Computer Literacy in a Traditional Nursing Program: A 7-Year Study to Identify Computer-Based Skills Needed for Success

Mona P. Ternus
Associate Professor
University of New Mexico
College of Nursing
Albuquerque, NM USA
MTernus@salud.unm.edu

George F. Shuster
Associate Professor
University of New Mexico
College of Nursing
Albuquerque, NM USA
Gshuster@salud.unm.edu

Abstract

Computer literacy is critical to student success in higher education today. Assessment of student knowledge related to computers is generally for either hardware capabilities or overall ability, without an assessment of specific computer competencies. The focus of this study was to identify the literacy level of nursing students over a 7-year period to assess which computer competencies need the most support and development and to determine how literacy levels varied in successive years. A convenience sample (N = 401) of undergraduate nursing students admitted from 1999 to 2005 were given an assessment of computer literacy at the beginning of the upper-division nursing program. Results indicated that the literacy of students increased with each successive group of students. Literacy varied across technological functions, with students having the lowest literacy levels in the data inquiry skill set, and students who owned computers were more computer literate than those who did not. An assessment of general computer literacy can provide an overall appraisal of computer competency, but it is important to examine the separate dimensions of specific skills within general knowledge, as these are the points on which faculty will need to focus.

Keywords: computer skills, online learning, student assessment

Introduction

Computer literacy is a critical competency for the success of undergraduate students. Many programs either enhance courses with online learning platforms or deliver courses completely online. With the diverse populations attending the traditional 4-year Bachelor of Science in Nursing (BSN) program at our institution, a varied level of skill and competency was evident in classes of incoming students. The focus of this study was to identify the literacy level of nursing students over a 7-year period to assess which computer competencies needed the most support and development and to determine how literacy levels varied in successive years. Computer literacy is defined for this study as technical skills and level of competency in four areas: general computer knowledge, documents and documentation, data inquiry (databases and search engines), and communications and surfing.

Literature Survey

Use of Online Learning Platforms in Higher Education

Universities are reporting that online learning is critical to delivering and maximizing programs for students. More than 96% of universities with over 15,000 enrollments offer online courses, and an estimated 3.2 million students were taking at least one online course in Fall 2005, marking a substantial increase over 2.3 million students the previous year (Allen & Seaman, 2006). Palloff and Pratt (2001) reported that almost 90% of institutions with enrollments of 10,000 or more are offering some form of Internet-based learning. Allen and Seaman (2006) reported that 62% of academic leaders believe the learning outcomes in online education are superior to or the same as those in a face-to-face classroom.

Hosie and Schibeci (2005) noted that learning through online platforms is a mega trend. Predictions regarding the virtual university of the world without any national boundaries have been prevalent in the literature (Moe & Blodget, 2000; Taylor, 2001), with a slow but steady shift in this direction. There have been many proponents of the use of Internet technology as a tool for delivering health science education (Cobb & Baird, 1999; Franck & Langenkamp, 2000; Thurmond, Wambach, Connors, & Frey, 2002), as well as those who address the challenges of this delivery method (Frase-Blunt, 2000; Monke, 2005/2006; Reynard, 2007; Schmitt, Titler, Herr, & Ardery, 2004; Sit, Chung, Chow, & Wong, 2004). Among academic leaders, 73% believe that online education reaches students not served by the face-to-face programs, and 58% rate online learning as critical to the long-term strategy of the institution (Allen & Seaman, 2006). There is no doubt that online learning is vital to all disciplines involved in education today.

Computer Literacy

The most critical barrier noted by 64% of academic leaders is the need for more discipline on the part of online students (Allen & Seaman, 2006). Reynard (2007) observed that in online education, there is increased learner autonomy where students are central to their own learning process and need to maximize self-direction, organization, and interactions. Computer skills and competencies are one of the factors cited as essential for student success with online programs. The ability to leverage the Internet and the chosen online learning platform for information, research, communication, and interaction are critical to student motivation, persistence, and success (Bernard, Brauer, Abrami, & Sturkes, 2003; Tyler-Smith, 2006). Technical problems and a low level of student technical skills are two of the top eight factors considered as posing the most significant barriers to online learning (Muilenburg & Berge, 2005).

