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Reliability and validity of a model computerized simulation examination for nursing

Tippie Denton Pollard
University of Tennessee

To the Graduate Council:

I am submitting herewith a dissertation written by Tippie Denton Pollard entitled "Reliability and validity of a model computerized simulation examination for nursing." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Education, with a major in Educational Psychology.

Schuyler W. Huck, Major Professor

We have read this dissertation and recommend its acceptance:

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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We have read this dissertation
and recommend its acceptance:

John L. Matthews

Donald J. Dickinson

Sylvia E. Hart

Accepted for the Council:

C. W. Minkel

Vice Provost
and Dean of The Graduate School

RELIABILITY AND VALIDITY OF A MODEL COMPUTERIZED SIMULATION EXAMINATION FOR NURSING

A Dissertation
Presented for the
Doctor of Education
Degree
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Tippie Denton Pollard

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ABSTRACT

Health care facilities and schools of nursing are beginning to utilize computer technology. There is limited availability of quality software in nursing for instruction and evaluation. In the present study, a computerized simulation examination to evaluate decision-making in nursing was developed and assessed in terms of its psychometric properties.

A clinical situation was established and then converted into a computerized simulation program. The computerized simulation examination was given to groups of nurses and non-nurses in order to improve clarity of instructions and to insure the functioning of the computer program. To obtain data indicating reliability and validity, the computerized simulation examination was given to two additional groups: "novices" who were college students without nursing experience and "experts" who were masters in nursing prepared faculty. Each person's performance was converted into three scores (performance index, efficiency index, and usefulness). The "known-groups" technique was then used to determine criterion-related validity. The faculty group was also given a questionnaire relating to the content validity of the simulation.

Expert scores on three major sections of the examination were correlated and reliability was supported by coefficient alphas of 0.81 for assessment, 0.84 for diagnosis, and 0.74 for nursing care. Comparison of mean differences, on all three scores, between novices and experts using a one way ANOVA were significant at the 0.00001 level for two of the three scores (proficiency index and usefulness). One score, the efficiency index, was not significant. Individuals were placed in one of the two groups significantly more frequently than chance would predict using a discriminant analysis.

Planned observations supported the usability of the computerized simulation examination. Statistical data supported the value of the examination as a test for decision-making in nursing. The computerized simulation examination was envisioned to have several uses: evaluation of clinical decision-making following the medical-surgical unit, validation of prior knowledge for registered nurses entering a baccalaureate program, and reduction of anxiety prior to clinical experience with similar clients.

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CHAPTER I

INTRODUCTION

Awareness of the existing concerns about clinical evaluation for nursing students and a newly awakened realization of the capabilities of computers led to this study. These factors and the resulting model computerized simulation examination are described within this report. The study focuses on reliability and validity of the computerized simulation examination.

Chapter I will introduce the investigator's decision to establish the reliability and validity of a model computerized simulation examination. The major categories of evaluation in nursing will be presented with a comparison of cognitive and performance evaluation. The specific use of simulations will be highlighted as a basis for the study's focus on computerized simulation. Research questions are identified as well as the significance of the study.

Evaluation in Nursing

Performance evaluation is a task required of many individuals. Any person who is responsible for a task that will be performed by another person may be called upon to make a decision about the quality of that person's performance of the assigned task. Employers frequently base decisions related to continued employment and/or wages upon an evaluation of performance. Educators make decisions about grades based on the demonstrated performance of their students.

Evaluation methods may be more commonly known as tests or examinations when referring to evaluating cognitive competence. Tests are the tools used to obtain information. However, evaluation is defined technically (by measurement experts) as the process of placing a value on that information. When the focus is upon clinical performance, the term evaluation is commonly used to refer to both the tool and the process. Nursing educators are asked to base student grades upon two major areas of student performance: cognitive competence and clinical performance.

Cognitive Evaluation

Tests of cognitive competence are used in most educational settings. Therefore, there is more information available regarding the reliability and validity of such tests. Criteria for the construction of a valid, reliable test of the cognitive aspects of a course exist and are used widely in nursing and non-nursing settings (Hills, 1976; Hopkins & Stanley, 1981; Rezler, 1979; Rezler & Stevens, 1978; Schneider, 1979). Also, most teacher education programs offer a course in test construction that includes constructing and administering the commonly used types of tests for cognitive competence. Cognitive competence is usually measured with paper-and-pencil test.

Paper-and-pencil tests are commonly used to establish student's knowledge of facts and concepts presented by instructors in the classroom and by authors thorough their textbooks. This type of testing is usually done under controlled circumstances and is designed to measure recall, understanding, synthesis, analysis, and comprehension of the material presented. Measurement of clinical performance in actual practice settings is more difficult because it is application that is being evaluated in a "real life" situation.

Performance Evaluation

Clinical performance evaluation in nursing education is an attempt by nursing faculty to establish the extent to which students are meeting clinical course objectives. Because of the complexity and variability of clinical practice situations, clinical performance evaluation is one of the most challenging tasks that nurse educators must face. Sometimes the client's status changes drastically, creating a different situation from the one for which the student is prepared. Each student-client encounter is different because students and clients respond differently to the situation in which they find themselves. Both student and client are affected by time, surroundings, and the events occurring. As conditions change, behaviors and expectations change, a phenomenon that makes performance evaluations difficult (Forbes & Nelson, 1979; Wood, 1982).

Certain factors have a facilitative effect on clinical performance assessment. Experienced nursing faculties which have open discussions about levels of expectations show greater reliability in assessing expected behaviors (Forbes & Nelson, 1979). Reliability is increased when faculty members have three or more years of experience and have worked together long enough to have established some consistency in their interpretations. Inexperienced faculty members, on the other hand, and faculties that do not communicate sometimes have radically different interpretations of the same behavior.

Nursing faculties spend a great deal of time establishing tools and criteria for evaluating clinical performance consistently and accurately. Wood (1982) studied methods of clinical performance evaluation in current use and reported that the nursing process was the organizational framework most commonly used for evaluation tools. She also found more specificity in the behavioral characteristics against which students are evaluated and an increase in self-evaluation activities among students. Contract grading as a method for clinical evaluation has also been reported (Schoolcraft & Delaney, 1982). The authors believed that use of contract grading improved students' ability to see evaluation as a means of learning. Evaluation by simulation represents another approach to clinical performance assessment.

Evaluation Using Simulation

Simulation is an artificial representation or model of a real life situation. The use of simulation for examination purposes controls the variability that each student and client brings to the actual clinical setting. Simulation permits use of the same situation for an entire group of students, something that is impossible with real clients. Simulation provides the student with an artificial model of reality without the dangers of a real life encounter. In a simulated situation, students can follow their actions and decisions to completion without fear of endangering the client.

Types of Simulations

Simulation can be accomplished through role playing, video vignettes, models, or computers. Each method has advantages and disadvantages for testing purposes. Role playing may not remain consistent through several repeats of a situation since the knowledge and memory of the participants change over time. The ability of the actors may vary widely; if professional actors are used, cost can become prohibitive. Video vignettes are consistent regardless of number of repeats and become cost effective if they are used many times. Students, however, cannot interact with the vignette, nor can the situation be altered. The validity of the vignette is easily lost since students can readily share the information with one another. Models have the advantage of ensuring the active involvement of the student but models obviously cannot react to the student's actions. Models do have some utility for testing manual skills but unless combined with other formats do not test decision-making.

Simulations are being used for evaluation purposes (Berven & Scofield, 1980; de Tornyay, 1968; Holzemer, Schleutermann, Farrand, & Miller, 1981; Sumida, 1972). Computerized simulations, however, are a relatively new form of evaluation that is becoming more common as technology for producing both hardware and software advances. Early computer simulations were on expensive mainframe computers and were only accessible to the small number of individuals who had the necessary programming skills. Microcomputers appeared in the mid-1970's and changed the economic argument regarding the use of computers for testing. With complete, ready-to-use microcomputer systems now available for less than $2000, this equipment is as economical to obtain as videotaping equipment. The availability of high quality software programs is the only impediment remaining to frequent utilization of computer assisted simulation for purposes of evaluation.

A Model Computerized Simulation

In a computerized clinical simulation, the computer is programmed to react as a client in a realistic client care situation. The clinical situation used for this model is from the acute care arena of medical-surgical nursing. Acute care nursing is defined as that which takes place in an institutionalized setting such as a major hospital. Medical-surgical nursing is defined as care provided to a client whose pathological state requires medical treatment or surgical intervention. The examination consists of a series of student interactions with the computer via the keyboard to make decisions about the client's care. The computer program responds to the student's keyboard selections in the same way that a real client would respond to the actions the student chose. The client's situation will vary depending on the decisions made by the student. The computer program is designed to be the same for all students but differences in student responses will create different client situations.

This study is designed to establish beginning validity and reliability for a computerized clinical simulation tool designed to evaluate the ability of nursing students to make clinical decisions under somewhat controlled circumstances. The computerized simulation is designed to present the student with a consistent representation of a client encounter. The student is asked to make decisions based upon this encounter. Each time the student makes a decision, he/she influences the entire situation and, therefore, any further decisions to be made.

Research Questions

This study was designed to establish the validity and reliability of an original computerized clinical simulation tool for use in evaluating nursing students' use of the nursing process as a model for decision-making. The computerized simulation examination was administered to two groups: (1) a "novice" group consisting of college students who have no nursing background (students may have indicated nursing as their major but have not have taken any nursing courses) and (2) a group of "expert" nurses. Medical-surgical faculty members in schools of nursing who held a minimum of a masters degree in medical-surgical, acute care, or adult health nursing were identified as the "expert" group.

The first research question is:

> Do the individuals in the expert group agree that this simulation is representative of an actual client situation?

