The Diffusion of Computer Use in Schools of Nursing

By

Katherine S. Shaver, RN, BS
shaverk@ohsu.edu

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APPROVED:

[redacted]

Barbara Gaines, RN, EdD, Professor and Special Assistant to the Dean; Research Advisor.

[redacted]

Leslie N. Ray, RN, PhD, Assistant Professor, Community Health Care Systems; Committee Member.

[redacted]

Kent Spackman, MD, PhD, Professor and Director of Health Informatics; Committee Member.

[redacted]

Jane Marie Kirschling, RN, DNS, Associate Professor and Associate Dean for Graduate Studies.

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ABSTRACT

TITLE: **The Diffusion of Computer Use in Schools of Nursing**

AUTHOR: Katherine S. Shaver, RN, BS.

APPROVED: [redacted]
Barbara Gaines, RN, EdD, Professor and
Special Assistant to the Dean.

Health care environments rely on computerized systems to manage patient care information. This requires nurses to access and use the information stored in these systems. Nursing education must prepare its students beyond computer literacy. Today's nurses must be information literate.

This study describes diffusion of computer use in schools of nursing. Specifics examined include the extent of computer use, expectations of use, views of leaders, and selected institutional characteristics. Leaders in computer use at 106 randomly selected National League for Nurses (NLN) accredited schools of nursing received the 123 item, investigator-developed, survey. The survey achieved a useable response rate of 69%. Findings show extensive diffusion of computer literacy, most notably Email, among administration and faculty. Conversely, diffusion of computer-based information literacy, that is, the use of computer technology as a tool that enables the identification, acquisition, and analysis of nursing information, is inadequate. Nursing education has made little progress over the last 10 years integrating computer-based information literacy into the educational process.

The diffusion of innovation in nursing warrants further study. Future research could include: patterns of computer use by specific user groups, the identification of communication patterns in nursing education, and the impact of nursing's culture and history on the diffusion of innovation.

INTRODUCTION

The use of computer technology has exploded in health care during the last decade. Hospitals and health care organizations rely on complex computerized information systems to manage data within the organization. Computer use has moved from simple data management to the facilitation of information literacy. For example, the electronic patient record is no longer a futurist idea. Therefore, nurses entering the workforce must be able to access and retrieve data, as well as manage information using this technology. To prepare nurses for these challenges, schools of nursing must make computer-based information literacy integral to their academic programs.

Computer literacy is increasingly an expected behavior. However, the use of computers as a tool for the identification, acquisition, and analysis of information is not. As early as 1987, opinion leaders for the American Nurses Association (ANA) shared their vision of the role of computer use in nursing education. "A curriculum that does not include the access and retrieval of information and communication via electronic networks is deficient in preparing professional nurses".[1] Nursing education has yet to achieve the professional preparation envisioned by the these early leaders.

This study describes the diffusion of computer use in schools of nursing, examining the extent of computer and information literacy, expectations of use, views of leaders, and selected institutional characteristics. Elements of the diffusion of innovation[2] framework provide a basis for interpretation of the research findings.

Diffusion of Innovation.—

Diffusion is "a process by which an innovation is communicated through certain channels over time among members of a social structure".[2, p.5] To evaluate computer and information literacy, this study considers two important

elements of the social structure that effect diffusion: norms and opinion leaders. Norms establish a pattern regarded as typical behavior. The norms of computer and information literacy are apparent in equipment availability, user support systems, admission requirements and curricula.

Innovations enter a social system through opinion leaders, who often hold upper level positions in organizations. The communication of ideas occurs either horizontally, among members of similar social standing, or vertically, among members of lower social standing. Horizontal communication occurring among like-members of a social structure is the first step in diffusion. Vertical communication, however, among unlike members of the social structure promotes diffusion throughout the organization.

Diffusion of Computer Literacy.—

Over the past 30 years, two themes have emerged describing computer literacy. These themes include the concepts of: the use of computers to: accomplish tasks, and the use of computers to facilitate learning.[3-8] These concepts provide the definition of computer literacy for this study.

With regard to task accomplishment, discussion in the literature addresses the educational computing needs of health professionals, benefits and barriers to computer literacy, strategies for overcoming barriers, new applications of computer use, and the implications for nursing education.[1,3,4,8-25]

Although there was effort to integrate computer use in nursing education,[11,12] there was little evidence that nursing's social structure had changed sufficiently to incorporate this technological innovation into the mainstream of curricula or educational use.[8, 18-23]

In 1984, Walker[7] illustrated the poor diffusion of computer use among leaders in nursing education. Her national study found the primary use of computers in schools of nursing was word processing with some research functions. Moreover, few deans and chairs of schools of nursing used computers themselves. These leaders had little knowledge of computer capabilities, the ethical and legal implications of use, and potential outcomes of use.

Information Literacy.—

The term information literacy is new to nursing literature. Ranum (1994) [22] uses the term to describe the need for information literacy among pre-medical students. Information literacy includes computer literacy as a component, but encompasses the ability to identify the need for information, the ability to identify the specific information needed, the ability to acquire, evaluate and use the information. Ranum[22] reported that medical students remain ill-prepared for computerized management of information.

In 1988, a group of nurse leaders participated in the Working Group Eight Task Force on Education of International Medical Informatics Association (IMIA). These nurses defined broad competency statements in nursing informatics for practicing nurses.[23] However, widespread integration of this task force's work into all levels of nursing education has been slow. Most frequently, computer-related education applies to the activities of graduate level programs.[6,18,20,21,23,26-30] For example, Heller et al.,[18] demonstrated there was an unmet need for nurses with specialized preparation to provide leadership and direction in the applications and management of information technology in nursing and health care. While by 1992, four academic programs prepared nurses for specialized practice in nursing informatics, Anderson

[24,p.166] reported "...it is rare to find even an introductory computer class included in undergraduate curricula".

Clearly nursing education recognizes the need for information literacy. The skill prepares students to understand and use various modes of inquiry, acquire and interpret relevant nursing data and information, to think critically, and to problem-solve[31]. While nurse leaders associated with the informatics are developing new ways of structuring nursing knowledge and systems to assist in decision making,[29,30] the use of computers as tools to promote these skills in nursing education remains poorly diffused.

Nevertheless, many nurses recognize that computer technology increasingly provides new ways to access information. Participation on mailing lists (listservs) through Internet is available for most nursing specialties. The National League for Nurses (NLN), the ANA, and Sigma Theta Tau have on-line resources for nurses. Clearly, the literature indicates that computer literacy as an increasing expectation. Further, computer-based information literacy is beginning to diffuse, as evidenced by availability of graduate coursework in informatics, research in new knowledge areas (expert systems, decision support tools), and the increased recognition that computers provide access to information which supports in practice. What is not clear in the literature is the current status of computer use in schools of nursing.

This study explores the current level of diffusion of computer and information literacy in nursing education by asking the following questions: 1) To what extent do schools of nursing demonstrate computer literacy and information literacy? 2) Is the ability to use computers a norm in schools of nursing? 3) How do the leaders in schools of nursing view computer use? 4) Are selected institutional characteristics associated with frequent computer use?

METHODS

Sample

The study surveyed a random sample of 106 schools of nursing from the November, 1993 NLN list of schools of nursing granting bachelor's or higher degrees in nursing. This random sample produced a representative distribution of schools from each of the four nursing alliances: Western Institute of Nursing, Midwest Alliance of Nursing, Southern Council for Collegiate Education for Nursing, and Northeastern Organization of Nursing. Prior to survey mailings, telephone calls to schools identified the individual most familiar with the extent of computer use. These opinion leaders included deans, directors of resource or computer learning centers, and faculty. This identified individual received the survey directly.

Instrument

Elements of Dillman's Total Design Method [32] provided the basis for the investigator-developed, 123 item, mailed questionnaire. User groups identified for each item included: administration, faculty, undergraduate and graduate students. Response categories were: frequent use (several times a week to daily), infrequent use (several times a term to several times a month), never, and don't know.

Section I described the extent of diffusion of computer and information literacy in nursing education. The use of applications to accomplish tasks operationalizes computer literacy. The use of applications that facilitate the access and management of information operationalizes information literacy.

Section II explored the norms of the school of nursing. The normative expectation of computer literacy is operationalized through the level of support for hardware, software, and users. The normative expectation of information literacy is operationalized by the computer literacy admission

requirements and the curricular integration of computer literacy courses. Opinion leaders' levels of agreement with positively-phrased statements about computer use further represent these norms. Section III determined selected institutional characteristics such as source of funding, educational mission, and region. Within the context of these variables, the study explores the scope of diffusion of computer and information literacy within the social structure of nursing education. Section IV asked respondents to comment on computer use in their school including groups of users and the effects computers had on education.

Data Analysis

The survey yielded an overall response rate of 72%. Of the 76 (N=106) returned surveys, 69% (n=73) were useable. Data analysis did not include 1 duplicate survey and 2 late arrivals.

Statistical analysis included frequency distributions reported in percentages, cross-tabulations and Pearson's chi-square analysis, with contingency correlation. Content analysis of qualitative data yielded consistent themes within each category.

FINDINGS

Computer Use

The survey results reveal a remarkable range of computer and information literacy among responding schools. A few schools indicated a high level of information literacy by reporting sophisticated integration of technology and curriculum, such as operating a community computing system and initiation of a "21st Century" learning lab with bedside terminals. Conversely, some schools indicated a low level of computer literacy by reporting a paucity of up-to-date equipment, poor administrative support, and low faculty motivation for computer use. One respondent reported that, although the associated

university was networked and completely on-line, the school of nursing was "neither connected nor wired for a LAN". On-line access to information, even for the computer expert, was not available. Computer equipment was old and money for upgrading was "not the highest administrative priority".

The frequencies of identified uses shows the diffusion of computer literacy in many schools (see Table 1). Consistent with diffusion of innovation theory, the heaviest user group is administration, followed by faculty. Administration and faculty are the most frequent users of word processing in over 90% of the reporting schools. Over 60% of schools report frequent student use. Conversely, Walker's[7] findings showed only 36.8% of faculty, students and staff used word processing.

Of particular interest are findings about Email use. Over 67% of schools report their administration and faculty use Email frequently. Considering the newness of this technology, the high level of use demonstrates a more rapid diffusion of Email than word processing. This occurred despite requirements of a network with special hardware and software. Rapid diffusion significant commitment of resources indicates the utilization of this technology as a normative expectation by the schools. Beyond word processing and Email, faculty and students most frequently use computers for computer-assisted instruction (CAI), on-line documentation, testing, and multi-media and visual aids.

Eighty-eight percent of schools report their administration frequently use computers for the management of student records. Slightly more than 50% of schools report their administration and faculty use the technology for course development. Comparatively, Walker[7] reported 31.2% of schools used computers in 1984 for these tasks.

Respondents to this study indicate many of the same benefits and limitations to computer use as researchers reported in the 1980's. Benefits include: individualized, self-paced learning; versatility of learning tools; improved efficiency/proficiency; enhanced learning environment; improved access to data/resources; prepared students to handle information. Limitations include: administrative support and resources for hardware/software, the training of faculty and staff, lack of motivation by faculty to learn, and fear of computers.[8,11-13,15,16,19-21,24,25] Interestingly, analysis of survey findings reveal a paradox between espoused benefits of computer use for students and a remarkably limited knowledge of levels of student use. That is, respondents reported substantial agreement with benefits and barrier statements in literature, but also reported that they did not know how students used computers (see Tables 1 - 3, "don't know" responses). This contradiction indicates a lack of diffusion to student groups, yet warrants further study.