Measures of Computer Literacy

Many measures exist for assessment of program management and outcomes, faculty teaching, and structural organization of online courses (Billings, 2000; Jairath & Stair, 2004; Keinath & Blicker, 2003; Phipps & Merisotis, 2000; Richard, Mercer, & Bray, 2005; Williams, 2003; Wolf, & Stevens, 2007), but there are far fewer measures for assessing the technical skills associated with student competencies needed for success (Kirkwood, 2006; Osika & Sharp, 2002; Yu, Kim, & Roh, 2001). Kirkwood (2006) specifically explored the potential for mismatches between faculty assumptions and student competencies by surveying 1,017 students, and more than half of the students surveyed identified the following specific areas as those needing the most skill development: creating and manipulating images (61%), finding and using information effectively (60%), using electronic resources (e.g., libraries; 60%), understanding more about information computer technology generally (59%), building a website (53%), and using a computer for studying (52%). This same population was most experienced with word processing (73%), communicating with other people using e-mail (61%), and getting information from the Internet (54%). A survey of 257 students by Yu et al. (2001) concluded that skills and knowledge of computer technology and use of the Web should be provided formally or informally to facilitate online learning. This provision of formal or informal help to facilitate online learning is important because Osika and Sharp (2002) found that many students did not possess the technical skills required for success in online courses.

Learning Styles and Level of Literacy

There are multiple studies of learning styles, online learning satisfaction, and ability (Beyth-Marom, Saporta, & Caspi, 2005; Butler & Pinto-Zipp, 2006; Du, 2004; Graf, Viola, & Leo, 2007; Heiman, 2006; Lu, Yu, & Liu, 2003; Neuhauser, 2002; Richardson, 2007; Speth, Lee, & Hain, 2006). Lu et al. (2003) found that students were able to learn equally well in online courses despite differences in learning styles. Neuhauser (2002) compared learning styles and outcomes of students in two sections of the same course; one section was online, and the other was in the traditional classroom. She found that there were no significant differences between learning styles/preferences and the effectiveness of learning activities in either group. Butler & Pinto-Zipp (2006) explored learning styles in relationship to student preferences for online methodologies (N = 96) and found that students preferred asynchronous methods (99%) along with a high degree of interaction. They also found that students enrolled in the online course predominantly displayed a dual learning style (56%). Beyth-Marom et al. (2005) specifically looked at synchronous versus asynchronous materials and student learning preferences, and found that those students who preferred synchronous materials had stronger inclinations toward the positive aspects of interaction and scored lower on the need for autonomy and access to learning materials. In 2004, Du found a significant relationship between student satisfaction with online learning for those students with an accommodating learning style and computer literacy/competency.

Overall, the literature reveals that computer literacy is a key component for success with online education. A gap in the literature exists related to specific student skills assessment and evaluation.

Purpose of This Study

The purpose of this study was to measure and evaluate the literacy level of three groups of undergraduate nursing students entering an upper-division university BSN program, categorized according to their year of entrance into the college. The nursing students were admitted to the program in their junior year following completion of university core courses and required prerequisites. The authors hypothesized that the literacy levels would increase for each successive group among three groups of basic undergraduate students admitted to the program over the 7-year period of the study. Another hypothesis was that computer literacy varied across technological functions, with students having the lowest literacy levels in the data inquiry skill set. The final hypothesis was that students who owned computers would be more computer literate than those who did not.

Methods

Sample

The College of Nursing has three different groups of students that enroll in the baccalaureate program: second-degree students, who already have a baccalaureate degree and are returning for a nursing baccalaureate degree; associate-degree-to-baccalaureate students; and basic students who have completed 2 years of university courses, including all of the nursing prerequisite courses, and are entering their junior year after being accepted into the upper-division nursing program. The students in this convenience sample (N = 401) included seven incoming year-groups of basic students who completed a computer literacy survey at the start of their nursing program over a period of 7 years, from 1999 to 2005, as shown in Table 1 (all tables appear at the end of the narrative). Undergraduate enrollment data indicated that 42% of the students were minorities (29% Hispanic, 10% American Indian, and 3% Asian/Black). Women made up 94% of the total sample.

Measures

The Computer Literacy Survey was originally developed at the University of Oregon as a student self-assessment questionnaire. It was used with permission and modified for use in this study to help determine if students needed additional training or practice to meet the computer-related requirements of the nursing degree program. This computer literacy survey consists of 40 Likert-type questions measuring four specific dimensions of computer literacy (10 questions in each subscale): General Computer Knowledge (software and hardware), Documents and Documentation (word processing), Data Inquiry (data bases and search engines), and Communication and Surfing (e-mail, computer conferencing, and the Web). Each dimension is scored separately, with higher scores indicating a higher

level of computer literacy. Internal consistency for this sample, as measured by Cronbach's alpha, ranged between 0.89 and 0.64.