After completing the simulation program, the expert group was asked whether the simulated client is similar to a real client. They were also asked whether they would select this client for a student assignment. These kinds of questions help provide insights into the validity of the instrument. If the situation used for the simulation is representative of a true client situation, then proper decisions students make for the care of the simulated client should indicate a similar ability when caring for real clients.

The second question is:

> Does the expert group give the same responses on the simulation examination as the novice group?

The expert group has graduate preparation in nursing. Therefore, it is assumed that the expert group will be knowledgeable and skilled in the decisions needed for safe client care. The novice group has had no nursing preparation. Since the simulation tool requires nursing decisions, there should be very different responses from each group. If there is no difference between the novice and expert groups, it would mean there is nothing in the test beyond general knowledge and that the test does not measure the ability to make accurate nursing decisions. Disagreement between the two groups, on the other hand, would suggest that there is something causing one group to make different decisions and, possibly, that nursing knowledge is related to nursing decisions.

The third question is:

> Is there agreement among the members of the expert group on their responses to the simulation examination?

The expert group was expected to be a relatively homogeneous group in relation to decision-making in nursing. This group was selected in order to get experienced nurses with similar educational backgrounds. Members of the expert group, therefore, were expected to give similar responses to the simulation examination, assuming that the nursing content was accurate and the simulation was presented in a clear, unambiguous manner.

The fourth question is:

> Are all individuals, including those inexperienced in computer use, able to initiate and complete the computerized simulation examination using only the written instructions provided?

An examination cannot be reliable or valid if the student cannot understand the instructions for taking the examination. Students learn as early as first grade how to take most types of examinations. While many college age students are now quite knowledgeable, it cannot be assumed that all students possess this knowledge and skill. It is therefore very important that instructions for taking the simulation examination be very clear and complete. Unclear or ambiguous directions reduces the possibility for valid and reliable results.

Significance of Study

Availability of a valid, reliable tool to measure clinical decision-making has many implications for nursing education. This is particularly true if that tool is also on computer and can be administered virtually without consideration of time and/or personnel. The cost of such a program is minimal if prorated over the time of use, even though the initial investment would be significant. The computerized clinical simulation tool will provide one more alternative method for assessing clinical performance and decision-making ability of nursing students as the cost of microcomputers decreases. As the versatility of this technology improves, other alternatives can also be developed.

This clinical simulation tool will be useful for nurses at various educational levels. It will be useful to help decrease the beginning student's anxiety when caring for a similar client later. Nursing faculty can utilize test results to facilitate the student's learning effectively. This simulation and others like it might be used to provide advanced placement for registered nurses enrolled in baccalaureate nursing programs. Computerized simulations can also be used for independent study, for staff development, and for the continuing education of practicing nurses.

Technology has made microcomputers available to a large and growing sector of our society. Developing reliable and valid programs for nursing education is an appropriate and important extension of that technology.

Overview of Research Report

Chapter I has provided the background for this methodological research study. It described the difficulties inherent in evaluation of clinical performance and provided the rationale for utilizing computerized clinical simulation for this purpose. The chapter also included presentation of the research questions and the significance of the study.

Chapter II focuses on a review of literature on computerized simulation and on other methods used for evaluation of clinical performance. Methods of developing a realistic computerized simulation examination are reviewed. An assessment of the current status of computer simulation is included.

Chapter III presents the detailed methodology for the study. It includes information on the development of the computerized simulation examination, on the sample population, on ethical and human subject considerations, and on collection of data. The section on the development of the tool includes a discussion of the selection and development of the specific client situation, the conversion of client simulation into computer code, the development of written instructions, and the testing of the program. The sample population is discussed in terms of numbers, selection criteria, location, representativeness, and availability. Ethical considerations discussed included confidentiality, informed consent, and human subjects review. Collection of data is described in terms of initial contact, follow up contact, time involved, type of data, and method of recording data.

Analysis of data is reported in Chapter IV. This includes a description of the methods of analysis used, demographics, and tables of data. Also included is a discussion and tables of various comparisons for validity and reliability determination.

Chapter V contains a discussion of the results of the study. Included in this chapter are conclusions, implications, and recommendations arising from the study. Suggestions for further research are also included.

CHAPTER II

REVIEW OF LITERATURE

Evaluation is a necessary process at all levels and for every type of education. Because it is so important educators in nursing and all other disciplines are continually searching for more objective, reliable, and valid methods to evaluate students and programs. Knowledge has been and is being measured in a variety of established ways. Nurse educators must not only evaluate knowledge but also the application of that knowledge to clinical practice. Many methods are being used to evaluate clinical performance but additional methods are needed. Clinical practice situations are complex and highly variable. Evaluation by means of simulation provides a more controlled and repeatable situation. This research study is designed to develop a model computer simulation examination and to establish its validity and reliability. The simulation will be designed to test nursing students' ability to make appropriate judgments and decisions in nursing practice.

A current review of the literature reveals very few studies associated with the utilization of computer simulation to evaluate decision-making skills. Limited availability of affordable computers and quality software have probably contributed to this dearth of literature. However, related material is available describing computer simulations in general, and on how reliability and validity for simulation programs are established. Reports of computer simulations frequently deal with computer assisted instruction (CAI) rather than computer assisted testing (CAT). Some of these reports will be discussed in relation to reliability and validity of computer simulation.

Evaluation methods currently being used in nursing education will be reviewed with particular focus on those methods used for evaluating clinical performance. The discussion of each method will include recent improvements or changes and problems reported for each method.

Evaluation Methods in Nursing

Evaluating the decisions made by nursing students engaged in clinical practice can take many shapes. Evaluation of decision-making may be in relation to cognitive awareness or clinical application. Evaluation of cognitive awareness provides information about the student's knowledge base about the nursing process. Clinical performance evaluation focuses on how effectively a student applies that knowledge when making safe, effective decisions about a specific client's care.

Cognitive awareness is usually measured by paper-and-pencil tests. Two major categories of classroom tests are listed by J. R. Hills (1979): "provided response" tests and "created response" tests. Provided responses include multiple-choice, true-false, and matching items. These tests primarily measure knowledge of facts and concepts. In created response tests students must provide the answer through sentence completion, brief-essay, or extended essay. These tests are usually designed to measure synthesis or analysis.

Evaluation in Clinical Settings

Evaluation of clinical performance has great importance for both nursing faculty and nursing students. In earlier days evaluation of students' clinical performance consisted of "efficiency reports" from head nurses (Battenfield, 1986). Through the years, nursing faculties have been concerned with improving the techniques and procedures for performance evaluation. The process has been refined by identifying essential skills, by making expectations of students more explicit, by using the nursing process as a model, by discussing evaluation methods with faculty colleagues, and by communicating results of evaluation clearly (Battenfield, 1986; Bell, 1980; Forbes & Nelson, 1979; Lenberg, 1979; Schoolcraft & Delaney, 1982).

Wood (1982, p. 11-12) presents a set of issues which complicate clinical evaluation.

a. --- human observation exhibits inherent bias and subjectivity.---
b. --- changes of milieu, staff and clients, present both positive and negative learning elements ---.
c. --- assessment of an individual student's performance is inevitably based on a sample of the student's total experience.---
d. --- Evaluation must take place while the student is learning, a less than ideal situation.---
e. It is impossible for the nursing instructor to devise completely comparable learning experiences for each student.---

Wood believes that these problems will not disappear as long as direct observations are used for performance evaluation.

Methods in Use

The most prevalent method currently in use appears to be observation of clinical performance over a period of time. A variety of tools have been reported which were designed to improve the objectivity of these observations (Battenfield, 1986; Lenberg, 1979; Rezler & Stevens, 1978; Tanner, 1979). Among the tools developed are many forms of check lists and rating scales that include specific clinical behaviors identified by the nursing faculty as essential learning and its outcomes. These behaviors are sometimes weighted to reflect their relative value. Faculty members usually record critical incidents or anecdotal notes to document their ratings.

New York Regents Performance Evaluation Model

The New York Regents External Degree Program uses a series of clinical performance examinations to grant credit toward nursing degrees (Lenberg, 1979). Establishment of the New York Regents External Degree Nursing Programs necessitated the development of very precise, well-defined tests of clinical performance.

Lenberg (1979) and her colleagues developed and validated not just one but several direct observation performance examinations. Extensive validation has been done on these tests. Lenberg's performance evaluations are currently viewed as one of the most widely comprehensive methods currently in use for granting credit for clinical performance.

Lenberg's tests utilize as clinical settings clinical units at local hospitals. Students are assigned clients from the unit. A trained evaluator makes the client assignment and observes the student's performance for a specified time period. Specific criteria for performance are clearly stated and given in advance to the student. Interrater reliability among the evaluators has been high.

Simulation

In addition to direct observation, other ways to approach performance evaluation are being explored. One approach, which relates to this study, is that of simulation examinations. As Wolf and Duffy (1979, p.2) have pointed out, "Simulation is a method of representing reality." They "attempt to replicate the essential aspects of reality so the actual situation may be better understood and/or controlled." Since World War II, simulations have been used to find solutions to complex problems.

The common factors that make simulations an attractive form of evaluation are the reality of the situation and the focus on processing information rather than on memory (Tanner, 1979). Simulations allow the components of the problem to gradually unfold as the student makes decisions relating to solving the problem. This is realistic in the sense that information must be actively sought and that interventions effect the entire situational outcome. By gradually gaining information, students are forced to focus on the process required. Some other advantages of simulations listed by Kolb and Shugart (1984) include the ability of the evaluator to control variables, the requirement that faculty are forced to define critical elements, and the capability of easily identifying marginal performance.