Administration is the most frequent user of information literacy applications (see Table 2). Database management is a good example. While 32% report frequent faculty use, 70% of schools report administration frequently uses database management. This demonstrates a conceptual shift from task-focused computer use to computer use for data management and manipulation.

Development of databases presents a different story. Thirty-three percent of schools report faculty never develop nursing databases; almost 60% of schools report their students never develop databases. The lack of recognition of databases as an information management strategy represents a significant loss of valuable knowledge and experience for faculty and students.

Half of schools report that administration frequently uses advanced statistics, spreadsheets, and graphs. Thirty-three percent of schools report frequent use by faculty and graduate students. Diffusion and use of these applications to undergraduates is occurring in 49% of schools, at infrequent levels of use.

Frequent use of the Internet by administration and faculty occurs at nearly 50% of the schools. Yet, about 35% of schools report infrequent use of the Internet by students. Faculty and student groups at over 50% of schools frequently use local on-line library services. It is interesting to note that while less than 10% of respondents "do not know" the level of use of on-line library services by students, 25% of respondents did not know the level of Internet use for that group. Respondents report low frequency of use by students for other resources available via the Internet such as professional listservs, and national on-line library services.

Norms

Support for Computer Use.—

Although opinion leaders were unaware of how much students were using computers for various purposes, the normative expectation of computer literacy is evident for administration and faculty. Schools provided faculty with computers in all but 8 schools (11%). Most schools (86%) access wide area networks such as Internet or Bitnet, while local area networks (LAN) are in place in 60% of the schools. Rooms with computer access are available in most schools. These findings substantiate a significant financial commitment by the schools. On site computer labs, many staffed, are available in 99% of the schools surveyed. In addition, help desks, lists of experts and other support systems are very frequently available.

Computer literacy skills provide the foundation for development of information literacy. Schools that expect computer literacy from incoming

students will more easily build on these skills during the educational process, producing information-literate graduates. Except for the few schools that require computer literacy for admission or require computer courses, survey results do not demonstrate the normative expectation of information literacy. Only eight schools (23%) require computer literacy for undergraduate admission. This expectation increases slightly at the graduate level (12 schools, 29%). Fewer than 10 schools report plans to include computer literacy as a pre-requisite for either level of education.

In 1992, Zroskie[21] found that 79% of the schools surveyed did not require computer literacy. While some schools offered elective courses on nursing information systems, many schools did not offer any computer related courses. Although findings show minimal growth in this area, Zroskie's[21] study supports the finding that information literacy is not a normative expectation in nursing education.

To further clarify the types of computer classes available to nursing students, respondents from 48 schools described courses relating to computers and nursing offered at their schools. Most of the coursework was at the graduate level. Major categories included: research or theory courses requiring computer use, Informatics, and computer basics. Three schools offer advanced informatics. Eight schools reported computer classes available from other university divisions. These results support the finding that computer-based information literacy is not yet a normative expectation.

Opinion Leaders Views.—

Opinion leaders reported overall agreement with positively- phrased computer literacy statements (see Table 3). These positively-phrased statements explored the usefulness of CAI, electronic conferencing, computer exercises, and the ethical and legal issues of computerized information

systems. The statements were selected to provide an overview of the elements in the shift of thinking that will accompany strong valuing of computer-based information literacy. The lack of discrepancy between use and views demonstrates computer literacy is a normative expectation among opinion leaders. Horizontal diffusion is occurring as expected. However, vertical diffusion of this expectation has not yet diffused to student groups.

Examples of statements that generated the highest level of agreement were: "Informatics is increasingly important in nursing education" and "nursing has a definite role in the design and evaluation of computer information systems". The statement that generated the highest level of disagreement was: "nursing is primarily an information processing discipline".

Institutional Characteristics.—

The analysis for association between frequency of use items and institutional characteristics included: source of funding (public or private), region, and mission of school, with several items of use (high and low frequency), and statements on computer use in nursing. No significant association can be statistically inferred using Pearson's chi-square with contingency correlation ($p = .05$). The data were not sufficiently robust to support inference of statistical significance.

SUMMARY

An individual can be computer literate without being information literate. However, to be information literate today, computer literacy is essential. This study demonstrates diffusion of computer literacy through administration and faculty of most surveyed schools of nursing. The normative expectations of computer use by administration and faculty are evident in the financial commitment of schools in hardware, networking, and user support. Agreement by opinion leaders with statements validating computer use in

nursing education further endorse the normative expectation of computer literacy among administration and faculty.

Unlike administration and faculty, the level of student use is not as evident from survey results. The high numbers of "don't know" responses reported for this group suggest the lack of diffusion of computer use, or inadequate vertical communication; warranting further study.

The frequency of Internet use demonstrates the beginning of the diffusion of computer-based information literacy. User groups from many schools are accessing local on-line resources. Opinion leaders could facilitate increased access of national on-line resources through seminars and inservices. The use of the Internet to access a variety of resources would stimulate investigation of the limitless information available, while building computer-based information literacy skills. Integration of electronic conferencing into coursework can promote collaboration between students and faculty. A basic foundation in computer literacy can promote the development of information literacy skills for nursing students.

IMPLICATIONS FOR NURSING EDUCATION

Schools of nursing have not yet integrated the concept of computer-based information literacy into nursing education. Nurse educators must re-think the use of computers to support nursing judgment and clinical decision making. It is essential for schools of nursing to incorporate computer and information literacy skills into the core elements of nursing education thereby preparing students for the challenges of information management throughout their practice. In the first semester of nursing school, students could begin to build their own bibliographic databases, tools that will serve them through school and beyond.

The process of innovation diffusion in nursing warrants continued study. Understanding communication patterns within schools of nursing, and the impact of nursing's culture and history on nursing education, can help identify strategies to promote diffusion of innovation. It is critical to provide nurses with the necessary knowledge to meet the challenge of the volume of information diversity they will encounter throughout their education and professional careers.

REFERENCES

1. Grobe S, Ronald J, Tymchyshyn, P. *Computers in Nursing Education.* Kansas City, MO: American Nurses Association; 1987:2-27.

2. Rogers EM. *Diffusion of Innovations.* 3rd ed. New York, NY: The Free Press; 1983:1-86, 271-312.

3. Brose CH. Computer technology in nursing: revolution or renaissance? *Nurs Health Care.* 1984;5:531-534.

4. Newbern V. Computer literacy in nursing education: an overview. *Nurs Clin North Am.* 1985;20:549-556.

5. Bryson DM. *Empirical determination of computer literacy objectives for two-year and four-year nursing students.* Corvalis, OR: University of Oregon; 1989. Dissertation.

6. Jacobs A., dela Cruz F. *The informatics education needs of graduate nursing students.* New York, NY: National League for Nurses; 1992:(NLN Publication No. 14-2406).

7. Walker M. Nursing Education: Challenges of the computerized environment. *Comput Nurs.* 1986;4:166-171.

8. Renshaw, S. & Ganley, K. As computer technology invades health care settings, nurse educators need to focus on computer literacy. *The Pennsylvania Nurse.* 1987;42:6-7.

9. Collart, M. Computer-assisted instruction and the teaching-learning process. In: Zielstorff R, ed. *Computers in Nursing.* Rockville, MD: Aspen Systems Corporation; 1973:187-197.

10. Meadows L. Nursing education in crisis: a computer alternative. The *J Nurs Educ.* 1977;16:13-21.

11. Ronald, J. Introducing baccalaureate nursing students to the use of computers in health care. In: Saba V, Rieder K, Pocklington D. Eds. *Nursing and Computers: An Anthology*. New York, NY: Springer-Verlag; 1981:376-383.

12. Ball H, Hannah K. *Using Computers in Nursing*. Reston: Reston Publishing Company; 1984.

13. Kellogg B, Garcia S. Introducing nursing students to computers. *Comput Nurs*. 1985;3:128-132.

14. Nelson J, Carlstrom J. A new confrontation: nursing education and computer technology. *J Nurs Scholar*. 1985;17:86-87.

15. Lange L, Brownie J. Educating nurses to work in computerized nursing services. *Nurs Admin Quarterly*. 1986;10:64-70.

16. Parks P, Damrosch S, Heller B, Romano C. Faculty and student perceptions of computer applications in nursing. *J Prof Nurs*. 1986;2:104-113.

17. Saba V, McCormick K. *Essentials of Computers for Nurses*. Philadelphia, PA: JB Lippincott Company; 1986.

18. Heller B, Damrosch S, Romano C, McCarthy, M. Graduate specialization in nursing informatics. *Comput Nurs*. 1989;7:68-77.

19. Ziemer M. Computers have much to offer educator, administrator, staff nurse. *Pennsylvania Nurse*. 1987;42:9.

20. Summers S. High technology impact on nursing education. *The Kansas Nurse*. 1992;67:5-6.

21. Zroskie L. Information systems in graduate nursing curriculum. *Nurs Educ*. 1992;17:10.

22. Ranun D. "Pre-medical" informatics. *Proceedings from the 18th Annual Symposium on Computer Applications*. 1994;743-746.

23. Petersen H, Gerdin-Jelger U. Eds. *Preparing Nurses for Using Information Systems: Recommended Informatics Competencies, IMIA, working group*

8. New York, NY: National League for Nurses; 1988;(NLN Publication No. 14-2234):1-138.

24. Anderson B. Nursing informatics: Career opportunities inside and out. *Comput Nurs*. 1992;10:165-170.

25. Grobe S. Conquering computer cowardice. The Journal of Nursing Education. 1984;23:232-239.

26. Romano C, Heller B. Nursing informatics: a model curriculum for an emerging role. Nurse Educator. 1990;15:16-19.

27. McGonigle D, Eggers R. Establishing a nursing informatics program. Comput Nurs. 1991;9:184-189.

28. Noll M, Murphy M. Integrating nursing informatics into a graduate research course. Journal of Nursing Education. 1993;2:332-334.

29. Brennan P, Fitzpatrick J. On the essential integration of nursing and informatics. AACN Clinical Issues. 1992;3:797-803.

30. Ozbolt J, Graves, J. Clinical nursing informatics: developing tools for knowledge workers. Advances in Clinical Nursing Research. 1993;28:407-423.

31. PEW Health Professionals Commission. Health professions education for the future: schools in service to a nation. San Francisco, CA: PEW Health Profession Commission; 1993:83-90.