Completion of the survey takes 10 to 15 minutes. Potential scores range from 0 to 80 for the overall survey and from 0 to 20 for each of the four subscales. To determine their level of literacy, students answered each question using a 3-point Likert scale: 2 points for "yes," 1 point for "not sure, but likely," and 0 points for "no or unlikely." Students were also told that if they scored 16 points or more for any of the four specific dimensions of computer literacy, they probably had the skill level needed in that specific dimension for this BSN program; but if they scored between 10 and 15, although they had a significant amount of familiarity, they were given the suggestion that it would be beneficial to develop additional computer literacy skills in that specific dimension. If students scored below 10, they were advised to obtain additional training or practice in order to be successful applying those skills in the online education environment.

Procedure

Following approval from the Institutional Review Board, a survey design was used to collect data over a period of 7 years, as each cohort of basic undergraduate students enrolled at the start of their upper-division program in a required course. This computer literacy survey was given at the beginning of that course.

Data Analysis

SPSS 15.0 was used for data analyses. Students were divided into three groups based on the year they were admitted to the nursing program. The first, or early, group was admitted in 1999 and 2000 (n = 64); the second, or middle, group was admitted in 2001 and 2002 (n = 110); and the third, or most recent, group was admitted from 2003 to 2005 (n = 227). These three groups paralleled the progressive integration of Web-enhanced and fully online Web courses during the 7-year period of the study into the program curriculum. In the beginning (early group), only a few courses were Web-enhanced, and no courses were completely online. From 2001 to 2002, more courses were Web-enhanced, and by 2003, when the most recent group was admitted, the faculty had made significant efforts to Web-enhance almost all courses, and basic students had the option to take some courses completely online.

Descriptive statistics were calculated for all demographic and study variables. As a preliminary step, data were first analyzed for normality, skew, and kurtosis as well as assumptions for parametric and nonparametric statistical analysis. Although the distributions of the dependent variable data were similar, the results indicated a negative skew for both the total computer literacy scale and some of the subscales. Results from Kolmogorov–Smironov tests for deviation from normality were small but significant (Pett, 1997). Consequently, the first hypothesis was tested by nonparametric statistics using the Kruskal–Wallace tests and, when appropriate, with post-hoc analysis using Mann–Whitney U tests. Assumptions for using both the Kruskal–Wallace test and Mann–Whitney U tests were met for all the tested hypotheses (Pett, 1997). The last hypothesis was tested using a Mann–Whitney U test. Each of the hypotheses was tested in turn.

Results

The first hypothesis stated that computer literacy levels would increase for each successive group among the three groups of basic undergraduate students admitted to the program over the 7-year period. Results of the Kruskal–Wallace tests and appropriate post-hoc Mann–Whitney U tests supported this hypothesis with significant differences for the Computer Literacy Survey overall ($X^2_{K\text{-}W\ (2,\ N=401)}$ = 10.00, $p < .007$) and for two of the four computer literacy subscales. The results of the Kruskal–Wallace test for the Communications and Surfing Subscale were $X^2_{K\text{-}W\ (2,\ N=401)}$ = 13.70 ($p < .001$) and $X^2_{K\text{-}W\ (2,\ N=401)}$ = 8.42 ($p < .015$) for the Data Inquiry Subscale. Mann–Whitney U post-hoc analyses for these three Kruskal–Wallace results are presented in Table 2.

The second hypothesis stated that computer literacy would vary among all three groups of basic undergraduate students across technological functions, with students having the lowest literacy levels in the data inquiry skill set. Results by group for the overall Computer Literacy Survey, the four subscales, and the individual items that made up each of the four subscales are presented in Tables 3 through 6, which appear at the end of the paper. The third hypothesis stated that the basic undergraduate students who owned computers would be more computer literate than those who did not. This hypothesis was tested by nonparametric statistics using a Mann–Whitney U test. Only 9% of students (33 of 371) who answered this question did not own a computer. Students who did not own a computer received a significantly lower score on the total computer literacy survey than those who did own one ($z = -4.34$, $p < .001$).