Kolb and Shugart listed such disadvantages of simulation tests as the time and resources required for developing the tests. They point out that students are familiar with paper-and-pencil tests and have at least some idea of what is expected. Simulation introduces the students to an entirely new set of expectations which could be a factor in generating anxiety. In addition, some aspects of reality cannot be economically simulated and some information can be more effectively measured by other methods, i.e., factual information by paper-and-pencil exams (McGuire, Soloman, & Bashook, 1976). Wolf and Duffy (1979) suggest that simulations may simplify a process too much, teach the wrong values, or become too intense an emotional experience for the student.

Mannikins and Models

Most nurses are familiar with "Mrs. Chase"[1] an adult sized doll on which some nursing procedures can be practiced. Mrs. Chase is an example of a model that can be used to teach and evaluate clinical practice skills. The University of Illinois College of Medicine is using a modern and expanded version of Mrs. Chase (Sajid, Lipson, & Tleder, 1975). They have established a simulation laboratory that uses models to teach medical students assessment and procedural skills. Some of these models include ophthalmoscopy mannequins, glaucoma test head

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[1]"Mrs. Chase" is a name commonly applied to all life size mannikins used for practice of nursing skills such as: positioning, bathing, dressing changes, etc. Current mannikins are very complex, allowing for changing the sex of the mannikin and use of invasive procedures that would have damaged earlier models.

simulators, female pelvic models, intravenous injectable training arms, laryngeal models, and infant intubation models. Models and mannikins appear to be in wide use to simulate clinical practice situations.

Written Simulation

The American National Board of Medical Examiners and the Canadian Royal College of Physicians and Surgeons both use simulation testing. For these groups the simulation is computerized (Skakun, Taylor, & Wilson, 1979). The College of Veterinary Medicine at the University of Tennessee, Knoxville uses latent image testing, a form of written simulation, to test decision-making and problem-solving. They also use actors to provide simulation for interviewing owners of pets as well as mechanical simulators for practicing treatments (Reed, 1979).

Written simulations using a latent image response have had limited use in nursing and more extensive use in veterinary medicine and medical schools (Skakun, Taylor, & Wilson, 1979; Tanner, 1979). Written simulations are more cost effective than simulations with actors or computers but lack the interactive quality. Also the written form provides a list of forced choice options which suggests testing at the lower recall and recognition level rather than at the level of synthesis and independent decision-making where options are generated by the student. Self-generated or situation-generated options would seem to be closer to an actual clinical situation, and allow for a more individualized synthesis of material for decisions or actions.

Some written simulation tests have been developed for use in nurse practitioner programs. Practitioner programs have used the patient management problem, a type of written simulation, to test problem-solving skills. Research related to written simulation testing has shown a small positive correlation with multiple-choice testing (Holzemer, Schleutermann, Farrand, & Miller, 1981).

Actors

A simulation may be developed that uses actors as clients. Actors are given a script and are educated to portray disease symptoms so that students can practice realistic health interviews. In some disaster drills, makeup is used to indicate blood and injuries. Use of actors meets many of the criteria for an effective simulation but the actor may become tired and forget the assigned role.

Video Dramas

Videotapes and videodiscs are another form of technology used for simulations. Alexander and Lovering (1985) of Worcester State College have developed a series of simulations on videotape for testing levels of competence in communication skills and in the nursing process. These simulation tests were designed to provide validation credit for registered nurses entering a baccalaureate nursing program.

Another use for videotaped simulations was reported by the faculty of the University of Washington School of Nursing (Loustau, Lentz, Lee, McKenna, Hirako, Walker, & Goldsmith, 1980). They used the simulation to increase rater reliability among the faculty.

Computer simulations have been developed for evaluation of problem-solving skills of rehabilitation counselors (Berven & Scofield, 1980), psychology laboratory experiences (Anderson, 1982), and nursing (Sweeney, 1980). Correlations of simulations with existing test scores are equal or slightly better than those derived from other teaching methods. This is true of all types of simulations. Since this study is concerned with computer simulation for evaluation purposes, additional studies relating to computer assisted instruction, and computer use in evaluation follow.

Computer Simulation

As technology advances it usually is incorporated into the educational system. Some use of computer technology has been reported since the early 1970's. However the last five to seven years have seen an explosive interest in computer technology for education. One study reports perceptions about computers and three surveys indicate the number of schools of nursing actually using computers (Parks, Damrosch, Heller, & Romano, 1986; Southern Council on Collegiate Education for Nursing [SREB], 1983; Thomas, 1985).

Increased availability and expanded use of computers in educational settings is evident. Extending the use of computers to evaluation of student performance is a natural step. Although several studies have attempted to show effectiveness of computer assisted instruction (CAI), little real evidence of the effectiveness of computer assisted testing (CAT) has been presented. Reports and descriptions of ways in which computers have been utilized for evaluation are available but the data indicating effectiveness is inconclusive (Christensen, 1979; Davis & Williams, 1980; Hodson, Worrell, & Alzoni, 1984).

Evaluating clinical performance has been one way to use computers. Three different methods of using computers to facilitate clinical evaluation have been reported. Computer statistics have been used with a standard rating scale format to provide more objectivity (Dwyer & Schmitt, 1969). In another school, the faculty developed a master list of behaviors on computer cards. Cards appropriate to the evaluation of a given student were then fed into the computer card reader and the computer printed out a summary evaluation (Watkins, 1975). The third type of evaluation used a computer simulation. Students ran the simulation in lieu of caring for a patient and then completed the forms provided (Olivieri & Sweeney, 1980).

In 1979 Sweeney reported this new way to use computers for the evaluation of nursing students at the National Nurse Educator Conference in San Francisco (Sweeney, 1980). With a group of colleagues and a special project grant, Sweeney developed several programs for the Apple II microcomputer. The programs were patient simulations and asked for nursing judgments using the nursing process (Olivieri & Sweeney, 1980; Sweeney,1980; Sweeney, O'Malley, & Freeman, 1982). Students grades were based on a written test form completed as they progressed through the simulation. The limited use of this tool is probably due to low availability of compatible computer resources and the cost of obtaining these resources, both in hardware and software form. Sweeney's project laid the ground work for using microcomputers in simulation testing and provided a stimulus for this study.

Shaw-Nickerson and Kisker (1985) reported the only other computer simulation examination found in the nursing literature. The faculty of Ohio State University School of Nursing chose to develop computer simulations reflecting the subject matter in several of their courses. Their goal was to validate the prior nursing knowledge of their registered nurse students. Content validity was established by nursing faculty and nurse practitioners with expertise in specific areas of content reviewing the test. Passing scores were established by giving this test to the baccalaureate students who had completed the course being validated.

These two reports reflect the extent of computer simulation examination use by nurse educators. Other groups of health care professionals are also beginning to explore computer simulation as a way of measuring clinical judgments. One example is the Royal College of Physicians and Surgeons of Canada's work on a more efficient method of testing for pediatric certification (Skakun, Taylor, & Wilson, 1979). Previously a latent image simulation had been used. The latent image simulation was transferred to computer. Performance on the computer simulation was compared to a companion multiple-choice exam. There was no evidence that the computer simulation was a better measure of performance than the multiple-choice exam.

These three reports are representative of the current state of computer simulation evaluation. In the next section, problems associated with computer simulation evaluation and some methods of establishing the value of computer simulation evaluation will be explored.

Assessment of Computer Simulation Evaluation

In order to assess the current status of computer simulation examination, the literature was reviewed to determine the advantages and disadvantages of this evaluation method. Following assessment of computer simulation examination as a method, the current technical capabilities for simulations and computer function will be presented. The last component in assessment of computer simulation will be that of reliability and validity. Discussion of reliability and validity of computer simulations will describe the methods used in current studies and the results obtained.

Advantages and Disadvantages of Computer Simulation Evaluation

Advantages and disadvantages of using computers for simulation testing have been described by several authorities (Murphy, 1984; Reed, 1972; Woodbury, 1984). On the positive side, computers are available twenty-four hours a day and they do not get tired or irritable when students require frequent repetition. A computer can be called upon at any hour of the day or night, thus, providing students with independence and convenience. Students usually work alone with the computer. Thus, the student has privacy, can work at his/her own speed, and has access to immediate feedback. Computer responses depend solely on the student's input, not on the client's energy level or comfort. The same situation may be repeated several times with the student making a different set of decisions each time. Ability to experiment with clinical decisions on a computer does not endanger the client as students learn to make appropriate decisions. Computers allow students the freedom and independence to working at their own pace. However, computers are machines and have many disadvantages.

Disadvantages of using computers for simulations seem to result from technological status. Until recently the high cost of computer hardware[2] was impractical for most schools of nursing (Sweeney, 1985; Sweeney, O'Malley, & Freeman, 1982). An additional expenditure was necessary to purchase or develop software[3] applicable for nursing. Software was especially expensive because so few quality programs were available. In order to have more programs, increased numbers of faculty with experience in computers are needed.[4] For faculties to spend the time developing programs, their institutions must recognize and reward the development of computer programs in ways comparable to the way they value faculty publications.

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[2]Hardware refers to the physical boxes and machines comprising a computer system. Memory, logic, input, and output define required components. Memory and logic boards are the core of the computer's abilities. Input devices allow people to communicate with the computer. These devices may be keyboards, card readers, light pens, or touch sensitive screens. Output devices allow the computer to communicate with people. For this purpose a video screen or a printer are usually employed.

[3]Software refers to the programs which tell the computer how to process a particular activity.

[4]The development of authoring systems, such as NEMAS, will provide computer naive faculty members a way to write simulations appropriate to their coursework (Losh, 1985).