32. Dillman D. Mail and telephone surveys: the total design method. New York, NY: John Wiley & Sons; 1978:1-200.

TABLE 1
Percent of Schools
Reporting Extent of Computer Literacy Use

Application	User Group	Frequent	Infrequent	Never	Don't Know
Word processing, basic spreadsheets and graphics	Administration	93%	6%	0%	0%
	Faculty	82%	12%	0%	1%
	Undergraduate	60%	27%	0%	8%
	Graduate	69%	23%	1%	8%
E-Mail	Administration	74%	15%	7%	3%
	Faculty	67%	23%	7%	0%
	Undergraduate	26%	30%	21%	20%
	Graduate	29%	28%	21%	22%
Management of Student Records	Administration	88%	8%	1%	1%
	Faculty	41%	40%	9%	8%
Course Development	Administration	57%	26%	11%	3%
	Faculty	55%	34%	5%	3%
Multi-media and audio-visual aids	Faculty	49%	38%	8%	2%
	Undergraduate	21%	48%	20%	8%
	Graduate	19%	52%	19%	8%
Interactive Learning with Video Discs	Undergraduate	27%	48%	24%	1%
	Graduate	12%	38%	32%	12%
Interactive Learning with CD-Roms	Undergraduate	19%	30%	38%	10%
	Graduate	19%	30%	40%	11%
Interactive Learning with CAI	Undergraduate	37%	56%	1%	3%
	Graduate	15%	53%	16%	15%
Documentation : Clinical Settings	User Group Not Specified	41%	33%	16%	10%
Care Plans		23%	29%	33%	15%

TABLE 2
Percent of Schools
Reporting Extent of Information Literacy Use

Application	User Group	Frequent	Infrequent	Never	Don't Know
Statistics, graphs, advanced spreadsheets	Administration	51%	37%	3%	8%
	Faculty	34%	59%	1%	4%
	Undergraduate	5%	49%	19%	22%
	Graduate	30%	47%	6%	15%
Database Management	Administration	70%	22%	1%	6%
	Faculty	32%	51%	7%	8%
	Undergraduate	8%	23%	41%	29%
	Graduate	5%	36%	29%	29%
Development of Nursing Databases	Faculty	15%	30%	33%	21%
	Undergraduate	4%	14%	58%	19%
	Graduate	7%	23%	49%	18%
Internet	Administration	48%	33%	8%	8%
	Faculty	42%	37%	12%	4%
	Undergraduate	11%	36%	25%	25%
	Graduate	15%	33%	26%	26%
Electronic Conferencing	Faculty	47%	33%	18%	17%
	Undergraduate	14%	25%	40%	16%
	Graduate	19%	20%	41%	18%
LOCAL On-Line Library Services	Faculty	59%	33%	3%	1%
	Undergraduate	42%	38%	4%	9%
	Graduate	45%	40%	4%	8%
NATIONAL On-Line Library Services	Faculty	24%	48%	11%	14%
	Undergraduate	7%	41%	23%	25%
	Graduate	14%	41%	17%	25%
Professional Listservs	Administration	24%	21%	26%	25%
	Faculty	25%	27%	21%	23%
	Undergraduate	7%	19%	36%	33%
	Graduate	10%	19%	33%	34%

TABLE 3
Extent of Opinion Leaders Agreement with Statements on Computers and Nursing

Statement	Opinion Leader	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Don't Know
Nursing is primarily an information processing discipline.	Leader	30%	22%	19%	21%	3%	4%
	Faculty	12%	21%	20%	15%	4%	26%
Informatics is increasingly important in nursing education.	Leader	81%	18%	0%	0%	0%	1%
	Faculty	27%	32%	19%	4%	0%	7%
Nursing has a definite role in the design and evaluation of CIS.	Leader	79%	12%	4%	1%	1%	1%
	Faculty	27%	36%	21%	3%	0%	14%
CAI offers flexible and individualized learning experiences.	Leader	75%	21%	1%	1%	0%	1%
	Faculty	32%	45%	14%	1%	1%	5%
Computer exercises increase student comfort with NIS & HIS.	Leader	67%	30%	3%	0%	0%	0%
	Faculty	28	28	11%	0%	0%	12%
Elec. conferencing & file exchange ... promote professional development ...	Leader	67%	22%	4%	1%	0%	5%
	Faculty	27%	31%	19%	0%	0%	23%
Understanding the ethical and legal issues associated with ... CIS is important.	Leader	84%	15%	1%	0%	0%	0%
	Faculty	55%	26%	8%	0%	0%	11%

Leader = respondent's view.
Faculty = respondent's perception of faculty view.

SUPPORTING DOCUMENTATION

TABLE OF CONTENTS

INTRODUCTION

Nurses acquire, produce, use and disseminate huge amounts of information in their professional roles. Nurses entering the workforce must possess the technical skills to function effectively as care providers in sophisticated, information-intensive environments. Since hospitals and health care organizations rely on complex, computerized information systems to manage patient care data, these skills need to include computer literacy. However, as the volume of health care information and the technological advances in information systems explode, nurses must go beyond simple computer literacy and become information literate. Education in these processes will prepare nurses to undertake the challenges of information management during their education and throughout their careers.

Very simply, computer literacy is the ability to use the computer: to accomplish tasks, to learn, and as an effective tool in nursing practice. Computer literacy itself, however, does not provide the skill to manage information. Information literacy, on the other hand, includes computer literacy as a component but extends user understanding into the identification, acquisition and analysis of information. Therefore, the definition of information literacy is: 1) the ability to identify the need for information, 2) the ability to identify the specific type information needed, 3) the ability to find the information and

then 4) evaluate and use the information (Ranum, 1994).

Nursing education recognizes the importance of information literacy skills. It prepares students to understand and use various modes of inquiry, acquire and interpret relevant nursing data and information, and to think critically and problem-solve. Yet the use of computers as tools to promote computer and information literacy skills in nursing education remains poorly documented (Lange & Brownie, 1986; Grobe et al., 1987; Grobe, 1988; Ronald, 1988; Romano, 1988; Heller, et al., 1988; Graves & Corcoran, 1989; Heller, et al., 1989; McGonigle & Eggers, 1991; Brennan & Fitzpatrick, 1992; Ozbolt & Graves, 1993, Carty, 1994).

Therefore, the purpose of this study was to document the extent of diffusion of computer use in nursing education by exploring the following questions: 1) To what extent do schools/colleges of nursing demonstrate computer literacy and information literacy? 2) Is the ability to use computers an expectation in schools/colleges of nursing? 3) How do leaders in schools/colleges of nursing view computer use? 4) Are selected institutional characteristics associated with frequent computer use?

REVIEW OF LITERATURE

The use of computers in nursing has been a topic of discussion in the literature for 30 years. In that time, there was little documentation of the diffusion of computer use in

nursing education. A diffusion of innovation's framework provides some understanding of the progress. Although a comprehensive analysis of diffusion of innovation research and computer use in nursing education is beyond the scope of this paper, the elements of social structure, including norms, opinion leaders, and communication networks have been drawn from Rogers' (1983) work to provide a basis for interpretation of research findings.

Diffusion is a "process by which an innovation is communicated through certain channels over time among members of a social system" (Rogers, 1983, p. 5). Innovations, such as computer literacy and information literacy, usually enter a system through the most elite and innovative members, the opinion leaders. Members of this group usually share similar status, educational background, communication networks, and are highly conforming to system norms.

The norms of a social system establish a standard, model or pattern regarded as typical behavior. The social system supports the norms with mechanisms to promote the expected behavior. The norms of computer and information literacy are apparent in equipment availability, user support systems, and the integration of subject matter in admission requirements and curricula.

Essential to diffusion within a social structure, such as nursing education, is the communication of information. Communication networks consist of groups of interconnected

individuals linked by a "patterned flow of information" (Rogers, 1983, p. 25). Diffusion research has shown that most individuals evaluate an innovation on the basis of subjective peer evaluation within their communication networks. The communication of ideas happens most frequently between individuals who are "similar in certain attributes such as beliefs, education, social status" (p. 310). Diffusion between like members flows horizontally, with little or no diffusion to unlike groups. This can act as a potential barrier to diffusion. Effective diffusion is more likely to occur when communication is vertical - from opinion leader to novice, between unlike groups. The large body of literature on computers in nursing offers a vertical channel of communication with opinion leaders outside their individual social structure (school, college or department of nursing).

Computer Literacy

During the 1970's, schools of nursing that had computers primarily used them for storage, retrieval and manipulation of records and secretarial tasks (Ball & Hannah, 1984). As the technology evolved, the use of computers in some schools/colleges of nursing diffused to include the management of the educational environment, instruction, and educational research. Nurse leaders evaluated uses and the usefulness of computers in education. During the early 1970's, a study conducted under the auspices of the International Federation of Computing, identified the

educational needs of health professionals in computing. The findings showed that all nurses should have a general knowledge of the computer and data processing, and that this content should be a part of the curricula of schools of nursing. The study further asserted that some nurses should be educated so they could effectively use a computer and contribute to the development of automated systems (Ronald, 1981; Walker, 1986; Romano, 1988; Heller et al., 1989).

Ronald at the School of Nursing, State University of New York (SUNY) at Buffalo, developed an introductory course for baccalaureate nursing students in the use of computers in health care. As a result of this leader's work, "Implications for Computer Technology for Nursing" became a model for the development of parallel courses offered by other universities world-wide. The elective course focused on hands-on experience with a main-frame system, data collection, learning BASIC programming, and using an editing system to individualize standardized nursing care plans (Ball & Hannah, 1984; Ronald, 1981; Ronald et al., 1991).

Leaders identified benefits and barriers to the use of the computer and its applications in nursing education. These included: efficiency of productivity, flexibility and enhancement of learning, individualized learning, and increased comfort of use. Barriers included: computer-phobia and user anxiety,

resistance to relinquish control over learning process, high start-up costs and lack of administrative support, paucity of software. Strategies identified to reduce barriers addressed administrative issues such as resources for equipment, increase knowledge base and hands-on experience in the use of computers (Collart, 1973; Meadows, 1977; Ronald, 1981; Ball & Hannah, 1984; Billings, 1984; Brose, 1984; Grobe, 1984; Sweeney, 1985; Kellogg & Garcia, 1985; Nelson & Carlstrom, 1985; Lange & Brownie, 1986; Parks, 1986; Newbern, 1986; Saba & McCormick, 1986). Diffusion of computer use was just beginning. Studies demonstrated that the social structure of nursing education had not changed sufficiently to incorporate this technological innovation into the mainstream of curriculum or educational use.

In response to the concerns of leaders in nursing education, the American Nurse's Association (ANA) published a "user-friendly" pamphlet to assist schools of nursing and faculty in the integration of computers into their curricula (Grobe et al., 1987). The pamphlet addressed the most common questions and concerns of administrators and faculty who considered using computer-assisted instruction (CAI) in nursing education. Topics included: organizing for the integration of computer use, preparing faculty, planning for CAI, and hardware and software issues. The introductory style of the pamphlet indicated that many schools/colleges of nursing were only beginning to consider

computer use in nursing education. These respected and highly positioned opinion leaders provided a strong voice to promote diffusion of use.

In her 1984 national survey, Walker (1986) studied the extent of computer use among deans and chairpersons of schools of nursing. Part I of this survey addressed how and who used computers and computerized information in nursing education, and "philosophy of use" (p.167. Part II of the study identified factors that enhanced or prevented the use of computers in the nursing education environment. Part III asked respondents to identify potential outcomes and perceived benefits, and perceived constraints to adoption and use of computers.