Discussion

The results indicated that the literacy of students did increase with each successive group of the three basic student groups admitted over the 7-year period, although the difference between groups 2 and 3 was not statistically significant. For the overall computer literacy, Data Inquiry, and Communications and Surfing Subscales, this hypothesis was partially supported with statistically significant post-hoc tests between the early year's group and the middle and most recent year's groups. The only statistically significant difference between the middle and most recent year's groups was for the Data Inquiry Subscale, with the most recent year's group scoring higher.

There were no significant differences between groups on the other two subscales of General Computer Knowledge and Documents and Documentation. Student knowledge was consistent with some areas over time in regard to general computer knowledge and word processing, but the greatest difference in data inquiry may be related to an increase in the number of bibliographic and other databases available and expectations of faculty for students to be able to access and utilize this data. It is not surprising that each successive year-group was more computer literate, as there are more expectations to be familiar with computers in primary and secondary education, and some high schools are requiring an online class for every student, as well as the application of technology within working and home environments. More resources are also available and computer use is prevalent in today's society.

Among all three groups of basic undergraduate students, computer literacy varied across technological functions, with students having the lowest literacy levels in the data inquiry skill set. This hypothesis was supported as students across all year-groups had the lowest scores in the data inquiry skill set and the highest scores in documents and documentation. Across all groups within the subscales, there were eight individual items in which students scored lower than 1.25. For the General Computer Knowledge subscale, the only item was "Do you know what a pathway is and can you find a file with a pathway?" For the Documents and Documentation subscale, the only item was "Do you know how to tell your word processor to paginate?" For the Data Inquiry subscale, there were four items: "Can you explain how the following fit together: file, records, and fields?"; "Have you ever used an electronic clinical information system?"; "Have you ever sorted a database to put the records in a particular order?"; and "Do you know what MESH stands for and how to use them?" For the Communications and Surfing subscale, there were two items: "Have you ever participated in asynchronous computer conferencing?" and "Do you know what SHOUTING is in an email message?" These items are important to emphasize as technical and process/interaction skills, particularly the MESH technique, which had the lowest scores. If students are not aware there is a common classification of subject headings, they will not be able to appropriately retrieve all resources and then sort them accordingly from a bibliographic database. Faculty cannot assume that students have these skills and need to ensure that either students already have these skills or these skills are taught at the outset of their course. Faculty may not realize the difficulties some individual students are experiencing, particularly in online courses because they do not have face-to-face interaction with students.

The third hypothesis that basic undergraduate students who owned computers would be more computer literate than those who did not own computers was supported by statistical analysis; however, there was only a small group of students who did not own a computer. Also, the effect size related to the impact of not owning a computer was relatively small. One reason that the impact was relatively small could be because students have access to computer laboratories at the university, at the public library, through friends and family, or at work. Because university students are required to submit projects and papers using computer software, most of them own their own computers.

Implications

How do you remediate computer skills if you are teaching an online program and you have students who are deficient in computer skills enrolled either on campus or at a distance? Can this be done with or without a computer from campus or at a distance? Do you use the computer itself to teach computer skills? With the advent of computer instant messaging, chats, and video chats, can you teach computer skills online, or should university programs consider providing modular instruction DVDs or Web-based tutorials for teaching computer skills? One finding of this study suggests that you cannot assume that students have all skills or that if they are proficient in some skills, they are proficient in all. There needs to be some assessment of the minimum computer literacy skill level necessary for success in individual courses or the program of study. If your assessment reveals problems, what are the resources that can be provided to remediate these computer skill deficits?

Most university programs assess the computer capabilities of students based solely on computer hardware requirements for taking Web-based courses. Consideration must also be given to the skills related to software, communication in an online Web-based course environment, and to the use of databases, particularly bibliographic databases, which are necessary for success at the university level. An Internet etiquette portion of instruction should also be included with all online courses so that students become familiar with the best ways to communicate online. For example, when all capitalized letters are used in a word, it may come across as if the writer is shouting, when in fact he or she may be just trying to emphasize a point.

In general, outcomes for both face-to-face and online methods of delivery are validated and have parity; however, there is little research on particular skills and identified competencies for students. This research clearly points to the need for further development of skills in data management and data inquiry, especially as the amount of information increases exponentially every year. As noted in the literature review, two of the most significant barriers are technical problems and a low level of technical skills (Muilenber & Berge, 2005). The purpose of technology is to enable distance education, not to create a barrier to it. For this to be the case barriers need to be identified and students need these fundamental skills to be successful.