Lack of classroom socialization for students has been identified as another problem arising from computer use in education (Murphy, 1984). The faculty role changes inherent in an emphasis on computer use is another concern (Ackerman, 1982; Pogue, 1982). Orientation of faculty to appropriate uses of computers should decrease this latter concern.

Technical Assessment

Predictions of the extent to which technology will be used in nursing education by 1990 place computers at the center of the technology movement. Several roadblocks to technological progress must be overcome. Nurse educators' acceptance of technology is probably the greatest challenge facing those who are trying to promote increased use of technology in education. Lack of quality software is another constraint but it is likely to diminish as nurse educators become more computer literate. On the positive side, computers and other technologies are becoming more cost-effective. With the implementation of technology, teachers will have more time to deal with those areas requiring personal interaction. Presently schools of nursing are using computers for computer managed instruction (CMI), for computer assisted instruction (CAI), and occasionally for testing (Ackerman, 1982; Thomas, 1985).

The concept of computer assisted instruction (CAI) refers to the use of computers to provide instruction. A variety of formats have been utilized in preparing CAI programs. These formats include tutorial instruction, drills, simulation, games, tests, discovery learning, and dialogue (Alessi & Trollis, 1985; Ball & Hannah, 1984; Burke, 1982;

Meadows, 1977; Sweeney, 1985). Each format has a unique place among CAI programs. For example, the untiring persistence of the computer strengthens tutorial and drill programs. The interactive aspect of CAI shows up best in simulation, dialogue, and discovery learning programs.

A CAI simulation is similar in structure to a computer simulation test but it has more feedback. Since the evaluation format is relatively new and untested, it is logical to use information obtained through the testing of CAI programs. CAI programs have increased in number, quality, and availability and have decreased in cost within the last ten years. One of the earliest CAI programs in nursing education was the PLATO system (Bitzer & Boudreaux, 1969). This program requires a fairly large computer system and is, therefore, costly. The PLATO system is still in use in many large universities. Most smaller schools of nursing could not afford this system.

The MESS program for simulating research problems was used to generate values of specified dependent variables for use as raw data (Newman & O'Brien, 1978). The nursing research course at the University of Pennsylvania used the MESS program to generate student research assignments. This program is similar to PLATO in that it requires a large costly computer system for use.

Since the PLATO studies others have looked at the effectiveness of CAI as a method of teaching. The bulk of these studies came in the 1970's when the availability of microcomputers stimulated a revival of interest in CAI. In 1978 the nursing faculty at the University of Calgary developed and implemented a computer assisted instruction project (Hannah, 1978). Other reported CAI projects were involved in tutorial drill programs (Conklin, 1983; Mullen & Love, 1980; Schleutermann, Holzemer, & Farrand, 1983; Sumida, 1972).

The published studies indicate that students do learn from CAI programs but there is no evidence that the learning is better or faster than from traditional methods (Bitzer & Boudreaux, 1969; Conklin, 1983; Fishman, 1984; Hannah, 1978; Kirchoff & Holzemer, 1979; Mullen & Love, 1980; Schleutermann, Holzemer, & Farrand, 1983). Ronald (1979) and Newman and O'Brien (1978) indicate a possible positive effect on motivation for learning. From these studies it cannot be concluded that CAI has value in areas other than achievement. More recent data suggest that CAI has now evolved to the interactive video stage.

Two reports of interactive video program development and utilization have revelance for this study (Parker, 1984). The Children's Medical Services of the Florida Department of Health and Rehabilitative Services developed a videodisc learning system to improve case management skills. The system uses videodiscs combined with computer control to simulate model cases. No data on effectiveness were presented. The system is mobile, available at any hour, and has received positive reactions. Total cost of developing the system was $100,576 compared to a cost of $44,120 for each session of live instruction. Another interactive computer-assisted video instruction program, this one on cancer chemotherapy, was developed at Massachusetts General Hospital (Fishman, 1984). These examples indicate that CAI programs are becoming more cost effective and that quality is improving.

Reliability

Reliability has most often been defined as consistency of measurement (Hills, 1976; Hopkins & Stanley, 1981; Knapp, 1985). Common methods to establish reliability are test-retest, split-half, or parallel forms. These comparisons work well with tests having similar questions for each student. The structure of simulations is such that each student follows a different path through the simulation and, therefore, is faced with different "questions". Alterations in the path through the simulation, also, occurs if the same student retakes the test. In effect each time a student completes the simulation a parallel form of the test is given. A parallel form which changes so often presents unique challenges for establishing reliability (McGuire, Soloman, & Bashook, 1976).

Three methods of establishing reliability of a simulation have been reported. Although not recommended for simulations test-retest was used by McIntyre, McDonald, Bailey, and Claus (1972). Test-retest assumes that on the retest students will get an equivalent form of the test. Another assumption in test-retest is that scoring of the test is equivalent for each test and for each student. Because of the branching that occurs in simulation this assumption may not be valid.

In a variation of test-retest, Dincher and Stidger (1976), used the same test but changed the weight for each item. The assumption that simulations do not have one true score was the basis for this change.

A third test-retest method was reported by Shuman (1979). Performance on the simulation was compared to another criterion, a checklist completed by preceptors. The method used by Dincher and Stidger (1976), namely, changing weights and comparing the two sets of scores, is recommended for use with simulations (McGuire, Soloman, & Bashook, 1976).

In a simulation test, common branching points can be identified. Decisions at these points could be thought of as miniature tests and correlation between these items can be performed. Hills (1976) recommended this type of correlation in relation to standardized test reliability. Comparison of answers for common decision sets is the method used to establish reliability for the model computerized simulation test. Results reported in all three studies showed small but significant correlations.

The Pearson-Product Moment and Spearman Rho are statistical measures frequently used to compute reliability coefficients (Hills, 1976; Hopkins & Stanley, 1981; Knapp, 1985). These procedures require interval or ratio level data which may not be available for some simulations. Variations of split-half techniques using the Spearman-Brown correlation coefficient are frequently used for establishing test reliability. However, most split-half techniques cannot be used with simulations because the two halves are not parallel. Cronbach (1970) and Allen and Yen (1979) indicate that the coefficient alpha can be used to establish reliability if the two halves cannot be assumed to be parallel. Coefficient alphas will be used to compare three of the major decision sets in the computerized simulation examination. The scoring system results in interval level data, therefore, statistical procedures for validity will compare the mean differences between the expert group and the novice group. Oneway analysis of variance will be used to compare the two groups. A discriminant analysis will follow to see if group membership can be predicted by scores on the computerized simulation examination.

Validity

The final area to be explored relative to computer simulations is validity. Validity is defined as the extent to which an instrument measures what it is intended to measure (Hills, 1976; Hopkins & Stanley, 1981; Lynn, 1986; McGuire, Soloman, & Bashook, 1976; Rezler & Stevens, 1978). Three types of validity are in common use today: content, criterion-related, and construct.

Content validity is defined as the representativeness of the sample. Judgment of subject matter experts, users, and students were reported as sources for evidence (McGuire, Soloman, & Bashook, 1976). Lynn (1986) describes the frequent confusion reported between content validity and face validity and stresses the need for adhering to a rigid process for expert determination of content. McGuire, Soloman, and Bashook (1976, p. 241) stated that "the best single source of data regarding the content validity of a set of simulations is to be found in the judgments of subject-matter experts and other teachers or examiners who propose to use the exercise." All agreed with Lynn that a detailed review by those experts was needed.

The most common mechanisms reported for content validity of simulations were an expert review board and a review of current literature relating to content (de Tornyay, 1968; McIntyre, McDonald, Bailey, & Claus, 1972; Shaw-Nickerson & Kisker, 1985; Sherman, Miller, Farrand, & Holzemer, 1979; Sumida, 1972). However in some cases only one or two reviewers were utilized. Other authors including Sedlacek and Natress (1972) and Holzemer, Schleutermann, Farrand, and Miller (1981) reported clearly that an in-depth review by a group of experts had occurred. Their process for establishing the validity of their simulation was clear and comprehensive.

Criterion-related validity can be either: predictive or concurrent (Hopkins & Stanley, 1981; McGuire, Soloman, & Bashook, 1976). Both types deal with comparisons of two measurements by correlations. Concurrent validity compares two current measurements while predictive validity compares performance on measurements over time. Several studies of criterion-related validity demonstrate a variety of possible comparison scores but most samples were too small to be conclusive.

Shuman (1979) compared scores from a patient management problem with scores from a 100 item multiple choice test using a sample of nine students in a family nurse practitioner program. A criterion group of twelve rehabilitation counselors was used by Berven and Scofield (1980) to establish the validity of a latent image simulation developed for physicians in the training of rehabilitation counselors. Performance of students appeared consistent with performance of established rehabilitation counselors.

In one study having an adequate number of participants (79), minimal differences were seen between the performance of certificate and masters prepared nurse practitioners on a battery of performance measures. However, results could have been effected by the number of different tests each individual completed (Holzemer, Schleutermann, & Miller, 1981).

In another study with a larger sample, Farrand, Holzemer, and Schleutermann (1982) reported that construct validity had been measured by comparing eighty-seven nurses and nurse practitioners on a written simulation designed for nurse practitioners. According to Beck (1985) the study reported by Farrand, Holzemer, and Schleutermann established criterion-related rather than construct validity. These groups were measured for consistency across three different simulations and a multiple-choice test. Nurses and nurse practitioners did not appear to respond differently for any simulation. However, neither group was consistent across the three simulations.

The third type of validity reported in the simulation literature is construct validity (Hopkins & Stanley, 1981). Construct validity is used when an abstract psychological trait or ability is described. For example, a latent image simulation was administered to a group of nursing students during their final semester (Dincher & Stidger, 1976). The investigators compared the rank order of the subject's performance on the tool with the rank order of the subject's clinical judgment, as evaluated by clinical instructors.

