SDs indicating a broader range of responses. However, most of the TAS item responses indicate a positive ATT. Of the 743 participants', the overall mean TAS score was 5.11 ($SD = 0.77$).

The independent variable, age, was divided into 2 groups, ≤ 21 or ≥ 22 years old, and the dependent variable was the participant's mean TAS score ($P \leq .05$). The 1-way ANOVA was significant, $F_{1,733} = 14.87$, $P = .000$. The younger group (≤ 21 years old, $n = 348$) demonstrated a lower mean TAS score ($M = 4.99$, $SD = 0.81$) than did the older group (≥ 22 years old, $n = 387$; $M = 5.21$, $SD = 0.74$) at the 95% confidence level. More specifically, the younger group demonstrated a lower mean "confidence level in their ability to learn about technology" (item response 3) score when compared with the older cohort of students. This was confirmed by conducting a 1-way ANOVA and it was significant, $F_{1,731} = 11.87$, $P = .001$. However, the older group of student participants reported a higher mean TAS item 2 score, "liking to use technology," when compared with the younger group. The 1-way ANOVA was significant, $F_{1,731} = 6.37$, $P = .012$, therefore confirming this finding. The participants' TAS results are provided in Table 3.

An independent-samples t test was conducted to determine if the hypothesis that gender has an effect on students' ATT. The test was not significant, $t(736) = -1.28$, $P = .199$. However, males ($n = 73$) demonstrated a higher mean "confidence level in ability to learn about technology" score when compared with the female cohort ($n =$

663). A 1-way ANOVA was conducted and was found to be significant, $F_{1,734} = 6.74$, $P = .010$. These data are shown in Table 3. The issue of gender in relation to learning about technology and other sciences has been reported in the literature 24 and recently debated among academicians.25

The independent variable, academic level, as shown in Table 3, was divided into 6 groups, ranging from undergraduate freshman to doctoral students, and the dependent variable was the participants mean TAS scores. The ANOVA was significant, $F_{6,736} = 2.28$, $P = .035$. After this analysis, the 6 groups were collapsed into 2 groups, undergraduate ($n = 501$) and graduate levels ($n = 168$). The ANOVA was significant, $F_{1,667} = 9.34$, $P = .002$, thereby indicating graduate students demonstrating a higher mean TAS score. Based on a hypothesis that graduate students are perhaps more confident in general than undergraduate students, as a product of age, an analysis of the collapsed academic levels and "confidence level in ability to learn about technology" was conducted. The 1-way ANOVA was found to be significant, $F_{1,665} = 10.70$, $P = .001$, indicating graduate students having a higher confidence level in learning about technology.

Self-Reported Education in Technology

The participants were asked to answer the question, "Have you received specific instruction in any of the following during your nursing education?" by checking a box for each listed technology application. A 1-way ANOVA was conducted to ascertain an interaction between student participants' self-reported EIT and mean TAS scores. The test indicated no significant interaction between EIT and students attitudinal measures, $F_{8,734} = 0.527$, $P = .836$. The results counter the research hypothesis of the amount of IT education having a direct effect on a nursing student's overall ATT.

Of the 743 students who responded to the question regarding EIT applications, 374 (50%) and 332 (45%) stated having instruction in e-mail clients and Internet browsers, in that order. The percentage of student participants' reporting education in the use of word processing, computer software, and computer hardware, as well as databases in this study, was similar (32%, 31%, 26%, and 30%, respectively). A small percentage of students stated education in Web site design (7%) and the use of handhelds, such as PDAs (7%). To further elucidate student participants' ($N = 743$) formal EIT applications, an EIT score was calculated by assigning a 1 for each checked box and a 0 for all unchecked boxes next to the 8 IT applications listed on the questionnaire. A 1-way ANOVA was used to determine if age affected the student participants' mean EIT scores. The test was significant, $F_{1,733} = 3.74$, $P = .05$. The younger group (≤ 21 years

old) demonstrated a higher mean EIT score ($M = 2.43$, $SD = 1.95$), thereby indicating more exposure to educational opportunities during nursing school than the older cohort of students (≥ 22 years). These data findings are illustrated in Table 3.