An assessment of general computer literacy can provide an overall appraisal of computer competency, but it is important to examine the separate dimensions of specific skills within general knowledge, as these are the points on which faculty will need to focus. Certain skills, such as e-mail skills or knowledge of fonts, are consistently high and do not need further attention. Our study supported Kirkwood's (2006) findings about students' mastery of word processing skills. Some platforms for online learning guide the student and are easy and intuitive to use. Students will often be able to perform well within these environments until they need to supplement their learning with a search in a database, which is not as intuitive. Students then need support to access various ways of searching for credible, relevant, and timely sources, whether they be journal articles, data, or other resources. This finding also supports Kirkwood's study, which indicated that almost two thirds of the surveyed students needed better online database search skills.

Very few educators question the importance of computer literacy for success in today's educational system, but results from this and other studies suggest that faculty and administrators cannot assume that their students are computer literate across all of the areas required for academic success. The assessment of skills needs to be systematic and methodical, and it should occur at the beginning of an educational program to best facilitate student success. As computer literacy is related to student satisfaction (Du, 2004), assessment of skills will allow students to know that they have the skills necessary to navigate either on campus or within distance education program expectations. When assessment of computer skills indicates a deficit, academic programs need to provide options for remediation so the use of technology becomes an enabler for education and not a barrier to learning.

Acknowledgement

The authors wish to thank Anne Mattarella for her editorial support.

Table 1. Number of BSN Students by Year and Percentage of Sample

Year-Group	N (%)
1999	35 (8.6)
2000	29 (7.1)
2001	48 (11.8)
2002	62 (15.2)
2003	31 (7.6)
2004	153 (37.6)*
2005	43 (10.6)

*The numbers for 2004 are higher because of increased enrollment and students from both semesters participated. All other cohorts only had students from one semester participate during the year.

Table 2. Comparison of Year-Groups for Overall Computer Literacy and Two Subscales

Group	Comparison	Mann–Whitney z statistic	Test of significance
Overall Computer Literacy			
1 vs. 2	Early vs. middle	-1.85	.05
1 vs. 3	Early vs. most recent	-3.02	.002
2 vs. 3	Middle vs. most recent	-14.75	ns
Communication and Surfing Subscale			
1 vs. 2	Early vs. middle	-2.951	.003
1 vs. 3	Early vs. most recent	-3.66	.000
2 vs. 3	Middle vs. most recent	-.45	ns
Data Inquiry Subscale			
1 vs. 2	Early vs. middle	-2.67	.008
1 vs. 3	Early vs. most recent	-2.72	.007
2 vs. 3	Middle vs. most recent	-1.9	.05

Note: Group 1 indicates the 1999-2000 group (early years; n = 63), Group 2 indicates the 2001-2002 group (middle years; n = 108), and Group 3 indicates the 2003-2005 group (most recent years; n = 225); ns = not significant.

Table 3. Results by Group for the Questions in the General Computer Knowledge Subscale

	Group 1 1999-2000 Mean (SD)	**Group 2** 2001-2002 Mean (SD)	**Group 3** 2003-2005 Mean (SD)
Can you name one input device and one output device?	1.28 (.73) n = 61	1.36 (.74) n = 108	1.41 (.73) n = 225
Do you know what RAM stands for and how much RAM your computer has?	1.32 (.68) n = 60	1.20 (.74) n = 107	1.14 (.80) n = 224
Do you know what an "icon" is and what to do with it?	1.93 (.31) n = 60	1.98 (.14) n = 107	2.0 (.07) n = 224
Do you know how to use a mouse to "drag" an item?	1.93 (.35) n = 61	1.88 (.32) n = 108	1.97 (.16) n = 225
Do you know the acceptable form for a filename?	1.42 (.74) n = 60	1.44 (.68) n = 107	1.49 (.70) n = 224
Do you know what a pathway is and can you find a file with a pathway?	1.12 (.80) n = 60	1.06 (.79) n = 107	1.21 (.81) n = 224
Do you know what a modem is used for?	1.78 (.52) n = 60	1.86 (.38) n = 107	1.83 (.44) n = 224
Do you know how to reboot your computer?	1.49 (.84) n = 61	1.67 (.61) n = 108	1.81 (.50) n = 225
Can you find the command line on a Windows program screen?	1.52 (.65) n = 61	1.54 (.62) n = 108	1.49 (.69) n = 225
Do you know how to open up more than one program at a time in Windows and move quickly between them?	1.46 (.71) n = 61	1.84 (.48) n = 108	1.81 (.49) n = 225
Total Scale Score for General Computer Knowledge	15.76 (3.42) *n* = 62	16.25 (2.31) *n* = 110	16.27 (2.91) *n* = 227