In a simulation validation study Holzemer, Resnik, and Slichter (1986), questioned use of simulation tests based on repeated reports of investigators' inability to establish criterion-related validity. They indicate three implications raised by this difficulty: (1) educators should consider using simulation for instructional purposes only; (2) inadequate knowledge of clinical problem solving might be the cause of the difficulty and (3) the traditional techniques for establishing reliability and validity may not be appropriate for simulations. The literature does not yield any proven procedures for establishing the validity of computer simulation tests.

A Model Computer Simulation Examination

Two factors contributed to the initiation of this study: an interest in the educational capabilities of computers and a need to develop additional methods for evaluation of clinical performance. Development of a realistic and valid simulation examination appeared to be in order. While several simulations were available commercially or from other schools of nursing these simulations were designed for specific courses. Finding a simulation without value laden feedback was another problem since most simulations were written for CAI purposes.

Nursing Process

The nursing process is the problem-solving method most commonly used in the nursing community (Walker & Nicholson, 1980). The nursing process provides a framework for planning, delivering, and evaluating nursing care. The use of the nursing process as the problem-solving model for a computer simulation makes the program a useful one for large numbers of nursing programs.

In 1967 Yura and Walsh described a four phase nursing process that included assessment, planning, implementation, and evaluation. More recently a five phase process is being utilized (Griffeth & Christensen, 1982; Iyer, Taptich, & Bernocchi-Losey, 1986; Tanner, 1979). The difference between the four and five step models is in that the assessment phase is followed by the diagnosis phase.

Tanner (1979) has suggested that simulation is an appropriate method for testing clinical problem-solving skills. She recommends that format selection for the simulation be based either on mode of presentation or degree of interaction. Methods of presentation suggested were paper-and-pencil exams, mediated exams, simulated patients, and computer simulations. She encouraged as high a degree of interaction as cost and time would permit. The computer simulation model includes a high degree of interaction.

Nursing Competencies

In order to develop an evaluation tool of any kind, it is essential to know what outcomes are expected. In nursing programs the outcomes are nursing competencies. These competencies are usually written as level, course, or terminal objectives. It is probable that most nursing competencies are common to all nursing programs at the same level, i.e., baccalaureate, master's, etc.

The National Council of State Boards of Nursing identified critical behaviors of nurses in order to validate the State Board Test Pool

Examination (Jacobs, Fivers, Edwards, & Fitzpatrick, 1978). These critical behaviors are those associated with safe nursing practice.

Another list of nursing competencies was developed by Sweeney, Hedstrom, and O'Malley (1982). These competencies are the psychomotor skills needed for safe, effective nursing practice. One hundred and twenty-one skills were selected as essential by 90% or more of the faculty polled. These skills and the critical behaviors developed by the National Council of State Boards of Nursing have been incorporated into the computerized clinical simulation.

Simulation Development

Simulation is an alternative or substitute for a real-life situation or event and in order to be useful must have certain characteristics (Lange, 1978; McGuire, Soloman, & Bashook, 1976; Page & Saunders, 1978; Shuman, Miller, Farrand, & Holzemer, 1979). First, the simulation must be realistic. It must be presented in a way that resembles a real nursing situation. Secondly, a good simulation presents opportunities for a series of sequential, interdependent decisions that cannot be retracted. Schneider (1979) emphasizes the importance of providing clear and explicit instructions.

McIntyre, McDonald, Bailey, and Claus (1972, p. 429) proposed several criteria for problem-solving simulations:

> The problem should sample a variety of decision-making behaviors and provide genuine alternatives including those which would, in practice, be unnecessary or even harmful.
>
> The choices available to the examinee should vary in the risk associated with their consequences.
>
> The examinee should be able to combine the selections in a variety of sequences.

> The test should place real demands on the student's understanding of the problem, the ability to diagnose the problem at various phases of its evolution, to assess the critical steps to be taken, to plan strategies for its solution, and to respond to the consequences of actions.

Computer Simulation Development

Expansion of a simulation into a computer simulation requires some additional considerations as outlined by three reports (Dongen, 1985; Sweeney, O'Malley, & Freeman, 1982; Tamashiro, 1985). The first step in the development of a computer simulation is selecting the topic. This includes reviewing the subject matter and narrowing the topic to manageable limits. The second step is to develop objectives and lesson activities that are computer compatible (McMeen & Templeton, 1985). Learning task analysis and appropriate computer coding is a part of this process (Rockwell, 1982). The simulation tasks that are selected must be compatible with the objectives. Problem-solving lends itself to this kind of compatibility and a branching multitrack design is highly compatible with a decision-making model. The language utilized must be appropriate for the computer that will be used to run the program. Dongen (1985) and Losh (1985) recommended use of a CAI authoring system, such as PLATO or NEMAS; a CAI authoring language, such as PILOT; or a general programing language, such as BASIC. Student worksheets must be developed that include instructions for computer use, the objectives to be achieved, and clear and complete directions for completing the program.

This chapter included a review and analysis of the literature dealing with computer simulations, the nursing process, and the process of establishing validity and reliability of computer simulation programs. Chapter III will discuss in detail the methodology for this study.

CHAPTER III

METHODOLOGY

The purpose of this study and the research questions were introduced in Chapter I. Chapter II presented current literature relating to the study's purpose and research questions. The present chapter contains a detailed discussion of the steps used to answer the stated research questions.

Developing the examination is the first step and requires development of the simulation, conversion of the simulation to computer format, development of supporting written materials, and a test of the program. This step is necessary for two reasons. First, available simulations are designed for learning and not for testing. Second, the majority of simulations currently available, whether for instruction or testing, are written for mainframe computers, for minicomputers, or for versions of APPLE and IBM-PC microcomputers which are not usable on the TRS-80 Model 3.

The simulation is developed to be representative of a real-life situation and coded into computer language so that students have the desired image and challenge. Written materials are needed to explain a new type of test and to maintain realism. Testing the program provides a way to insure workability of the program.

Discussion of research methodology includes the subjects selected for the research study. Characteristics of the subjects are be described as well as methods of selection. Methods for assuring the rights of human subjects are also discussed in this chapter. The research design is described with potential threats to internal and external validity. Finally, a description of data collection methods is included. A thread within this section is the avoidance of bias.

Development of the Computerized Simulation Examination

In this section of the report, development of the examination tool is discussed. The first component necessary is development of a computerized clinical simulation examination with multiple decision branches that can be implemented via a microcomputer. Collateral written materials are developed to support and supplement the computer program.

Development of the Simulation

In order to develop a simulation examination, the topic, the target audience, and the problem-solving model must be identified. Then, content related to the topic can be compiled into a specific case which uses the problem-solving model at the knowledge level of the target audience.

Selection of Case Topic

The combined medical diagnoses of diabetes mellitus and peripheral vascular disease with aortic graft surgery were the diagnoses chosen as case topics that would provide students with both medical and surgical concepts. According to current medical-surgical textbooks (Beland & Passos, 1981; Luckmann & Sorensen, 1980), diabetes mellitus and peripheral vascular disease are frequently seen medical conditions with which most nurses and nursing students would have some familiarity. In addition textbooks have fairly consistent agreement about symptoms and treatments for both conditions. The two conditions are frequently associated because diabetes mellitus is thought to be a causative factor in the development of some cases of peripheral vascular disease. Aortic graft surgery was included to test surgical as well as medical concepts. Aortic grafts are fairly common for later treatment of circulation blockage caused by peripheral vascular disease (Luckmann & Sorensen, 1980).

Identification of Target Audience

Simulation responses are designed for a target audience with beginning level problem-solving skills in the care of a client following vascular surgery. Beginning level problem-solving refers to those decisions made in the direct care of a client with a common problem and that follow the steps of the nursing process. At this level the simulation is applicable for a large number of clinical settings.

Students functioning at this level are those who have completed the course in adult medical-surgical nursing. A simulation examination at the beginning problem-solving level is appropriate for the following uses: (1) a final examination for the adult medical-surgical nursing course, (2) validation of knowledge for students with prior education or experience in the area of medical-surgical nursing, (3) a practice exercise prior to caring for similar clients, or (4) review of abilities for practicing nurses (Olivieri & Sweeney, 1980; Sweeney, O'Malley, & Freeman, 1982).

Model for Problem Solving

The five-phase nursing process is used as the problem-solving model for the simulation (Griffeth & Christensen,1982; Iyer, Taptich, & Bernocchi-Losey, 1986). The nursing process is a widely accepted problem-solving model within the nursing community that is familiar to most nurses and nursing students. The five-phase model asks for nursing diagnoses, the preferred way of stating the client's problems. The simulation shows, overtly, the steps of assessment, diagnosis, implementation, and evaluation. It is assumed that planning will result in the specific choices and in the timing of implementation and evaluation steps. Therefore, planning is not shown as a separate step in the simulation menus.

Development of Case Content

Using the topic chosen and the problem-solving model at the level of the target audience, the simulation examination is designed to be as realistic as possible. Frequently used textbooks of medical-surgical nursing are a major source of client symptoms, responses, and treatments in order to improve the content validity of the program (Beland & Passos, 1981; Luckmann & Sorensen, 1980). The investigator's involvement with several clients similar to the one used in the simulation provides familiarity with timing and placement of decision options. Use of the client's third postoperative day provides a relatively simple situation but retains the possible occurrance of critical events. Dangerous results from any critical events can be prevented by making appropriate decisions that require collection of data, prioritization, and knowledge of nursing options.

Nursing content chosen for the simulation relates to medical-surgical nursing of the adult client in an acute setting. Medical-surgical nursing is a major division of nursing practice. An examination written for the area of medical-surgical nursing is representative of at least one area of nursing knowledge and practice.