Walker found the primary use of computer technology was word processing, with some research functions. She also noted a lack of strategic planning and decision-making regarding computer integration into curriculum or administration. Furthermore, few deans or chairpersons used computers themselves. This group reported little knowledge of computer capabilities, potential outcomes of use, or the social, ethical and legal implications of use. Walker stated "Nursing must address the challenges and rethink the total educational environment. The degree of impact that computer technology will have on nursing will be influenced by our ability to recognize issues, prepare suitable responses, and actively formulate solutions" (p.170).

In 1992, Zroskie undertook a study to determine trends in graduate nursing education with regard to computer literacy. The investigation examined content, method of presentation, and the inclusion of required, rather than elective, information systems courses. Also surveyed were computer literacy requirements for admission to and graduation from the programs. Findings showed the majority of graduate nursing programs included nursing information systems courses, although most were electives. There were also a "sizable" number of programs that offered neither information systems content or computer literacy. Zroskie's findings demonstrate that the norms of many schools had not yet actualized the diffusion of computer literacy into their educational systems.

Computer literacy in medical education has progressed along a time-line similar to nursing. Medical education has used computers for teaching tools with educational software (simulations) since the 1970's. The use of these tools continued their technological development progressed. However, the use of artificial intelligence (AI) to develop clinical decision-support systems began much earlier. The work in AI developing programs such as MYCIN and INTERNIST provided the foundation for knowledge-based programming. Work in this area contributed to the development of expert systems in almost every field, including nursing (Clancey et al., 1979, Gorry, 1984, Shortliffe & Clancey,

1984, Veloski & Blacklow, 1986, Hoffer & Barnett, 1990, Holmes et al., 1992, Pincetl, et al., 1992, Wormuth, 1992, Cooper & Owens, 1994, Stephens & Reber, 1994, Pincetl, et al., 1993).

By comparison, schools of business have used mini/mainframe and microcomputer technology in their educational environments extensively since the 1970's. Frand & Britt (1989) surveyed 175 schools of business nationally to assess where business schools were in the computerization process. The study reported faculty and student literacy and productivity, and faculty analytic use of computers in a "late growth phase", showing a "real use of and dependence on this technology" (p.72). Clearly, the use of computer technology and the diffusion of computer literacy has been more extensive in schools of business than in schools of nursing or medicine..

Information Literacy

By the mid-1980's, the nursing literature shifted from teaching computer literacy to the study of informatics. However, as Zroskie (1992) demonstrated computer literacy was not widespread. The leaders in the use of computers in nursing had embraced computer and information literacy. The next step was the development of a new nursing specialty.

A nursing specialty, informatics, evolved from the integration of computer science, information science and nursing science. Nursing's role in the design and implementation of

systems and computer applications for nursing practice, administration, research, and education became evident in the nursing information community. The implications for redefining and expanding nursing knowledge seemed boundless (Ball & Hannah, 1984, Walker, 1986, Lange & Brownie, 1986, Schwirian, 1986, Grobe, 1988, Hannah, 1988, Norman, 1988, Renshaw & Ganley, 1987, Romano, 1988, Ronald & Skiba, 1987, Heller et al., 1989, Saba, 1989).

Leaders in nursing informatics moved to coordinate their voices with those in other informatics groups.

In 1988, a group of nurse leaders participated in the Working Group Eight Task Force on Education of International Medical Informatics Association (IMIA). These opinion leaders defined broad competency statements in nursing informatics for the nurse educator. The competency statement identified three levels of competency (user, modifier, and innovator) and functions within each level for the nursing role. Primary informatics functions required of the nurse educator were communication, test processing, data base management, data analysis, and computer-assisted instruction.

However, widespread integration of the task force's work into the structure of nursing education has been slow. For example, in 1989 Heller et al., surveyed acute care hospitals, nurse experts and nursing students to document the need and rationale for developing nursing informatics as a graduate level

specialty. The results clearly favored the development of a graduate specialty in nursing informatics by all groups surveyed. Further, the study demonstrated there was an unmet need for nurses with specialized preparation to provide leadership and direction in the applications and management of information technology in nursing and health care. As a result, the University of Maryland developed a program of graduate study. The wide-spread use of micro-computers, the increasing body of knowledge in nursing informatics, and leaders work on informatics committees within professional organizations (for example the ANA, NLN, and IMIA), provided impetus for development of other formal and informal programs of informatics study across the country.

In spite of the number of reported new programs, there was little documentation of the diffusion of informatics and computer technology into nursing education. Most frequently, the discussion of informatics was in relation to the activities of graduate level programs. The literature describes course work and certification programs (Romano & Heller, 1990; McGonigle & Eggers, 1991; Jacobs & dela Cruz, 1992; Summers et al., 1990; Summers, 1992; Zroskie, 1992; Noll & Murphy, 1993). By 1992, four academic programs prepared nurses for practice in nursing informatics. Three of these granted master's degrees and one awarded a doctoral degree. In spite of the progress being made, nursing informatics had not, on the whole, received the educational attention it

deserves (Simpson, 1992). Validating the need for preparation of nurses in these new roles, career opportunities for nurse informaticists were expanding rapidly as the field developed (Anderson, 1992, Carty, 1994). Carty stated "it is imperative educational needs of the specialty be addressed" (p.177).

As a product of the work in informatics, nursing literature is replete with new concepts in nursing, such as minimum data sets and the development of nursing expert systems. New ways of thinking about the types of knowledge nurses possess and use are being explored. Nursing knowledge itself is being examined and redefined (Moritz, 1990; Wainwright, 1991; Brennan & Fitzpatrick, 1992; Ozbolt & Graves, 1993).

The literature shows that although work on artificial intelligence, the development of decision-support systems, and expert systems began earlier in medicine than in nursing, even medical students remain ill-prepared for the management of information in their professional lives. Naeymi-Rad et al. (1993) argue that medical education should move from the lecture format to methods such as problem-based learning, in which learning is student directed, and occurs in groups as well as individually. He states "physicians must become information managers" and the integration of information technology into curriculum will contribute to their success. Ranum (1994) identifies informatics concepts missing from the pre-medical preparation of students that

limit their ability to access and utilize up-to-date information available to them. Ranum states that although computer literacy is useful, it is only one element of the knowledge base necessary to cope with the information needs of a medical student or practicing physician. Surely, the information management needs of clinical nurses are as great as those of their colleagues.

Limited literature exists discussing the number of schools or colleges of nursing that offer undergraduate and graduate courses in nursing informatics or computer literacy. One survey done in 1989 of 1559 schools of nursing reported that only 16% of baccalaureate and higher degree programs required courses in computer technology. In fact, Anderson (1992) reported ".....it is rare to find even an introductory computer class included in undergraduate curricula" (p.166). As early as 1987, opinion leaders identified the value and need for nurses prepared to function competently in computerized environments. "A curriculum that does not include the access and retrieval of information and communication via electronic networks is deficient in preparing professional nurses" (Grobe et al., 1987).

The last two years have produced large numbers of articles in newspapers and popular publications on the Internet. DeLoughry in the November 2, 1994 edition of the Chronicle of Higher Education reported that being involved in mailing lists on the Internet is the best way to keep current in one's area of

expertise. In this medium, people discuss the latest news in their discipline and share up-to-date information on research. Today, "lists" are active on the Internet for almost every specialty of nursing. Major nursing organizations such as Sigma Theta Tau, NLN, and the ANA have valuable resources that are accessible via the Internet.

New leaps in technology suggest that multi-media communication will soon be commonplace in many homes. The diffusion of this technology has staggering implications for nursing practice. It is time that informatics be an integral part of all nursing or pre-nursing curricula, and that nurses take a leading role in directing the growth of this technology in health care.

> The purpose of nursing education is to prepare individuals for the practice of the profession of nursing. That preparation should both encompass the requirements for entry into practice, and to the greatest extent possible, anticipate the requirements for the nursing practice in the future (Hannah, 1988, p.12).

How have the use and integration of computer technology diffused throughout the system of nursing education in the past decade? This study explores the following questions:

1) To what extent do schools/colleges of nursing demonstrate computer literacy and information literacy?

2) Is the ability to use computers a norm in schools/colleges of nursing?

3) How do the leaders in schools/colleges of nursing view computer use?

4) Are selected institutional characteristics associated with frequent computer use?

METHODS

Design

The design of this study was descriptive. Dillman's (1978) total design method provided the basis for a mailed survey. The investigator explored the extent that schools and colleges of nursing demonstrate computer and information literacy within a diffusion of innovation framework.

Sample

The study surveyed a random sample of 106 NLN-accredited schools and colleges of nursing that grant bachelor's and higher degrees in nursing (50% of population). An initial telephone call to the selected schools/colleges of nursing identified the individual most familiar with the extent of computer use. The opinion leaders most frequently identified were deans, directors of learning resource or computer resource centers (LRC/CRC), and faculty. A post-card followed the initial mailing one week later. Schools/colleges of nursing received a follow-up phone call 3 weeks post-mailing. Non-respondents received a complete mailing 4 weeks later (see Appendix A).

The four nursing alliances: Western Institute of Nursing

(WIN), Midwest Alliance of Nursing (MAIN), Southern Council for Collegiate Education for Nursing (SCCEN), and Northeastern Organization of Nursing (NEON), formed the basis for evaluation of possible regional influences. The random sample produced a representative spread of schools/colleges of nursing from each alliance.

Of the 76 (N = 106) returned surveys, 73 were useable, yielding a response rate of 72%. The usable response rate was 69% (n = 73). Data analysis did not include 1 duplicate survey and 2 late arrivals.

In an attempt to have non-respondents return the surveys, the survey requested recipients to return the questionnaire even if they were unable or unwilling to answer them. The investigator received completed questionnaires only.

Instrument

The investigator developed a 3 part, 123 item questionnaire (see Appendix B). Using a Likert scale, respondents described the frequency of computer use for different user groups and level of agreement with statements regarding computer use in nursing. Identified user groups included: administrators, faculty, undergraduate and graduate students. The likelihood of frequent use provided the basis for the choice of user groups for each item.

Section I described the extent of diffusion of computer and

information literacy in nursing education (items 1 - 73). Specific types of computer use represented computer literacy and information literacy. For this study, the operational definition of computer literacy was the use of applications that accomplish tasks such as word processing; e-mail; documentation of nursing practice; testing knowledge; managing student and personnel records. The operational definition of information literacy was the use of applications that facilitate the access and management of information such as development and management of data bases; advanced statistics; use of Internet; and budget analysis. Section II explored the norms of the school/college of nursing (items 73 - 118). Opinion leaders' level of agreement with statements about computer use and the extent of equipment, user support, curricular integration and admissions requirements represented these norms. Section III determined selected institutional characteristics such as source of funding, educational mission, and region (items 119 & 120). Within the context of these variables, the study explored the scope of diffusion of computer and information literacy within the social structure of nursing education.

Prior to mailing, external and internal reviewers (2 each) evaluated the questionnaire. Peers identified these individuals as experts on computer applications in nursing. In conjunction with the review of literature, the experts provided additional

evidence of the questionnaire's content validity, instrument clarity, format and efficiency. Random selection of 106 schools or colleges of nursing (50% of population) controlled threats to external validity. Time constraints prevented a pilot study. Human rights protection followed the guidelines of Oregon Health Sciences University.