Table 4. Results by Group for the Questions in the Documents and Documentation Subscale

	Group 1 1999-2000 Mean (SD)	**Group 2** 2001-2002 Mean (SD)	**Group 3** 2003-2005 Mean (SD)
Do you know what font or typeface is?	1.98 (.13) n = 60		1.99 (.15) n = 224
Do you how to right and left justify a document?	1.59 (.77) n = 61	1.77 (.57) n = 108	1.56 (.73) n = 225
Do you know how to cut and paste a block of text?	1.56 (.78) n = 61	1.77 (.61) n = 108	1.77 (.55) n = 225
Do you know how to use a mouse to "drag" a block of text?	1.68 (.57) n = 61	1.60 (.69) n = 108	1.69 (.62) n = 225
Do you know how to reset margins in your word processor?	1.46 (.74) n = 61	1.67 (.64) n = 108	1.50 (.73) n = 225
Do you know the difference between "Insert" and "Typeover"?	1.77 (.62) n = 60	1.76 (.55) n = 107	1.73 (.59) n = 224
Do you know what the clipboard does?	1.27 (.82) n = 60	1.42 (.75) n = 107	1.49 (.71) n = 224
Do you know how to tell your word processor to paginate?	.78 (.91) n = 61	.98 (.91) n = 108	.71 (.81) n = 225
Can you use a spell checker?	1.97 (.26) n = 61	1.98 (.14) n = 108	2.0 (.07) n = 225
Do you know how to create a page break?	1.0 (.89) n = 61	1.12 (.96) n = 108	1.33 (.84) n = 225
Total Scale Score for Documents and Documentation Skills	16.94 (3.10) *n* = 64	17.22 (2.28) *n* = 110	17.41 (2.42) *n* = 227

Table 5. Results by Group for the Questions in the Data Inquiry (Databases and Search Engines) Subscale

	Group 1 1999-2000 Mean (SD)	**Group 2** 2001-2002 Mean (SD)	**Group 3** 2003-2005 Mean (SD)
In a database do you know what a record is?	1.32 (.85) n = 60	1.24 (.73) n = 107	1.33 (.73) n = 224
Can you explain how the following fit together: file, records, and fields?	1.10 (.83) n = 61	.94 (.76) n = 109	.97 (.75) n = 226
Have your ever searched an electronic library catalog?	1.52 (.78) n = 62	1.73 (.65) n = 107	1.83 (.55) n = 224
Have you ever used an electronic clinical information system?	.63 (.84) n = 60	.84 (.87) n = 107	.80 (.90) n = 224
Have you ever used a personal database such as a computerized address list?	1.29 (.88) n = 62	1.44 (.86) n = 107	1.54 (.79) n = 224
Have you ever searched a database for a particular item?	1.63 (.68) n = 62	1.85 (.47) n = 107	1.89 (.39) n = 224
Have you ever sorted a database to put the records in a particular order?	1.03 (.91) n = 62	.96 (.89) n = 107	1.25 (.87) n = 224
Do you know what difference “AND” or “OR” would make in combining the results of two searches?	1.50 (.77) n = 60	1.73 (.58) n = 107	1.79 (.55) n = 224
Have you ever used a “search engine” (i.e., Yahoo, Infoseek, Medline, CINAHL)?	1.87 (.46) n = 62	1.96 (.27) n = 107	2.0 (.07) n = 224
Do you know what MESH stands for and how to use them?	.18 (.47) n = 60	.20 (.40) n = 107	.16 (.41) n = 224
Total Scale Score for Data Inquiry (Databases and Search Engines) Skills	11.98 (4.22) *n* = 63	12.85 (3.52) *n* = 109	13.58 (3.16) *n* = 226

Table 6. Results by Group for the Questions in the Communications and Surfing Subscale