All information required by nurses for this client in an average medical-surgical unit is included in the simulation. Data normally found on the client's chart comprises part of an accompanying written document. Other data are programmed into the simulation and can be accessed by asking the appropriate questions or selecting the appropriate menu item. Organization of the program follows the nursing process. Categories for assessment data, NANDA approved diagnoses, and possible nursing actions are included in the simulation.

Feedback from the patient is written as patient responses, nursing observations of the client, and/or results from current monitoring equipment. The program does not provide feedback with value statements, so students make decisions based on concrete responses, not prior value judgments.

Computerizing the Simulation

Converting the clinical simulation into a computer program requires a computer system, a computer language, screen formats, feedback to students, and a format for saving data. Each of these components will be described in this section of the report.

Computer System

The computerized simulation examination is written in BASIC to run on a TRS-80 Model 1, 3, 4 or 4D using the NEWDOS-80 operating system. The TRS-80 is being used in educational programs as evidenced by software listings in Creative Computing and Computers and Nursing. TRS-80's are the third most commonly used microcomputer in nursing education as reported by the Southern Council on Collegiate Education for Nursing (1983). Availability of computer hardware for the time period required to develop and test a computerized simulation examination weighed heavily in the decision to use the TRS-80.

BASIC is a computer language available on most microcomputer systems including the TRS-80 Model 3. Programming in standard BASIC can usually be converted to run on an IBM-PC, a microcomputer commonly used in nursing education, with minimal alteration. Use of BASIC as the programming language and avoidance of programming techniques specific to the TRS-80 allows for future conversion to a more widely used computer system.

Microcomputers with disc drives are a more efficient system when running simulations that need more space than that found in the computer memory. Computer systems with disc drives must have a disc operating system.[5] A disc operating system may come with the computer but there are other operating systems available. Operating systems in frequent use are CPM, PC-DOS, MS-DOS, APPLE DOS, and TRS-DOS. The TRS-80

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[5]The disc operating system provides computer instructions for reading and writing to the disc.

Model 3, used for this simulation, usually works with the TRS-DOS operating system. However, for a more flexible system NEWDOS-80 was chosen. NEWDOS-80 operating system has many features, not available on TRS-DOS, that allow easier programming and use of a complex computerized simulation examination with frequent disc access.

Program

Development of menus, screen layout, and student feedback are necessary for converting the simulation to run on a computer. Menus are lists of decisions available at a given point in the program (Dongen, 1985; Orwig, 1983). For this simulation the main menu is based on the nursing process (Figure 3.1). Students return to this menu after completing each set of decisions during the program to implement their next decision.

```
  *******************************************************
 *                                                     *
 *                                              7:41 AM *
*          1. Obtain Data                               *
*          2. Establish Nursing Diagnosis               *
*          3. Implement Nursing Care                    *
*          4. Evaluate Outcome                          *
*          5. Record on Chart                           *
*          6. Other                                     *
*          7. Finished                                  *
*                                                       *
*  Type the number indicating what you want to do.      *
*  Then press ENTER.                                    *
*  -                                                    *
 *                                                     *
  *******************************************************
```

FIGURE 3.1: Main Menu

Submenus are developed for each of the main menu selections. Figure 3.2 illustrates selections available for collection of data. The submenu for nursing diagnosis asks the student to indicate if he/she wants to write his/her own diagnoses or to select diagnoses from the approved North American Nursing Diagnosis Association (NANDA) list (Kelly, 1985). If the NANDA list is chosen, the student is presented with a menu of diagnoses approved at the fifth national conference. The approved NANDA list contains 42 items and is reproduced in Appendix B. A listing of selections from the nursing orders submenu can be found in Appendix C. Recording and evaluating do not have submenus but work directly from the main menu. The "other" selection is an alternative means of entering the simulation. This alternative is open ended and contains no menus, only the question "What do you want to do now?" The seventh option allows the student to indicate that he/she wants to leave the program. When choosing option seven, an additional question verifies that the student does want to stop the program. All menus are presented to the student through screen layouts.

Screen layouts for the computerized simulation examination consist of narrative text material as opposed to diagrams or graphics (Call-Himwich & Steinberg, 1977; Dongen, 1985; Larson, 1984; Orwig, 1983). Each screen layout stays before the student until the student presses ENTER. The student has control of progress through the program and material is not lost before the student can read it. After each screen of text the screen is cleared before more text or decision options are displayed. In this manner, there are no leftover lines to

```
  **************************************************
 *                                                  *
*                                          8:27 AM  *
*                                                   *
*       DATA SOURCE MENU                            *
*                                                   *
*       1. CHARTS (MEDS)                            *
*       2. NURSING STAFF                            *
*       3. OTHER HOSPITAL STAFF                     *
*       4. PHYSICIAN                                *
*       5. CLIENT INTERACTION                       *
*       6. FAMILY                                   *
*       7. HEALTH EXAM                              *
*       8. EQUIPMENT                                *
*       9. DONE                                     *
*                                                   *
*  Type in the number indicating your selection.    *
*  Then press ENTER.                                *
*  -                                                *
 *                                                  *
  **************************************************
```

FIGURE 3.2: Data Source Menu

confuse the student. For text that is several screens long, the student has the option of rereading the material before continuing with the program. Requests for decisions and prompts to press ENTER always appear at the bottom of the screen (Figure 3.1; Figure 3.2).

A subjective time digital clock appears in the upper right hand corner of the screen (Figure 3.1; Figure 3.2). Subjective time is the computer displayed time indicating the total number of minutes used out of the alloted four hours. The time is incremented by a predetermined number of minutes with each action taken. The approximate time required for each action determines the minutes alloted to that action. The subjective time for the program starts at 7 a.m. and ends at 11 a.m. When this clock reaches 11:00 AM, the program is automatically terminated and the student cannot continue. The student cannot select all possible actions in the alloted time. Upon termination of the program the keyboard locks and no further information can be entered.

Students receive feedback designed for information and not values (Carter, 1984; Dongen, 1985; Orwig, 1983). Following each decision, the next bit of information needed to proceed is shown as narrative text. Since this computerized simulation is designed as a test, no indication is given about correctness of response during the program. Indications of correct or incorrect answers would bias the remainder of the examination. However, a statement does inform the student if the program is terminated due to errors leading to client death.

In order to use the simulation successfully, both students and faculty need additional instructions. These instructions as well as other written materials will be discussed next.

Collateral Materials

Computer use in education is relatively new in nursing and few nursing students or faculty are comfortable with computers (Dongen, 1985; Orwig, 1983). For this reason, it is especially important to have explicit written instructions accompanying computer programs. Written materials for the computerized simulation examination include the objectives of the simulation, the uses of the simulation, faculty computer instructions, student computer instructions, the client's chart, a list of NANDA approved nursing diagnoses, and a list of nursing orders available in the program.

Because the NANDA approved list of nursing diagnoses is so long, the author decided to include the list in the collateral materials. The list is formatted exactly as it appears on the computer screen (Appendix B). On the computer only one complete diagnosis appears at a time (Figure 3.3).

```
  ********************************************
 *                                          *
*                                    8:22     *
*  5. Diarrhea                                 *
*     a. Actual                                *
*     b. Potential                             *
*        1. medications                        *
*        2. tube feedings                      *
*        3. disease process                    *
*        4. contaminated food/water            *
*                                              *
*  Type A or B and the number of your selection  *
*  if applicable, or just press ENTER to continue. *
 * -                                          *
  *                                          *
  ********************************************
```

FIGURE 3.3: Nursing Diagnosis Screen

The menu for nursing orders is also very long. This list (Appendix C) is included in the written materials for clarity. Figure 3.4 shows how nursing orders appear to the student on screen.

Other written materials given to students include a copy of the simulated client's chart. The chart is prepared using a set of generic hospital chart forms. Information in the chart includes kardex, medication records, nurses notes, graphic charts, physician orders, physician progress notes, test results, and admission information. The

```
 **********************************************
 *                                            *
*                                    10:05 AM  *
*  7. SKIN CARE                                *
*     a. back rub       c. position change     *
*     b. bath           d. special bed/equipment *
*                                              *
*              NURSING CARE MENU (22 items)    *
*  Type in the number and character representing *
*  your selection.  If not applicable just press *
*  ENTER to continue.                          *
*  -                                           *
 *                                            *
  *                                          *
 **********************************************
```

FIGURE 3.4: Nursing Order Screen

chart is complete until the day of care that is the computerized simulation examination.

Instructions for use of the computer by both students and faculty are included in documentation for the program. Faculty instructions include objectives, materials they need to provide, and how to use the computer program (Appendix D). Instructions for the student include how to respond to the computer program, how to use collateral materials, and what to do when the program ends (Appendix E). Additional instructions are programmed into the computer as needed.

Testing the Program

The simulation was given to a volunteer group of individuals to establish clarity of instructions and wording. Four registered nurses and three computer experienced individuals completed the computer simulation examination using only the written instructions provided for students. The computer experienced individuals were the first to take the test as a means of debugging[6] the computer program. Considerable computer experience was available among this group of engineers. By taking the test several times each and deliberately selecting every possible option listed, the engineers provided feedback used to correct several programming errors.

After the program was running smoothly, the test was administered to a group of registered nurses enrolled in a baccalaureate program to decrease ambiguous language and confusing presentation. This group of nurses was easily available, provided a nursing background, and did not deplete the limited number of nursing faculty members needed for later validation. They were instructed to ask questions where necessary for clarity as they progressed through the test. The author recorded the questions asked, the program area involved, and the time required to complete the test. Results will be summarized in the following paragraphs.