The strength of this descriptive design was its ability to gather a large amount of data from a population sample effectively and efficiently. This design utilized a "snap-shot" picture of the current level of computer and information literacy to evaluate diffusion. The limitations of the study include: no pre-test; potential responder bias; some survey items that produced confusing responses. Finally, not every use-related question evaluated all user groups. The findings indicated gaps in potentially significant information about the use of electronic communication by administration.

Data Analysis

Using the statistical program CRUNCH, a data set included the school/college, its region, all items and each possible response as variables. Missing data included unanswered questions and multiple responses for a single-answer item. During early analysis of the data, it became evident that questions designed to elucidate "yes or no" answers did not provide the clarification intended (items #89, 91, 111, 117). In addition, the low use

responses for questions about documentation in nurse run clinics and in faculty practice (items #58 and 59) indicated the wording of the questions did not provide for extraneous variables. Item # 121 (developmental stage of computer use) lacked a fully developed a framework for response. The investigator eliminated these items.

Frequency distributions and percentages evaluated the level of diffusion of computer and information literacy in schools/colleges of nursing. Analysis of the frequencies for each item indicated that collapsing response categories clarified interpretation of the results. The categories `daily' and `several times a week' comprised the category `frequent use'. The categories `several times a term' and `several times a month' comprised the category `infrequent use'. Results report response categories `never' and `don't know' separately.

Cross-tabulations and Pearson's chi-square analysis (with contingency correlation) evaluated potential associations between selected items and institutional characteristics. Percentages are based on the total number of returned, usable questionnaires from responding schools (N = 73).

During the discussion of the survey results, the term `school' describes a school, college or department of nursing. The terms `undergraduate' and `graduate' refer to student populations.

FINDINGS

Survey Results

Computer Literacy.--

Word processing, basic spreadsheets and graphs are the most frequently and widely used computer applications in nursing education (see Appendix C). Ninety-three percent of the schools surveyed report administration frequently uses these applications, while >60% of schools report frequent use by faculty and students. Walker (1986) found only 36.8% of surveyed faculty, students and staff used word processing. These and subsequent computer literacy findings are significantly higher than Walker's findings.

Schools (87%) reported administration frequently used computers for the management of student records, while 50% the number of schools reported frequent use by faculty. Administration and faculty in over 50% of reporting schools used the computer for course development and management. Only 53% of schools reported administration frequently used the computer for personnel management. With use of the technology up significantly since the mid-1980's, the following finding was most remarkable.

Nearly 90% of schools reported use of e-mail by administration and faculty. While schools reported student groups used Email much less frequently, it is noteworthy that 20% of schools did not know the level of use for these groups. A further 21% reported students never use e-mail. The independent nature of

Email use may have contributed to the lack of knowledge about student use, especially if faculty do not communicate with students through this medium.

Greater than 70% of schools reported use of computers for testing student's level of knowledge by both faculty and undergraduate groups, while graduate use was much less. In 50% of schools, faculty frequently used computers for multi-media and audio-visual aids. Over 30% of reporting schools never used the computer to develop problem analysis skills. Over 40% of schools report students never used computers for distance education. Although many nurses use computerized care plans in work environments, 30% of schools surveyed did not incorporate the technology into this task during the educational process.

Over 80% of schools reported use of CAI for interactive learning in both student groups, the highest use among undergraduates. Interactive learning with video-discs or CD ROMs was less widely and less frequently used.

Clearly, computer literacy, as operationalized by these applications, was more diffuse among the leaders: administration and faculty. Word processing, basic spreadsheets and graphs and Email, however, widely used by all groups.

Information Literacy.--

As with computer literacy applications, administration is the most frequent user of information literacy applications (see

Appendix D). Database management is a good example of this. Seventy percent of schools reported administration frequently uses this computer application. Faculty frequently used database management in 32% of schools reporting. These findings demonstrated a shift in the focus of use from task and production to the management of data. Students, in general, have not made this shift as demonstrated by less frequent use. Forty percent of the schools reported undergraduates never manage databases, while graduates in the same number of schools used database management infrequently. Nearly 30% of schools did not know if students used this application.

The development of databases is quite a different story. Thirty-three percent of schools reported faculty never develop nursing databases. Up to nearly 60% of schools reported their students never develop nursing databases. Nearly 20% of respondents did not know the level of database development by these groups. Unfortunately, this represents the loss of a huge base of untapped knowledge and experience.

Administration most frequently used advanced statistics, spreadsheets and graphs at 51% of schools. An additional 37% of schools reported infrequent use by this group. About 33% of schools reported that faculty and graduate students also frequently used advanced statistics, graphs and spreadsheets. Interestingly, the use of these applications was diffusing to

undergraduates at 49% of schools, although at infrequent levels of use.

Sixty-one percent of schools reported frequent use of computers by administration for budget analysis. Only 23% of schools reported infrequent use for budget analysis. Faculty at 40% of the schools never used a computer for budget analysis.

Frequent use of the Internet by administration and faculty occurred at nearly 50% of the schools. Approximately 35% of schools reported infrequent use of the Internet by students, while 25% reported students never use the Internet. Over 75% of schools reported frequent use by faculty and both student groups of local on-line library services. Interestingly, while 25% of respondents did not know if students used the Internet, less than 10% did not know if students used on-line library services.

Resources available via the Internet such as professional listservs, accessing national on-line library services or databases were much less frequently used by all groups. However, respondents frequently reported "don't know" about the level of use in student groups.

Norms

Support for Computer Use.--

The level of support for hardware and equipment operationalized the normative expectation of computer literacy in schools of nursing. Findings demonstrated this norm. IBM or PC's

were the predominant computing environment in 57% of schools. The remaining 40% of schools reported mixed PC/ Macintosh, with 2 schools reporting `other'. Sixty-one percent of schools reported using local area networks (LAN). Eleven percent more had plans to develop LAN's. Despite the fact that respondents in 5% percent of the schools did not know if their school used a LAN, these findings indicate a major financial commitment by schools to the technology.

Of the schools reporting, 86% participated in a wide area network (WAN), such as Internet or Bitnet. Eighty-eight percent of schools participated in a larger university system. Schools provided computers and access to the Internet to faculty, though the questionnaire ineffectively evaluated the mechanism for this. Sixty-three percent of schools reported encouraging students to own computers, while only 33% encouraged ownership of modems. Over 50% the schools reported they had rooms capable of supporting electronic or computer-linked equipment to enhance the educational process. However, 14% of the schools reported their schools had none.

User support systems were also in place in the majority (78%) of schools reporting. Computer labs were open and staffed at 72 of the 73 schools reporting (99%), 82% of which had computer labs in the schools themselves. To augment the use of computer labs, lists of experts and a help desk were available at 70% of

the reporting schools. These results indicate that access and support for computer use was available to students. Further, the results suggest that the schools expected the use of these technologies as part of their educational process.

In the area of curriculum, computer literacy was an admission requirement for undergraduates or graduates in less than 20% of reporting schools. None of the remaining 80% were considering it a pre-requisite. Courses were available to undergraduates `to ensure computer literacy' at 52% of reporting schools, with most of them offered on an elective basis. For graduates, however, the availability was not quite as high: 42% of schools offered computer courses to graduate students, again predominantly elective.

As requested, some respondents wrote in courses offered at their schools of nursing relating to computers and nursing. Of the 48 schools (66% of sample) completing this section, 15 offer classes on `Computers in Nursing,' 9 at the graduate level (2 required), and 6 at the undergraduate level (all elective). Among the 28 informatics courses described, 1 school of nursing reported a series of graduate courses leading to a degree in informatics. One school described courses in informatics required at the undergraduate level.

The majority of courses identified, however, did not specifically focus on computers in nursing. The required courses

focused on research, theory or statistics courses at both the undergraduate and graduate levels. Schools also reported the availability of elective courses on statistical packages and specific applications.

Views of Leaders.--

This section of the survey included 7 positively phrased statements concerning computer literacy and information literacy in nursing (see Appendix E). Participants indicated their level of agreement and perception of faculty agreement to these statements. Overall, the leaders agreed to strongly agreed with the statements. Faculty agreement consistently ranged between 20-30% less than the opinion leader's. Disagreement was reported as occurring more frequently in the faculty group. Cross-tabulations demonstrated some evidence of association between views and use, however, chi-square analyses were not statistically significant.

An interesting finding concerned the statement `CAI offers flexible and individualized learning experiences'. Consensus on this statement was overwhelmingly positive with one exception. Results included only one `strongly disagree' response in the leader and faculty opinion categories.

Five of 7 statements elicited `don't know' responses from the leaders: `computer exercises can increase student comfort with the use of hospital and nursing information systems' and `understanding the ethical and legal issues associated with the

use of computerized information systems is important'. Items regarding faculty opinion yielded between 4 - 19 `don't know' responses. The statements focusing on the professional role of nurses and the implications of information processing or information processing systems for nursing returned high responses in the `don't know' or `neutral' categories. These responses may be due, in part, to an insufficient knowledge base of the nursing implications of the technology, or a reluctance of opinion leaders to verbalize ideas contrary to the norms of their institution.

Institutional Characteristics

The institutional characteristics assessed in this study were: region, source of funding (public or private); educational classification of school - teaching (liberal arts and comprehensive), research (doctoral granting and research), or academic health center.

The analyses of association between items representative of computer and information literacy, and the various institutional characteristics included cross-tabulations and Pearson's chi-square (with contingency correlation). Although there was some evidence in a few calculations that associations may exist, the evidence was not strong enough to be conclusive at traditional levels of statistical significance ($p < .05$).

For example, the comparison of the mission of the schools and electronic conferencing in the undergraduate group rendered a

p = 0.0510. However, the minimum expected frequency was 1.1 and 6 of 9 cells (66.7%) had expected frequency of <.5. Therefore, the chi-square p value was not necessarily accurate. Most p values reported in statistical analysis of the data were >.7. The data were not robust enough to support inference of statistical significance for the items measured.

Respondent's Comments.--

The survey asked respondents to comment on information about identified groups of users, major effects of computerization on nursing education, and provide any other comments on computer use at their school of nursing. Of the 49 (67%) respondents who completed the user section, 14 (29%) reported `Everyone is a user'. An additional 14 respondents reported a `wide variety of users'. In rank order, administrators, secretaries, researchers, informatics faculty, and "young" faculty and those who use computers at home were the 5 individual user groups most frequently identified.

Respondents (n = 50) most frequently identified the following major effects computers had on nursing education: individual, self-paced learning (22%); versatility of learning tools (14%); rapid/improved communication; distance learning (10%). The following less frequently mentioned effects of computer use were (in descending order): enhances classroom/learning environment; improves access to resources/data;

prepares students to handle/process information; improves efficiency/proficiency (including word-processing, organization of records, and presentation of information); increases decision making skills; and prepares students for the workplace; increase knowledge base; promotes exploration, collaboration and change; and provides new teaching strategies. Finally, 2 schools stated that `pre-computer methods were the mainstay of the program' and `computers had little effect on nursing education'.

Interestingly, the respondents indicated many of the same limitations researchers reported in the 1980's: administrative support and resources for hardware/software, the training of faculty and staff, lack of motivation by faculty to learn, and fear of computers (Ball & Hannah, 1984, Grobe, 1984, Walker, 1984, Armstrong, 1986, Lange & Brownie, 1986).