	Group 1 1999-2000 Mean (SD)	**Group 2** 2001-2002 Mean (SD)	**Group 3** 2003-2005 Mean (SD)
Do you have an e-mail address?	1.93 (.31) n = 61	1.95 (.30) n = 108	1.98 (.19) n = 225
Do you have an Internet provider for your home or office computer?	1.54 (.81) n = 61	1.81 (.59) n = 108	1.89 (.43) n = 225
Have you ever subscribed to a listserv?	1.15 (.96) n = 62	1.77 (.59) n = 107	1.63 (.75) n = 224
Have you ever used a browser like Netscape or Internet Explorer to visit the World Wide Web?	1.97 (.25) n = 62		1.94 (.35) n = 224
Have you ever participated in asynchronous computer conferencing?	.37 (.68) n = 62	.51 (.82) n = 107	.51 (.82) n = 224
Do you use e-mail regularly?	1.68 (.70) n = 62	1.95 (.25) n = 107	1.93 (.35) n = 224
Do you know what SHOUTING is in an e-mail message?	.75 (.93) n = 60	.92 (.93) n = 107	1.11 (.92) n = 224
Can you locate three major search engines on the Web?	1.59 (.76) n = 61	1.93 (.30) n = 108	1.86 (.46) n = 225
Do you know what an electronic “bookmark” is and how to create one?	1.40 (.85) n = 60	1.56 (.76) n = 107	1.63 (.70) n = 224
Have you ever participated in an online chat session?	1.47 (.86) n = 62	1.42 (.87) n = 107	1.57 (.78) n = 224
Total Scale Score for Communications and Surfing Skills	13.71 (4.42) *n* = 63	15.91 (2.53) *n* = 108	16.04 (2.49) *n* = 225

References

Allen, I. E., & Seaman, J. (2006). *Making the grade: Online education in the United States, 2006*. Retrieved May 29, 2007, from http://www.sloan-c.org/resources/survey.asp

Bernard, R. M., Brauer, A., Abrami, P. C., & Surkes, M. (2003). The development of a questionnaire for predicting online learning achievement. *Distance Education, 25*(1), 31-47.

Beyth-Marom, R., Saporta, K., & Caspi, A. (2005). Synchronous vs. asynchronous tutorials: Factors affecting students’ preferences and choices. *Journal of Research on Technology in Education, 37*(3), 245-262.

Billings, D. M. (2000). A framework for assessing outcomes and practices in web-based courses in nursing. *Journal of Nursing Education, 39*(2), 60-67.

Butler, T. J., & Pinto-Zipp, G. (2006). Students’ learning styles and their preferences for online instructional methods. *Journal of Educational Technology, 34*(2), 199-221.

Cobb, S. C., & Baird, S. B. (1999). Oncology nurses' use of the internet for continuing education: A survey of Oncology Nursing Society Congress Attendees. *Journal of Continuing Education in Nursing, 30*, 199-202.

Du, Y. (2004). An evaluation of the effect of learning styles and computer competency on students' satisfaction in web-based distance learning environments. *Dissertation Abstracts International Section A: Humanities and Social Sciences, 64*(9-A), 3118.

Franck, L. R., & Langenkamp, M. L. (2000). Mandatory education via the computer: Cost-effective, convenient, and creative. *Journal for Nurses in Staff Development, 16,* 157-163.

Frase-Blunt, M. (2000, January). Distance learning is changing and challenging nursing education. *American Association of Colleges of Nursing, Issue Bulletin.* Retrieved May 29, 2007, *http://www.aacn.nche.edu/Publications/issues/jan2000.htm*

Graf, S., Viola, S. R., & Leo, T. (2007). In-depth analysis of the Felder-Silverman learning style dimensions. *Journal of Research on Technology in Education, 40*(1), n.p. Retrieved May 29, 2007, http://www.iste.org/Content/NavigationMenu/Publications/JRTE/Issues/Volume_401/Number_1_Fall_20071/In-Depth_Analysis_of_the_Felder-Silverman_Learning_Style_Dimensions.htm

Heiman, T. (2006). Assessing learning styles among students with and without learning disabilities at a distance-learning university. *Learning Disabilities Quarterly, 29*(1), 55-63.

Hosie, P., & Schibeci, R. (2005). Checklist and context-bound evaluations of online learning in higher education. *British Journal of Educational Technology, 36*(5), 881-895.

Jairath, N., & Stair, N. (2004). A development and implementation framework for web-based nursing courses. *Nursing Education Perspectives, 25*(2), 67-72.

Keinath, B., & Blicker, L. (2003). Evaluating readiness in your online course: Student-readiness site review rubric. Retrieved May 29, 2007, from Metropolitan State University, Minneapolis, Web site: http://www.metrostate.edu/col/rubric_2.pdf

Kirkwood, A. (2006). Getting networked learning in context: Are on-line students' technical and information literacy skills adequate and appropriate? *Learning, Media and Technology, 31*(2), 117-131.