A 1-way ANOVA was conducted to determine an interaction between academic level and EIT mean scores. The independent variable, academic level, was significant, $F_{1,667} = 16.99$, $P = .000$. The undergraduate cohort ($n = 501$) reported more EIT ($M = 2.48$, $SD = 2.00$) applications during nursing school when compared with their graduate counterparts' ($n = 168$) mean EIT scores ($M = 1.76$, $SD = 1.74$). The 1-way ANOVA was significant, $F_{6,736} = 4.75$, $P = .000$, for each academic level and mean EIT scores. The cohort of student participants displaying the lowest EIT mean score was the undergraduate freshman ($n = 63$; $M = 1.83$, $SD = 2.00$) and the doctoral students ($n = 43$; $M = 1.49$, $SD = 1.37$). Whereas the undergraduate juniors ($n = 185$) and seniors ($n = 182$) reported a mean EIT score of 2.69 ($SD = 1.98$) and 2.56 ($SD = 2.07$), respectively. A post-hoc analysis was conducted, and the Dunnett t (2-sided) results showed pairwise differences between the undergraduate junior cohort and the doctoral students (1.20, $P = .002$), as well as between the undergraduate senior cohort and the doctoral students (1.07, $P = .006$). The total mean EIT score for the groups combined ($N = 743$) was 2.28 ($SD = 1.99$). The cumulative percentage of students scoring 0 to 2 on the EIT measure was 59%. Therefore, over half of the sample responded to having formal instruction in 0 to 2 listed technology applications.

To determine a difference in the participant's mean EIT score in relation to the type of university/college the participant reported attending, a 1-way ANOVA was conducted. The independent variable, type of university/school (private, public, or religious), was significant, $F_{2,732} = 8.06$, $P = .000$. Students attending private universities ($n = 165$) demonstrated a higher mean EIT score ($M = 2.81$, $SD = 1.95$) when compared with the students attending public and religious universities. These data indicate nursing students attending private universities reported having more exposure to formal EIT applications. These data are also presented in Table 3.

Factor Analysis

A principal component analysis was conducted by using a maximum likelihood factor analysis to determine the dimensionality of the 15-item TAS variables. A scree plot indicated a hypothesis of unidimensionality as being false. Based on the results of the scree plot, 2 factors were rotated using a Varimax procedure. The TAS contains 9 items that clearly convey positive ATT and 6 items that express individuals' negative emotional views. The results of the rotated solution are highlighted in Table 2. The

results yielded an eigenvalue of 6.75 for factor 1 and 2.78 for factor 2, and accounted for 45% and 19% of the variance, in that order.

As portrayed in Table 2, item statements 1, 3, 4, 6, 8, 11, and 13 describe positive dispositions toward technology that pertain to "learning and knowledge" constructs. Item statements 2 and 10 express an individual's positive self-efficacy about using technology. This factor seems to highlight the participant's confidence that using and learning about technology will be beneficial. Item statement 15 loaded on more than 1 factor and was assigned to the factor that it loaded most against (.488 for factor 1 and .133 for factor 2). Item statements 5, 7, 9, 12, and 14 unveil an individual's negative attitude in regard to using technology (feelings of stupidity, anxiety, and uneasiness). The internal consistency of the TAS items was determined by calculating a Cronbach [*alpha*]. The Cronbach [*alpha*] is .89 ($n = 721$), showing the factors within the variables as highly interrelated. The item statement mean scores and SDs are provided in Table 2 and show the average agreement/disagreement of the participants' responses.

Discussion

The study's results indicate that nursing students attending universities across the United States have positive ATT. However, over half of the sample reported "no to little" formal EIT applications during nursing school. Either the IT curriculum was not offered or the students did not choose to take IT application courses. Contrary to common belief, the younger student participants displayed a significantly lower overall mean TAS score, lower confidence in ability to learn about technology, and a lower mean score in "liking to use technology." These data refute the assumption that younger students (≤ 21 years old) who have been exposed to technology throughout primary and secondary school have more positive views and confidence in learning about technology. Some educators assume younger students enjoy using technology; however, the data garnered from this study refute this idea. Perhaps younger students are bored with using technology or take it for granted because they have been raised in the information age. Overall, this cohort of younger students reported more exposure to IT educational opportunities during nursing school.