Sadly, one respondent reported that, although the associated university was networked and completely on-line, the school of nursing was not connected nor was the building wired for a LAN. On-line access to information, even for the `computer expert', was not available at this particular school of nursing. Computer equipment was old and money for upgrading was "not the highest administrative priority". This example illustrates the powerful role a school's social structure, specifically its norms, has on the diffusion of innovation.

DISCUSSION

This national survey focused on the diffusion of computer literacy and information literacy in nursing education. A "snap-shot" picture of the level of use and support for computer technology, combined with the views of leaders in computer use within the organization, illustrated the extent of diffusion over the last decade.

An innovation usually enters a social system with the leaders and diffuses to individuals of lower status. In 1984, Walker's study of computer use among deans and administrators of schools of nursing showed a very low level of use. This has changed. Administration and faculty are computer literate and many go beyond.

Of interest was the rapid diffusion of Email use in nursing education. Email, is a fairly new application by comparison to word processing. Furthermore, it requires that users be networked with special hardware and applications. In 1986, Walker reported only 36% of faculty, staff and students used word processing in schools of nursing (p.168).

Today, the extent and frequency of e-mail use are competitive with the extent and frequency of word processing use in nursing education. Furthermore, it is very similar to the level of Email use in the business school environment. The rapid integration of e-mail into nursing education shows the significant commitment in resources to the utilization of this technology.

The commitment of resources demonstrates that Email and other computer literacy computer uses have become normative behaviors in nursing education. The near universal provision of equipment, LAN's, availability of computer labs and CAI among responding schools supported this.

The diffusion of information literacy is beginning in all groups. The frequency of Internet use at the majority of schools is a good example. Accessing local resources is wide-spread among schools and user groups. Although accessing national on-line resources is much less frequent, opinion leaders could easily facilitate this. Seminars on the use of electronic communication to access, retrieve and utilize information would develop skills necessary to move around the Internet. Accessing information from a variety of national resources, sharing ideas on professional listservs or reading Sigma Theta Tau's on-line journal would stimulate investigation of limitless resources while building information literacy skills. Students (from all user groups) would soon be `surfing the Net'. Faculty could include aspects of classwork on-line through the use of conferencing software, thus promoting collaboration and discourse between students.

The development of information literacy requires a foundation of computer literacy. Findings showed that computer literacy is not an expected knowledge base of beginning nursing students. A near absence of computer literacy admission

requirements and the paucity of required courses demonstrates this. Diffusion of information literacy into the norms of nursing education has not occurred.

Schools reported much lower use among students than other groups. The `don't know' response rate for this group was consistently high. This was especially true for information literacy items such as electronic communication and resource management. These responses could have resulted for the following reasons: students are using the technology independently or students do not communicate their computer activities to opinion leaders. If communication among information literate students is horizontal, then it is possible for the knowledge and use of the technology to progress independently of leaders in the school environment. This is an area for future research. This study's findings however, indicate communication of this innovation remains restricted to the leader groups: administration and faculty.

Rogers (1983) states that if a social system is resistant to change, the behaviors of its opinion leaders reflect the norms of that system. Diffusion of innovation will be slow. Although the expressed opinions of the leaders support the concepts of computer and information literacy, the strength of their agreement does not correlate with level of use. Barriers within the social structure of nursing education limit a more extensive integration of the

technology into curriculum, admission requirements and the process of education.

Implications for Further Study

It is clear diffusion of innovation in nursing warrants continued research. Future research could include patterns of use by specific user groups, identification of communication patterns in nursing education, identification of factors to minimize the barriers to change. Understanding the impact of computerization on the types and uses of information in nursing practice can guide curriculum planning in nursing education. Finally, analyzing the impact of nursing's culture and history on the diffusion of innovation could provide opinion leaders with tools to facilitate the implementation of ideas.

Thirty years have passed since Bitzer (1963) introduced the first computer-assisted instruction module into her maternity nursing class. In the late 1970's, Ronald introduced the first computers in nursing course. Today, many of Walker's findings are still pertinent. Computer classes are available as electives in most schools, though computer literacy is still not a requirement for admission. More people are using computers and those that are, are using them a to accomplish a lot more.

Nursing education has not adopted the concept of computer-based information literacy as an integral process to enhance nursing practice. The knowledge and use of computerized

information systems facilitate the nursing process in clinical settings. Hospital databases contain a wealth of pertinent patient care data. Nurses prepared to access, retrieve and manage data available in computerized information systems will have a wealth of information to support their clinical judgment. Information literacy is one of nursing's most valuable tools.

In light of the trends in health care to redefine nursing, it seems prudent that nurses be able to demonstrate their skills as information coordinators for patient care. Nurses have mastered this role over the centuries by assessing, planning, intervening and evaluating patient needs, and communicating the plan of care with the team. It is essential that nursing incorporate computer and information literacy skills into the core focus of nursing education. These skills can only serve to promote professional excellence and quality patient care.

REFERENCES

American Nurse's Association (1987). Computers in Nursing Education. New York: New York.

Anderson, B. (1992). Nursing informatics: Career opportunities inside and out. Computers in Nursing, 10(4), 165-170.

Armstrong, M. (1984). Computer competence for nurse educators. In V. Saba, K. Rieder & D. Pocklington (Eds.), Nursing and Computers: An Anthology (pp. 336-348). New York: Springer-Verlag.

Armstrong, M. (1986). Self-directed learning about computers and computers for self-directed learning. Journal of Continuing Education in Nursing, 17(3),84-86.

Ball, H. & Hannah, K. (1984). Using Computers in Nursing. Reston: Reston Publishing Company.

Ball, M., Snelbecker, G., & Schechter, S. (1985). Nurses perceptions concerning computer uses before and after a computer literacy lecture. Computers in Nursing, 3(1), 23-32.

Billings, D. (1984). Evaluating computer-assisted instruction. In V. Saba, K. Rieder & D. Pocklington (Eds.), Nursing and Computers: An Anthology (pp. 336-348). New York: Springer-Verlag.

Birkhead, L. (1978). Nursing and the technetronic age. In R. Zielstorff (Ed.), Computers in Nursing (pp. 207-213). Rockville: Aspen Systems Corporation.

Bitzer, M. & Boudreaux, M. (1969). Using a computer to teach nursing. In R. Zielstorff (Ed.), Computers in Nursing (pp. 186-197). Rockville: Aspen Systems Corporation.

Brennan, P. & Fitzpatrick, J. (1992). On the essential integration of nursing and informatics. AACN Clinical Issues, 3(4), 797-803.

Brose, C. H. (1984). Computer technology in nursing: revolution or renaissance? Nursing and Health Care, 5(10), 531-534.

Bryson, D.M. (1989). Empirical determination of computer literacy objectives for two-year and four-year nursing students. Ph.D. dissertation, University of Oregon.

Carty, B. (1994). The protean nature of the nurse informaticist. Nursing and Health care, 15(4), 174-177.

Clancey, W., Shortliffe, E. & Buchanan, B. (1979). Intelligent computer-aided instruction for medical diagnosis. In W. Clancey & E. Shortliffe (Eds.), Readings in Medical Artificial Intelligence, (pp. 256-275). Menlo Park: Addison-Wesley Publishing Company.

Collart, M. (1973). Computer-assisted instruction and the teaching-learning process. In R. Zielstorff (Ed.), Computers in Nursing (pp. 187-197). Rockville: Aspen Systems Corporation.

Cooper, G. & Owens, G. (1994). Patient simulation using seamless digital video. Proceedings from the 19th Annual Symposium on Computer Applications, p.796-800.

Cox, H., Harsanyi, B. & Dean, L. (1987). Computers and Nursing: Application to Practice, Education and Research. Norwalk: Appleton & Lange.

DeLoughry, T. (1994). For the community of scholars, `being connected' takes on a whole new meaning. The Chronicle of Higher Education, 41(10), 25-26.

Dillman, D. (1978). Mail and telephone surveys: the total design method. New York: John Wiley & Sons.

Frand, J. & Britt, J. (1989). The 5th annual UCLA survey of business school computer usage. Communications with the ACM, 32(1), 62-76.

Gorry, G. (1984). Computer-assisted clinical decision making. In W. Clancey & E. Shortliffe (Eds.), Readings in Medical Artificial Intelligence, (pp. 18-34). Menlo Park: Addison-Wesley Publishing Company.

Grobe, S. (1984). Conquering computer cowardice. The Journal of Nursing Education, 23(6), 232-239.

Grobe, S. (1988). Nursing informatics competencies for nurse educators and researchers. In H. Petersen & U. Gerdin-Jelger (Eds.), Preparing Nurses for Using Information Systems: Recommended Informatics Competencies, IMIA, working group 8 (NLN Publication No. 14-2234) (pp. 25-40). New York: National League for Nurses.

Grobe, S., Ronald, J., & Tymchyshyn, P. (1987). Computers in Nursing Education. Kansas City: American Nurses Association.

Hannah, K. (1988). Using computers to educate nurses. In M. J. Ball, K. J. Hannah, U. Gerdin-Jelger, & H. Peterson (Eds.), Nursing Informatics: Where Caring and Technology Meet (pp. 289-300). New York: Springer-Verlag.

Heller, B., Damrosch, S., Romano, C., & McCarthy, M. (1989). Graduate specialization in nursing informatics. Computers in Nursing, 7(2), 68-77.

Heller, B., Romano, C., & Damrosch, S. (1985). Computer applications in nursing. Implications for the curriculum. Computers in Nursing, 3(1), 14-22.

Hoffer, E. & Barnett, O. (1990). Computers in medical education. In E. Shortliffe & L. Perreault (Eds.) Medical Informatics (pp. 535-561). Menlo Park: Addison-Wesley Publishing Company.

Holmes, J., Lin, A., Fath, S.,& Gray, L. (1992). The paperless essay: one way to teach writing and computer skills in medical school. Medical Teacher, 14(1), 83-88.

Jacobs, A. & dela Cruz, F. (1992). The informatics education needs of graduate nursing students. (NLN Publication No. 14-2406). New York: National League for Nurses.

Jones, B., Navin, L., Barrie, J., Hillan, E., & Kninane, D. (1991). Computer literacy among medical, nursing, dental and veterinary graduates. Medical Education, 25(3), 191-195.

Kellogg, B. & Garcia, S. (1985). Introducing nursing students to computers. Computers in Nursing, 3(3), 128-132.

Lange, L. & Brownie, J. (1986). Educating nurses to work in computerized nursing services. Nursing Administration Quarterly, 10 (2), 64-70.

McFarland, M. (1989). An analysis of the relationship between learning style perceptual preferences and attitudes toward computer-assisted instruction. Unpublished doctoral dissertation, Oregon Health Sciences University, Portland.

McGonigle, D. & Eggers, R. (1991). Establishing a nursing informatics program. Computers in Nursing, 9(5), 184-189.

Meadows, L. (1977). Nursing education in crisis: a computer alternative. The Journal of Nursing Education, 16(5), 13-21.

Mikan, K. (1984). Creating a climate for computer integration into the curriculum. In V. Saba, K. Rieder, & D. Pocklington (Eds.), Nursing and Computers: An Anthology (pp. 369-375). New York: Springer-Verlag.