Lu, J., Yu, C., & Liu C. (2003). Learning style, learning patterns, and learning performance in a WebCT-based MIS course. *Information & Management, 40*(6), 497-507.

Moe, M. T., & Blodget, H. (2000). *The knowledge web: Part 1. People power: Fuel for the new economy*. New York: Merrill Lynch.

Monke, L. W. (2005, December/2006, January). The overdominance of computers. *Educational Leadership*, *63*(4), 20-23.

Muilenburg, L. Y., & Berge, Z. L. (2005). Student barriers to online learning: A factor analytic study. *Distance Education, 26*(1), 29-48.

Neuhauser, C. (2002). Learning style and effectiveness of online and face-to-face instruction. *American Journal of Distance Education, 16*(2), 99-113.

Osika, E. R., & Sharp, D. P. (2002). Minimum technical competencies for distance learning students. *Journal of Research on Technology in Education, 34*(3), 318-325.

Palloff, R. M., & Pratt, K. (2001). *Lessons from the cyberspace classroom: The realities of online teaching*. San Francisco: Jossey-Bass.

Pett, M. A. (1997). *Nonparametric statistics for health care research*. Thousand Oaks, CA: Sage.

Phipps, R., & Merisotis, J. (2000, April). Quality on the line: Benchmarks for success in Internet-based distance education. Retrieved October 10, 2007, from http://www.ihep.org/Pubs/PDF/Quality.pdf

Reynard, R. (2007, May). Hybrid learning: Challenges for teachers. *THE Journal.* Retrieved May 29, 2007, http://www.thejournal.com/articles/20664

Richard, P. L., Mercer, Z. B, & Bray, C. O. (2005). Transitioning a classroom-based RN-BSN program to the Web. *Nurse Educator, 30*(5), 208-211.

Richardson, J. T. E. (2007). Mental models of learning in distance education. *British Journal of Educational Psychology, 77*(2), 253-270.

Schmitt, M. B., Titler, M. G., Herr, K. A., & Ardery, G. (2004). Challenges of web-based education in educating nurses about evidence-based acute pain management practices for older adults. *The Journal of Continuing Education in Nursing, 35*(3), 121-128.

Sit, J. W. H., Chung, J. W. Y., Chow, M. C. M., & Wong, T. K. S. (2004). Experiences of online learning: Students' perspective. *Nurse Education Today, 25,* 140-147.

Speth, C. A., Lee, D. J., & Hain, P. M. (2006). Prioritizing improvements in Internet instruction, based on learning styles and strategies. *Journal of Natural Resources and Life Sciences Education, 35*, 34-41.

Taylor, J. C. (2001, April). *Fifth generation distance education Australia*. Keynote address presented at the 20ICDE Word Conference, Dusseldorf, Germany. Retrieved May 29, 2007, from http://www.fernuni-hagen.de/ICDE/D-001/final/keynote_speeches/wednesday/taylor_keynote.pdf

Thurmond, V. A., Wambach, K., Connors, H. R., & Frey, B. B. (2002). Evaluation of student satisfaction: Determining the impact of a Web-based environment by controlling for student characteristics. *The American Journal of Distance Education, 16*, 169-189.

Tyler-Smith, K. (2006). Early attrition among first time eLearners: A review of factors that contribute to drop-out, withdrawal and non-completion rates of adult learners undertaking eLearning programmes. *Journal of Online Learning and Teaching, 2*(2), 73-85.

Williams, P. E. (2003). Roles and competencies for distance education programs in higher education institutions. *American Journal of Distance Education, 17*(1), 45-57.

Wolf, K., & Stevens E. (2007). The role of rubrics in advancing and assessing student learning. *The Journal of Effective Teaching*, *7*(1), 3-14.

Yu, B., Kim, K., & Roh, S. (2001). A user analysis for web-based distance education. Proceedings of the Annual Topics on Distance Learning Conference, Purdue University. Retrieved August 24, 2007, from: http://eric.ed.gov:80/ERICWebPortal/custom/portlets/recordDetails/detailmini.jsp?_nfpb=true&_&ERICExtSearch_SearchValue_0=ED455830&ERICExtSearch_SearchType_0=eric_accno&accno=ED455830

Manuscript received 30 Nov 2007; revision received 20 Feb 2008.