These data also indicate the undergraduate group of students having the most formal EIT applications. In the undergraduate cohort, the freshman participants reported the least amount of IT instruction, whereas the undergraduate junior and senior participants reported the highest amount of IT educational exposure when compared

with the underclassmen results. This is not surprising because some nursing schools' curricula do not include IT instruction at the onset of a student's academic career. These findings clearly have implications for nurse educators preparing students for employment in today's healthcare settings.

The data gathered from men and women were not significantly different for mean TAS and EIT scores except for the level of confidence in learning about technology. Male student participants reported a higher confidence level in learning about technology when compared with the female student participants. The significance is remarkable based on the difference in the male and female sample size. Because women are a majority in the nursing profession, these data elucidate the importance of evaluating female students' level of confidence in using and learning about IT applications during nursing school to assure that this group meets the required IT competencies.

This study investigated the differences in academic level in an attempt to determine undergraduate and graduate students' ATT and overall exposure to IT application education. These data indicate significant findings for differences between undergraduate and graduate nursing students. Overall, graduate student participants' reported higher TAS scores and specifically higher confidence levels in ability to learn about technology.

When compared with the undergraduate student cohort, the graduate students reported an overall lower EIT score. They reported less exposure to formal IT education during the nursing school experience. The graduate students seem to have an overall higher self-confidence and belief in the use of technology without the actual formal education.

Faculty teaching at the graduate level may examine the curriculum and consider offering more formal education in ubiquitous technical applications. For example, the use of handhelds (eg, PDAs) in clinical settings is increasing; students want to learn how to use them and know what type of PDA software is available to assist them with patient care and their overall learning. Graduate students studying for a doctorate reported the lowest exposure to IT education. Graduate students, who are traditionally older than undergraduate students, do have positive ATT, enjoy working with

technology, and therefore may be quite successful at using more IT applications in clinical and educational settings. There was no correlation between the amount of exposure to EIT during the participants' academic tenure and the participant's mean TAS score.

Student participants attending private universities showed the highest mean EIT score when compared with public and religious university participants. These data are remarkable considering the sample size associated with private university attendance. These findings suggest that private university nursing schools offer students more IT educational opportunities.

This study was limited by the convenience and self-reported sample, thereby preventing analysis of students' ATT on a larger population. Nonetheless, these data suggest that nursing students' overall ATT is favorable, therefore, perhaps indicating students' willingness to take IT courses if made available during nursing school. Upperclassmen at the undergraduate level seem to have had more training during nursing education when compared with new entrants to SONs and doctoral students. These findings indicate that undergraduate freshman and sophomore students could benefit from being exposed to healthcare informatics educational opportunities early in college, and educators of graduate programs could be more cognizant of offering a richer IT curricula. Early exposure to commonly used technology applications could serve as a framework for developing more sophisticated healthcare and nursing informatics courses that delve into hospital information systems, computer information systems, and telehealth that are becoming more prevalent in today's clinical settings.

Conclusion

This national study reveals nursing students' ATT as being positive; however, the student participants' reports of formal education in technology are low. Therefore, there are direct implications for nurse educators, curriculum developers, and SON administrators. Curriculum committee members should consider creating an entry-level technology skills test to determine students' level of technology competency upon admission to nursing school. In addition, educators need to know if today's nursing students are capable of transferring their present technology skills to nursing/hospital information systems in clinical settings or e-learning technologies used in academia. Threading technology courses throughout the nursing curriculum, with the goal of better

preparing students for this era of rapidly changing technological advancements, is paramount. An introductory course to nursing/healthcare informatics should be required of each student graduating from an SON. This educational imperative will assist future nurses to demonstrate informatics competencies at the point-of-care and assist interested future nurse educators to use appropriate ubiquitous e-learning tools in classroom settings. The initial aim of this study was the assessment of students' ATT; however, the results led to the development of important recommendations for future nursing curricula enhancements.

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