Moritz, P. (1990). Information technology: a priority for nursing research. Computers in Nursing, 8(3), 111-115.

Naeymi-Rad, F., Trace, D., Shoults, K., Suico, J., O'Brien, M., Evens, M., Carmony, L., Roberts, R., & Zelanski, R. (1993).

Informatics workup. Proceedings from the 17th Annual Symposium on Computer Applications, 545-549.

Nelson, J. & Carlstrom, J. (1985). A new confrontation: nursing education and computer technology. The Journal of Nursing Scholarship, 17(3), 86-87.

Newbern, V. (1985). Computer literacy in nursing education: an overview. Nursing Clinics of North America, 20(3), 549-556.

Noll, M. & Murphy, M. (1993). Integrating nursing informatics into a graduate research course. Journal of Nursing Education, 32(7), 332-334.

Norman, S. (1989). Effective use of instructional information systems: a preparation for nurse teachers. In Petersen & Gerdin-Jelger (Eds.), Preparing Nurses for Using Information Systems: Recommended Informatics Competencies, IMIA, working group 8 (NLN Publication No. 14-2234) (pp. 73-82). New York: National League for Nurses.

Ozbolt, J. & Graves, J. (1993). Clinical nursing informatics: developing tools for knowledge workers. Advances in Clinical Nursing Research, 28(2), 407-423.

Parks, P., Damrosch, S., Heller, B., Romano, C. (1986). Faculty and student perceptions of computer applications in nursing. Journal of Professional Nursing, 2(2), 104-113.

Polit, D. & Hungler, B. (1991). Nursing Research, Principles and Methods (4th Ed.). Philadelphia: J. B. Lippincott Company.

Petersen, H. & Gerdin-Jelger, U. (Eds.) (1988). Preparing Nurses for Using Information Systems: Recommended Informatics Competencies, IMIA, working group 8 (NLN Publication No. 14-2234). New York: National League for Nurses.

Pincetl, P., Kent, S., & Liao, R. (1991). A toolbook based environment for learning pathology. Proceedings from the 15th Annual Symposium on Computer Applications, p.713-717.

Pincetl, P., Cobbs, E., Hubsman, J., Liao, R., Baranano, S., Heller, R., Fry, E., & Piemme, T. (1992). PC ClinSim: a toolbook based clinical simulation environment. Proceedings from the 16th Annual Symposium on Computer Applications, p.793-794

Pocklington, D. (1983). Models for evaluating faculty / student acceptance and effectiveness of computer technology in schools of nursing. In V. Saba, K. Rieder, & D. Pocklington (Eds.), Nursing and Computers: An Anthology (pp. 351-365). New York: Springer-Verlag.

Ranun, D. (1994). "Pre-medical" informatics. Proceedings from the 18th Annual Symposium on Computer Applications, 743-746.

Renshaw, S. & Ganley, K. (1987). As computer technology invades health care settings, nurse educators need to focus on computer literacy. The Pennsylvania Nurse, 42(5), 6-7.

Rogers, E. M. (1983). Diffusion of Innovations (3rd Ed.). New York: The Free Press.

Romano, C. (1988). Preparing nurses for the development and implementation of information systems. In Petersen & Gerdin-Jelger (Eds.), Preparing Nurses for Using Information Systems: Recommended Informatics Competencies, IMIA, working group 8 (NLN Publication No. 14-2234) (pp. 83-92). New York: National League for Nurses.

Romano, C. & Heller, B. (1990). Informatics: preparation for new nursing rules. (NLN Publication No. 14-2365). New York: National League for Nurses.

Romano, C. & Heller, B. (1990). Nursing informatics: a model curriculum for an emerging role. Nurse Educator, 15(2),16-19.

Ronald, J. (1981). Introducing baccalaureate nursing students to the use of computers in health care. In V. Saba, K. Rieder, & D. Pocklington (Eds.), Nursing and Computers: An Anthology (pp. 376-383). New York: Springer-Verlag.

Ronald, J. & Skiba, D. (1987). Computer education for nurses: curriculum issues and guidelines. In H. Petersen & U. Gerdin-Jelger (Eds.), Preparing Nurses for Using Information Systems: Recommended Informatics Competencies, IMIA, working group 8 (NLN Publication No. 14-2234) (pp. 15-23). New York: National League for Nurses.

Saba, V. (1989). Nursing information systems. (ANA Publication No. NP-74). Kansas City: American Nurses Association.

Saba, V & McCormick, K. (1986). Essentials of Computers for Nurses. Philadelphia: J. B. Lippincott Company.

Saba, V., Rieder, K. & Pocklington, D. (Eds.). (1989). Nursing and Computers: An Anthology. New York: Springer-Verlag.

Sancho, J., Gonzalex, J., Patak, A., Sanz,F. & Sitges-Serra, A.(1993). Introducing medical students to medical informatics. Medical Education, 27(6), 479-483.

Schwirian, P. (1986). Nursing information systems: the key top the future?. Computers in Nursing, 4(3), 102 & 136.

Shortliffe, E. (1987). Clinical decision support systems. In E. Shortliffe & L. Perreault (Eds.), Medical Informatics (pp. 466-502), Menlo Park: Addison-Wesley Publishing Company.

Simpson, R. (1992). Informatics: nursing's newest specialty. Nursing Management, 23(8), 26.

Stevens, R. & Reber, E. (1994). Maximizing the utilization and impact of medical education software by designing for local area network (LAN) implementation. Proceedings from the 18th Annual Symposium on Computer Applications, p.781-785.

Summers, S. (1992). High technology impact on nursing education. The Kansas Nurse, 67(12), 5-6.

Summers, S., Penny, S., Forten-Boyer, J., Loutzenhiser, J. & Arnold-Baglioli, B. (1990). Creative use of microcomputer software by graduate nursing students. Computers in Nursing, 8(5), 198-200.

Sweeney, M. (1985). The Nurse's Guide to Computers. New York: Macmillan Publishing Company.

Veloski, J. & Blacklow, R. (1986). The integration of the computer into medical education. In J. Javitt (Ed.), Computers in Medicine, Applications and Possibilities (pp. 134-156). Philadelphia: W. B. Saunders & Company.

Wainwright, P. (1991). Informatics for the uninitiated. Nursing Standard, 5 (41), 18-19.

Walker, M. (1986). Nursing Education: Challenges of the computerized environment. Computers in Nursing, 4 (4), 166-171.

Wormuth, D. (1991). An innovative method of teaching advanced cardiac life support, or why Cosmic Osmo may someday save your life. Proceedings from the 15th Annual Symposium on Computer Applications, 864-865.

Williams, R. & Benedict, S. (1990). RN education flexibility utilizing laptop computers. Computers in Nursing, 8(5), 201-203.

Zielstorff, R. (Ed.). (1980). Computers in Nursing. Rockville: Aspen Systems Corporation.

Zroskie, L. (1992). Information systems in graduate nursing curriculum. Nurse Educator, 17(6), 10.

APPENDIX A

Copy of Letters to Repondents

COMPUTERS and NURSING EDUCATION
17615 S.W. BRYANT ROAD, LAKE OSWEGO, OREGON 97035

January 3, 1995

Dear Dr.,

Nurses are increasingly using computers in their practice. It is important to know how nursing educational programs currently use computers and their associated technologies.

In order to develop the most accurate picture of the level of computer use in nursing education today, your response is essential to the success of this study. Your school has been selected randomly from the list of NLN accredited schools and colleges of nursing that offer bachelor's and higher degrees. Completion and the return of the questionnaire in the stamped envelope provided, serves as consent to participate in this study. The confidential questionnaire is coded with a number known only to the investigator, and upon return, will be kept in a locked cabinet. All data will be reported in the aggregate.

The benefits of this national study are that it will provide evidence of the current level of integration of computer use and computer technology in nursing education. In light of health care reform, it is important that we be aware of whether our educational programs are preparing individuals to function effectively in the workplace. There are no identified risks.

If you would like a summary of the results of the study, print "copy of results" on the back of the return envelope and sign it. Please, **do not** put this information on the questionnaire itself.

I would be happy to answer any questions you might have, as would Barbara Gaines, RN, Ed.D., advisor. Please feel free to call. The telephone number is (503) 697-7512 for Katherine Shaver; or (503) 494-3815 for Barbara Gaines.

Thank you for your assistance with this survey.

Sincerely,

Katherine S. Shaver, RN, BS
Principal Investigator

COMPUTERS and NURSING EDUCATION
17615 SW BRYANT ROAD, LAKE OSWEGO, OREGON 97035

Example of Follow-up Postcard

January 10, 1995

Last week a questionnaire seeking information on computer use in your school/college of nursing was mailed to you.

If you have already completed and returned the questionnaire, please accept our sincere thanks. If not, please do so today. Because the questionnaire has been mailed to a small but representative sample of schools/colleges of nursing, it is extremely important that yours be included in the study if the results are to accurately represent the current use of computers in nursing education.

If by some chance you did not receive the questionnaire, or it was misplaced, please call me at (503) 697-7512 and I will put another in the mail to you today. Thank you.

Sincerely,

Katherine S. Shaver, RN, BS
Principal Investigator

COMPUTERS and NURSING EDUCATION
17615 SW BRYANT ROAD, LAKE OSWEGO, OREGON 97035

January 3, 1995

Dear Dr.,

About four weeks ago, I wrote to you seeking information on computer use in your school/college of nursing. As of today, I have not yet received your completed questionnaire.

Many nurses are using computers in their practice on a daily basis. This research was undertaken because I believe it is important to know how nursing educational programs currently use computers and their associated technologies, and how the use of this technology is being addressed in the educational process.

I am writing to you because of the significance each questionnaire has to the usefulness of the study. Your school has been selected randomly from the list of NLN accredited schools and colleges of nursing that offer bachelor's and higher degrees. In view of the size of the sample, your response is essential for the results to be truly representative of computer use in nursing education today.

In the event that the questionnaire was lost or misplaced, I have enclosed another. Please complete it to the best of your ability and return it as soon as possible. As mentioned in the earlier letter, if you would like a summary of the results of the study, print "copy of results" on the back of the return envelope and sign it. Please **do not** put this information on the questionnaire itself.

I would be happy to answer any questions you might have, as would Barbara Gaines, RN, EdD., advisor. Please feel free to call. The telephone number is (503) 697-7512 for Katherine Shaver; or (503) 494-3815 for Barbara Gaines.

Your participation is greatly appreciated.

Sincerely,

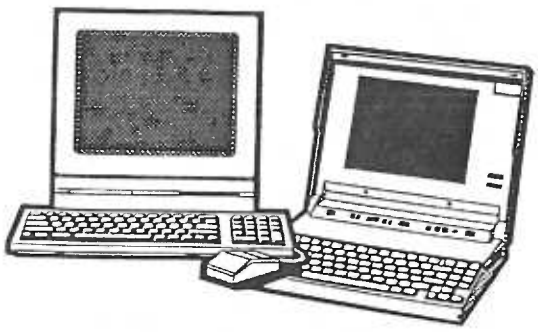
Katherine S. Shaver, RN, BS
Principal Investigator

APPENDIX B

Copy of Survey Instrument

COMPUTER USE IN NURSING EDUCATION

Are we preparing nurses to use information in a way that will allow them to participate fully in the 21st century? This survey asks you to tell us the state of readiness of your school/college of nursing. Please answer all the questions using the overall level of computer use in your school/college of nursing as the referent. If you wish to comment on any of the questions or qualify your answers, please use the margins or the back page.