The nurses took from thirty minutes to two hours for completion of the exam with the mean time being one hour and fifteen minutes. No one ran the computer clock completely out to "11:00 AM". The time required to complete actions that the nurses indicated to be a problem were adjusted. The resulting time to complete the computerized simulation examination is approximately one hour.

Several problems were encountered which were corrected. Difficulty dealing with the long lists of options for nursing actions and nursing

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[6]Locating and correcting programming errors so that the program will run as expected in the process of debugging.

diagnoses resulted in inclusion of a copy of these two lists in the written materials. Typographical errors in screen layout and a math error in calculating dosage for nicotinic acid were corrected. The pilot group found no way to change the client's diet order and no way to change intravenous (IV) tubing and bottles. Adjustments were made in the program and in the instruction booklet to correct areas of difficulty in using the program that were encountered by the four registered nurses.

Responses given during the computerized simulation examination further supported the math and dosage errors which participants had reported. Wording of instructions and options were changed in several places to clarify information. Corrections to the computer recording process were made so that major selections were clearly indicated. The testing procedure resulted in a much clearer program. Feedback from the engineers and the nurses modified the author's opinions and decreased bias within the program.

Subjects

The first part of Chapter III focused on development of a computerized simulation examination. The remainder of this chapter will deal with procedures to establish reliability and validity of the computerized simulation examination. The target audience, defined under development of the simulation, is the one for whom the computerized simulation examination is written. In this section the groups taking the test to establish validity and reliability are described. Two groups differing in specific criteria are used in the "known-groups" technique (Polit & Hungler, 1978) to test validity.

An "expert" group consisting of nursing faculty who hold a minimum of a masters degree in medical-surgical, adult health, or acute care nursing and who teach medical-surgical nursing in a registered nurse program completed the computerized simulation examination. Demographic data for faculty included age, previous computer experience, type of nursing program, nursing education, nursing experience, and number of years employed in nursing education. After completing the program, nursing faculty were asked to answer questions indicating their "expert" opinion regarding the validity of the situation test (Appendix F).

A group of "novices" without nursing experience were also asked to complete the program. Individuals in this group were college students either having majors other than nursing or nursing majors who had not begun nursing courses. Demographic data for the novice group includes age, computer experience or education, and nursing experience or background (see Appendix F).

The known difference between the two groups is nursing education and nursing experience. It was assumed that the "expert" group would perform similarly and that the "expert" group would differ from the "novice" group. The assumption is based on the nursing education and experience difference. Agreement between "experts" at specific decision points would indicate the preferred choice at that point. Comparison of decisions made by both groups provided data regarding the validity of the computerized simulation examination. Both nursing and non-nursing participants were volunteers from schools and colleges in eastern Tennessee having registered nurse programs.

Selection of Subjects

Selection of subjects is based upon availability and the known-groups technique as described by Polit and Hungler (1978, p. 438). In the known-groups technique, "groups which are expected to differ on the critical attribute because of some known characteristic are administered the instrument." The known characteristic in this study is nursing knowledge. Use of the known-groups technique is one way to approach construct validity.

Availability of subjects is a consideration based upon two factors. The first factor involves the relatively small number of nursing faculty holding a masters degree in nursing with a focus in medical-surgical nursing. A second factor related to the availability of "experts" is the distribution of qualified individuals. Combined with the need to transport a bulky microcomputer to individual appointments, time and distance were also practical factors which affected the selection of a representative population sample.

Technical factors for administering the computerized simulation examination (e.g., a room with electrical outlets which could be used and a convenient parking place) were also a part of deciding on the sample population. With only one computer (others were borrowed at one testing site), each participant had to be tested individually, thus requiring one to one and one-half hours per subject.

With these factors in mind it was decided to select a convenience sample representative of medical-surgical nursing faculty and college students in the southeastern region of the United States. Faculty from all three types of registered nurse programs (diploma, associate degree, and baccalaureate) were included. Twenty-five faculty members meeting the criteria from state board approved nurse programs in eastern Tennessee completed the computerized simulation examination.

According to the Faculty Summary of the Tennessee State Board of Nursing's Annual Report (1985), eighteen schools representing all three types of basic nursing education plus two masters in nursing programs were located in eastern Tennessee. Of these schools, three were diploma, seven were associate degree only, three were baccalaureate only, three included both baccalaureate and associate degree programs, and two had baccalaureate and masters programs. Physically, all of these schools were within a commuting distance of 200 miles for the investigator.

One hundred and twenty-nine possible "experts" were employed at these eighteen schools according to the Tennessee State Board of Nursing Report (1985). Fifty-nine were clearly listed as having masters in medical-surgical nursing. An additional seventy had degrees listed which do not clearly specify area of clinical specialty. Some of this group had a medical-surgical clinical specialty.

Availability of students for the "novice" group was not considered a major problem. Each of the colleges and universities with nursing programs had students in pre-nursing courses or non-nursing majors on campus. It was felt that a minimum of twenty-five students could be found by contacting the same schools as those for nursing faculty.

Response Rate

Initial contacts to subjects in both the "novice" and "expert" groups were made through the deans and directors of East Tennessee schools of nursing approved by the Tennessee Board of Nursing. Deans and directors of East Tennessee registered nurse programs were contacted by letter (Appendix H) requesting faculty and students from that school to participate. The purpose of the study and a brief explanation of the procedure were included. Copies of the individual information/consent form (Appendix I) were included to promote informed consent.

A self-addressed, stamped return card (Appendix J) was included. The card had a checklist and spaces to indicate requested information. Information requested included a time to explain the study to potential participants and the name and telephone number of a contact person at the school. Computer availability and/or a contact person with computer information was requested in order to decide if more than one person could be tested at a time.

The letter, the information sheet, the return card, and the envelope were colored to attract and focus attention. A subdued ivory was used for the envelope, letter, and information sheet. A medium blue postcard was used for the return card. It was hoped that by using colors, these items would stand out in the recipients' mail. By focusing attention on the communication items it was hoped to raise the response rate.

Of the eighteen schools contacted, nine responded to the first contact. This initial contact, which included dates for data collection through October, occurred during April. At that time, many faculty and students of semester schools were leaving for the summer. Four of the nine schools responding indicated willingness to participate but stated that faculty would not be available until August or September. It was then decided to proceed with quarter system schools and any schools meeting in the summer and to contact again all other schools in late August. Since some of the schools may have felt that they could not be available and therefore had not responded, all schools not already participating were sent a second letter (Appendix K) and return card. Four additional schools returned cards.

A total of thirteen schools out of eighteen (72%) responded. Eight of these schools agreed to participate. The participating schools included three associate degree programs, two diploma programs, and three baccalaureate programs. Only one school had TRS-80 computers available to allow testing more than one person at a time.

One or more follow-up telephone calls to each contact person provided specific arrangements. Contact persons served as liaison with participating faculty and helped to make technical arrangements such as rooms, parking, and directions. These individuals were invaluable to the success of the study. The contact person in addition to the dean or director received information about procedures and confidentiality.

Rights of Subjects

The right of research subjects to protection is widely recognized. To ensure that protection, an information/consent form (Appendix I), procedures to maintain confidentiality, and review by the Committee of Research Participation at the University of Tennessee, Knoxville were a part of the research design.

The purposes of the study and expectation of participants were explained to faculty and student participants individually or, in one school, at a group meeting. The faculty and students were given copies of the information/consent form (Appendix I). Verbal communication and the information/consent form conveyed expectations of participants and the ways that results would be kept confidential.

Participants were asked to spend approximately one to one and one-half hours taking the computerized simulation examination. They were told that their answers would be recorded on a computer disc and would be available only to the researcher. Those responses would be filed under a five digit number selected from a random numbers table simply to allow the data to be accessed for analysis by individuals. At no time after the participant entered the number into the computer would that number be associated with the participant's name. The participant had sole access to the computer during the time of the test; then the disc file was closed. The program automatically started when the computer system was started and the break key was disconnected preventing any individual to access the files of other individuals.

The information/consent forms (Appendix H) were sent with the initial contact letters presenting the above information prior to the decision of either the school or the individual to participate. Additional forms were included in the written materials for each individual participant. All individuals were asked to read and sign the forms.

As further assurance that subjects were protected, this study was reviewed and certified by the Committee on Research Participation at the University of Tennessee, Knoxville (Appendix K). No school participating requested a further review process.

Research Design

The final two sections of this chapter deal with the research design and the method of data collection. This was a methodological study which sought to assess the reliability and validity of a computerized simulation examination. The study focused on the utility of the tool itself rather than use of the tool to determine other factors. As a result, design considerations encompass several areas.

Internal and External Validity

One of the first considerations in research design is external validity. As stated in population selection, the sample population for this study was selected from the southeastern United States. Therefore, indications of validity and reliability of the computerized simulation examination were deemed revelant for this region. Representativeness of the sample was discussed in the section dealing with selection of the sample; however, other characteristics of the environment also effect external validity.

Novelty effects are especially troublesome when new technology is concerned. Some individuals seem to react emotionally to dealing with computers. Even though reactions range from love to fear to hate, all affect the way an individual approaches use of a computer. The reaction to the computer itself potentially could affect the outcome of this research study. An attempt was made to explain the procedure to participants sufficiently to defuse anxiety. A more difficult problem was the individual facinated by computers. To be an effective computerized simulation, the model had to function for each of these individuals. Effective attempts to deal with the novelty effect included a truly "user-friendly" program. In such a program, instructions at each step are so obvious that all participants feel comfortable with their decisions, and their responses should support validity and reliability.

Experimental effect is another threat to external validity which could easily be a problem in a study of this variety. The same emotional response to computer use mentioned above affects researchers dealing with computers, usually on the side of facination. Therefore, bias may show up in design of the program, selection of the sample, and interpretation of the data. Methods for reducing bias in program design were discussed in the first section of Chapter III, under development of the computerized simulation examination. Other nurse collegues and computer experts provided input into the program design which helped to defuse the author's biases.