Return this questionaire to:
Computers and Nursing Education
17615 S.W. Bryant Road
Lake Oswego, Oregon 97035

Computer technology is used in a number of different ways in nursing education:
Using the following scale, please circle the most appropriate response to this set of questions. (The **overall** level of computer use in the school/college of nursing for identified groups is the referent.)

never	a few times a term	several times a month	several times a week	daily	don't know
1	2	3	4	5	6

At our school/college of nursing, computers are **used** for:

	never				daily	don't know
multi-media and audio-visual aids (ie: slide presentations, video displays, LCD/overheads):						
24. by faculty	1	2	3	4	5	6
25. by undergraduate students	1	2	3	4	5	6
26. by graduate students	1	2	3	4	5	6
distance education programs:						
27. for undergraduate students	1	2	3	4	5	6
28. for graduate students	1	2	3	4	5	6
electronic conferencing (through conferencing software or E-Mail):						
29. by faculty	1	2	3	4	5	6
30. by undergraduate students	1	2	3	4	5	6
31. by graduate students	1	2	3	4	5	6
E-mail:						
32. by administration	1	2	3	4	5	6
33. by faculty	1	2	3	4	5	6
34. by undergraduate students	1	2	3	4	5	6
35. by graduate students	1	2	3	4	5	6
Internet :						
36. by administration	1	2	3	4	5	6
37. by faculty	1	2	3	4	5	6
38. by undergraduate students	1	2	3	4	5	6
39. by graduate students	1	2	3	4	5	6
accessing on-line library services:						
locally						
40. by faculty	1	2	3	4	5	6
41. by undergraduate students	1	2	3	4	5	6
42. by graduate students	1	2	3	4	5	6
nationally						
43. by faculty	1	2	3	4	5	6
44. by undergraduate students	1	2	3	4	5	6
45. by graduate students	1	2	3	4	5	6

Computer technology is used in a number of different ways in nursing education:
Using the following scale, please circle the most appropriate response to this set of questions. (The **overall** level of computer use in the school/college of nursing for identified groups is the referent.)

never	a few times a term	several times a month	several times a week	daily	don't know
1	2	3	4	5	6

At our school/college of nursing, computers are **used** for:

	never				daily	don't know
interactive learning using:						
video discs						
68. by undergraduate students	1	2	3	4	5	6
69. by graduate students	1	2	3	4	5	6
CD-ROM's						
70. by undergraduate students	1	2	3	4	5	6
71. by graduate students	1	2	3	4	5	6
Computer-assisted instruction modules (CAI)						
72. by undergraduate students	1	2	3	4	5	6
73. by graduate students	1	2	3	4	5	6

****

Using the following scale, please circle the answer that best describes your opinion and your overall perception of how the **faculty** in your school/college of nursing see information, computers and nursing:

strongly disagree	disagree	neutral	agree	strongly agree	don't know
1	2	3	4	5	6

	strongly disagree				strongly agree	don't know
Nursing is primarily an information processing discipline.						
74. my opinion	1	2	3	4	5	6
75. faculty's opinion	1	2	3	4	5	6
Informatics is increasingly important in nursing education.						
76. my opinion	1	2	3	4	5	6
77. faculty's opinion	1	2	3	4	5	6
Nursing has a definite role in the design and evaluation of computer information systems.						
78. my opinion	1	2	3	4	5	6
79. faculty's opinion	1	2	3	4	5	6
Computer-assisted instruction offers flexible and individualized learning experiences.						
80. my opinion	1	2	3	4	5	6
81. faculty's opinion	1	2	3	4	5	6

If no: is this issue being discussed in curriculum planning?

98. Undergraduate
    1. yes
    2. no

99. Graduate
    1. yes
    2. no

Please list any courses relating to computers and nursing that are offered to students at your schoolcollege of nursing. (Please include course title, number of credits, educational level of the course, required or elective).

		UNDERGRADUATE		GRADUATE	
TITLE	CREDITS	Required	Elective	Required	Elective
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

Hardware and Software Issues:(circle the best answer)

100. Is your school/college of nursing using a Local Area Network (LAN)?
    1. yes
    2. no
    3. in development
    4. don't know

101. Is your school/college of nursing's computer system part of a larger university computer system?
    1. yes
    2. no
    3. don't know

102. Is your school/college of nursing accessing a wide area network (Internet or Bitnet)?
    1. yes
    2. no
    3. in development
    4. don't know

103. Are faculty provided an Internet/Bitnet address?
    1. yes
    2. no

104. if yes➞ ➞
    104a. service is an expense for faculty
    104b. service is provided for faculty by the institution or school/college of nursing

105. Are students provided individual Internet/Bitnet addresses?
    1. yes
    2. no

106. Is the service is an additional cost for the students?
    1. yes
    2. no

116. Computer lab(s)

1. yes
2. no
3. don't know

117. if yes➞ ➞ indicate location (circle all that apply)

117a. within school/college of nursing

117b. within larger university

118. Is computer lab staffed when open?

1. yes
2. no

hours open for use, if known _____

DEMOGRAPHICS (Please circle the best response).

119. Is your school/college of nursing:

1. Public
2. Private

120. What is the educational classification of the institution housing your school/college of nursing?

1. Liberal Arts
2. Comprehensive
3. Research
4. Doctoral granting
5. Academic health center

121. Which statement best describes the **developmental stage** of computer use in your school/ college of nursing:

1. investigation
2. start-up
3. growth
4. stability
5. re-evaluation

122. Are there "clumps" of computer use and/or computer users in your school or college of nursing (e.g.: administration, a particular group of faculty)? Please describe:

_____

_____

_____

123. Please indicate what you think are the major effect/effects computers have on nursing education at your school/college of nursing:

_____

_____

_____

APPENDIX C
Percent of Schools
Reporting Extent of Computer Literacy Use

Application	User Group	Frequent	Infrequent	Never	Don't Know
Word processing, basic spreadsheets and graphics	Administration	93%	6%	0%	0%
	Faculty	82%	12%	0%	1%
	Undergraduate	60%	27%	0%	8%
	Graduate	69%	23%	1%	8%
E-Mail	Administration	74%	15%	7%	3%
	Faculty	67%	23%	7%	0%
	Undergraduate	26%	30%	21%	20%
	Graduate	29%	28%	21%	22%
Management of Student Records	Administration	88%	8%	1%	1%
	Faculty	41%	40%	9%	8%
Personnel Management	Administration	53%	22%	10%	13%
	Faculty	16%	24%	33%	24%
Course Development	Administration	57%	26%	11%	3%
	Faculty	55%	34%	5%	3%
Multi-media and audio-visual aids	Faculty	49%	38%	8%	2%
	Undergraduate	21%	48%	20%	8%
	Graduate	19%	52%	19%	8%
Support of clinical activities	Undergraduate	32%	36%	10%	7%
	Graduate	26%	36%	22%	14%
Interactive Learning with Video Discs	Undergraduate	27%	48%	24%	1%
	Graduate	12%	38%	32%	12%
Interactive Learning with CD-Roms	Undergraduate	19%	30%	38%	10%
	Graduate	19%	30%	40%	11%
Interactive Learning with CAI	Undergraduate	37%	56%	1%	3%
	Graduate	15%	53%	16%	15%
Problem Analysis Skills	Faculty	12%	29%	33%	25%
	Undergraduate	12%	34%	29%	21%
	Graduate	11%	34%	30%	22%
On-Line Documentation in Student Clinical Settings	Unspecified User Group	41%	33%	16%	10%
On-line Documentation of Standardized Careplans	Unspecified User Group	23%	29%	33%	15%

APPENDIX D
Percent of Schools
Reporting Extent of Information Literacy Use

Application	User Group	Frequent	Infrequent	Never	Don't Know
Database Management	Administration	70%	22%	1%	6%
	Faculty	32%	51%	7%	8%
	Undergraduate	8%	23%	41%	29%
	Graduate	5%	36%	29%	29%
Budget Analysis	Administration	62%	23%	3%	11%
	Faculty	7%	32%	40%	19%
Statistics, graphs, advanced spreadsheets	Administration	51%	37%	3%	8%
	Faculty	34%	59%	1%	4%
	Undergraduate	5%	49%	19%	22%
	Graduate	30%	47%	6%	15%
Internet	Administration	48%	33%	8%	8%
	Faculty	42%	37%	12%	4%
	Undergraduate	11%	36%	25%	25%
	Graduate	15%	33%	26%	26%
Electronic Conferencing	Faculty	47%	33%	18%	17%
	Undergraduate	14%	25%	40%	16%
	Graduate	19%	20%	41%	18%
Local On-line Library Services	Faculty	59%	33%	3%	1%
	Undergraduate	42%	38%	4%	9%
	Graduate	45%	40%	4%	8%
National On-line Library Services	Faculty	24%	48%	11%	14%
	Undergraduate	7%	41%	23%	25%
	Graduate	14%	41%	17%	25%
Local On-line Healthcare Databases	Faculty	23%	35%	26%	14%
	Undergraduate	8%	29%	35%	22%
	Graduate	12%	35%	29%	21%
National On-line Healthcare Databases	Faculty	14%	37%	25%	22%
	Undergraduate	5%	22%	38%	28%
	Graduate	10%	27%	31%	28%
Professional Listservs	Administration	24%	21%	26%	25%
	Faculty	25%	27%	21%	23%
	Undergraduate	7%	19%	36%	33%
	Graduate	10%	19%	33%	34%
Development of Nursing Databases	Faculty	15%	30%	33%	21%
	Undergraduate	4%	14%	58%	19%
	Graduate	7%	23%	49%	18%

APPENDIX E

Extent of Opinion Leaders Agreement with Statements on Computers and Nursing

Statement	Opinion Leader	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Don't Know
Nursing is primarily an information processing discipline.	Leader	30%	22%	19%	21%	3%	4%
	Faculty	12%	21%	20%	15%	4%	26%
Informatics is increasingly important in nursing education.	Leader	81%	18%	0%	0%	0%	1%
	Faculty	27%	32%	19%	4%	0%	7%
Nursing has a definite role in the design and evaluation of CIS.	Leader	79%	12%	4%	1%	1%	1%
	Faculty	27%	36%	21%	3%	0%	14%
CAI offers flexible and individualized learning experiences.	Leader	75%	21%	1%	1%	0%	1%
	Faculty	32%	45%	14%	1%	1%	5%
Computer exercises increase student comfort with NIS & HIS.	Leader	67%	30%	3%	0%	0%	0%
	Faculty	28	28	11%	0%	0%	12%
Electronic conferencing & file exchange promote professional development, collaboration, and the generation of nursing knowledge.	Leader	67%	22%	4%	1%	0%	5%
	Faculty	27%	31%	19%	0%	0%	23%
Understanding the ethical and legal issues associated with the use of CIS is important.	Leader	84%	15%	1%	0%	0%	0%
	Faculty	55%	26%	8%	0%	0%	11%

Leader = respondent's view.
Faculty = respondent's perception of faculty view.