Selection of subjects has been discussed earlier in this chapter, including the rationale for choosing the specific groups used. A further effort in reducing researcher bias involved having a masters prepared medical-surgical nurse faculty member verify the decision points by coding each decision point using the list in Appendix M and the raw data printouts. The same individual evaluated the usefulness of the decision points list for recording the data. Comparison with the researcher's coding highlighted potential biases.

These two threats to external validity were, in the author's opinion, the major ones encountered with this project. Although others may have occurred, novelty and experimental effects seemed to overshadow them.

Measurement Error

Measurement error is of particular concern in evaluating a measurement instrument. A number of possible sources of measurement error--such as instrument clarity, response sampling, and instrument format--were a concern in this study.

Because computerized testing is relatively new many individuals were not familiar with the format. Accordingly, a more structured set of instructions was provided. Simulation has been used in many settings but was also new to most nurses. With a new format, creating a clear, understandable test was more difficult. Even though extra attention had been given to clarifying instructions, this was still a potential error factor in eventual results.

Simulation branching responses provided a wide variety of potential items/decision points. Therefore, an individual's score could depend upon which path was followed. This is an area not fully controlled by current research methods. The procedure for data collection provided some of the ways threats to validity were controlled.

Data Collection

In order to implement the research design, data had to be collected in an objective fashion. For this study, initial contact was made with deans and directors as described earlier. If the school agreed to participate, the dean or director returned the card with the name of a contact person and their telephone number. Telephone calls, to each contact person, were made in order to determine the number of faculty willing to participate and to explain more fully the procedure and expectations for the faculty.

Arrangements were made with the contact person for a room having a sturdy table, a chair, and close electrical outlets that would be available for the duration of testing. At some locations this required moving to another room. Any move required time to set up equipment again. Appointments were made, frequently via the contact person, with each faculty member for a specific testing time.

Procedure

The researcher returned to each school at the time arranged to administer the test. The computer and written materials were arranged conveniently for the participants' use. As each participant arrived at the assigned room, the investigator explained the procedure, started the program, noted the time, and if there were no questions retired to an area nearby but still convenient if problems or questions arose. This area was out of sight of the computer screen. Distractions to the participant were avoided by closing doors to remove backgroud noise and visible activities. A listing of the introductory instructions provided is located in Appendix N.

Upon completion of the program, the subjects notified the investigator who made sure the disc file was closed and noted the time. After the program was finished participants often had specific questions and comments which will be helpful in later refinements of the program. These discussions were encouraged as a subjective way to answer research question number four. The conditions were as consistent as possible in widely differing buildings.

Type of Data

All simulation decisions, the subjective time of the decision, the answers to demographic questions, and the validity responses were recorded on a disc in the order in which they were entered into the computer. The disc containing the data remained in possession of the researcher. The data were printed out giving an outline of decisions made at various points in the program by each individual.

The percentage of faculty answering "yes" to the question "In your opinion is this situation representative of a commonly seen medical-surgical patient care situation that you might assign to a student?" provided a beginning answer to research question number one and contributed to content validity. Additional questions (Appendix F) further clarifying this general one are included to obtain "expert" opinions about the validity of the client situation. Masters prepared nursing faculty who have completed the test were considered an expert panel since this group was chosen for their nursing background and knowledge related to nursing care of clients similar to the one in the simulation.

Scoring Procedure

A scoring system based on the answers of the expert group was developed. This system uses the principles reported by Berven and Scofield (1980) and Berven (1985, 1987). A "usefulness" value for each action was defined as the proportion of the expert group selecting each specific end option. Thus scores were computed at the end of each set of decision options (see Appendix E). As an example the student selected "DATA", "FAMILY", and the "WIFE" to recieve a score representing the proportion of experts that selected "WIFE". Each specific action had a usefulness value from 0.0 to 1.0. An individual's usefulness (U) score was the sum of all the usefulness values for that individual. The sum of all possible usefulness values on the simulation represented the total usefulness (T). A "proficiency index" (PI) and an "efficiency index" (EI), similar to those used by McGuire, Solomon, and Bashook (1976), was then computed. The PI represents the extent that all useful actions were selected by an individual. The PI was the individual's U score divided by the total usefulness (T). The EI was the average usefulness of actions taken by an individual and was derived by dividing the individual's U score by the number of actions (N) taken by that individual.

Summary

In Chapter III, development of the tool has been discussed showing the decisions made which support content validity. The methodological design for establishing reliability and validity of the computerized simulation examination was described. Components discussed in relation to design implementation were selection of subjects and data collection. Following in Chapter IV, the results of data analysis will be summarized.

CHAPTER IV

RESULTS

The methods used to construct a computerized simulation examination, to administer the examination to two groups of individuals, and to score the resulting responses were presented in Chapter III. The present chapter focuses on the results shown by the responses of both experts and novices. Data are presented regarding the reliability and validity of the computerized simulation examination. A description of the individuals in both groups is included, as well as the demonstrated abilities of these individuals to use the computer program.

Demographics

Descriptive data were collected for both groups of participants to support the differences between the two groups and to indicate the similarities of individuals within each group. The factors of interest were nursing experience, teaching experience within nursing, computer experience, and educational experience. Questions at the beginning of the computerized simulation examination asked for this information and for other data such as age and the type of nursing school represented. These data are summarized in Appendix G.

In the expert group, most individuals were over 30 years old (84%), female (92%), and held a minimum of a masters degree in nursing (100%). The individuals in the novice group tended to be under 30 years old (96%), female (96%), and indicated less than a year of college level work in general education subjects (100%). The novice group primarily represented baccalaureate nursing programs (92%). Baccalaureate (48%) and associate degree (40%) programs were highly represented in the expert group. Diploma programs were represented by 12% of experts and only 8% of novices.

Computer experience was low in both groups with the majority of individuals (56%) indicating no experience with computers. The maximum amount of computer experience indicated was five years by one expert. The novices reported no teaching or nursing experience. The majority of experts (72%) reported less than 20 years of nursing experience with the least amount of experience being one year for one individual. The most experience reported was 37 years. Teaching experience among the experts varied more widely, ranging from three months to 24 years. The largest number of experts (56%) had been teaching less than ten years.

In summary, the characteristics of the individuals in the expert group appear similar. Likewise, the novice group also reports similar characteristics. However, the differences between the two groups support the use of the "known-groups" technique.

Reliability

Conventional methods for establishing reliability are difficult to use with computerized simulation examinations. The characteristics which make a computerized simulation examination appealing impede clear reliability estimates. Split-half reliability estimates for a branching computer simulation examination cannot be assumed to be equivalent forms of the same test. Since the very act of repeating a computerized simulation examination alters the choices facing a student, test-retest estimates do not necessarily represent equivalent forms of the test. The time and cost required to develop a computerized simulation impedes the use of parallel-forms or alternate-forms reliability estimates.

According to Allen and Yen (1979), coefficient alpha can be used to calculate the reliability of tests which are assumed to be tau equivalent (true scores are the same except for an additive constant) but not parallel (assumed to have equal variances). Allen and Yen state that a high coefficient alpha indicates high reliability. However, a low coefficient alpha may indicate low reliability or it may indicate that the halves are not tau equivalent.

The computerized simulation examination has a very large number of possible responses. There are 793 unique responses possible and if combinations of responses are considered the number multiplies. Data collection, nursing diagnosis, and implementation are the three largest groups of decisions in the computerized simulation examination. These three areas are also primary areas of interest for evaluating nursing care. The unique decisions scored within these decision sets were 17% of the total possible unique decisions in the computerized simulation examination and they were seen to be representative of the total number of responses.

In order to have a more manageable and a more understandable result, coefficient alpha was calculated for responses of the experts in the three major decision sets of the computerized simulation examination (Table 4.1). In all three decision sets, the alphas were relatively high, thus indicating a high reliability between the experts' responses for these areas. The computerized simulation examination was estimated to have a high overall reliability since these three decision sets were representative of all decisions.

Table 4.1

Correlation of Expert Responses by Decision Set

DECISION SET	COEFFICIENT ALPHA
Data Collection	.8120
Nursing Diagnosis	.8418
Implementation	.7387

Validity

Content and criterion validity were considerations in development and validation of the computerized simulation examination. Indications of content validity were derived from methods of test construction and from expert agreement that content was appropriate. Support for criterion validity came from analysis of responses given by both experts and novices.

Content Validity

Establishment of content validity for the computerized simulation examination began with construction of the simulation as described in Chapter III. Content of the simulation was derived from current medical-surgical nursing literature (Beland & Passos, 1981; Luckmann &

Sorensen, 1980). Suggestions for refinements in the simulation made by a group of practicing nurses focused the simulation upon practice in the eastern region of Tennessee.

Further support for content validity was acquired by asking the expert group to indicate agreement or disagreement with a series of statements about the content of the computerized simulation examination (Appendix F). The expert group served as an expert panel of twenty-five which exceeds the minimum of three recommended by Lynn (1986) for expert panels. Table 4.2 contains a listing of the number and percent of experts agreeing with each statement. All of the experts agreed that the simulation is representative of a client that they might assign for student experience. Only 44% felt that the preset amount of time indicated for each activity was realistic. Forty-eight percent did not think that the assessment data were representative of that needed to care for an adult married male client with two children. Over 50% of the experts agreed with 88% of the statements, indicating support for content validity of the computerized simulation examination.

Criterion-Related Validity

Comparisons of performance by experts and novices formed the basis for criterion-related validity. Individuals selected for each of the two groups were chosen because of the obvious difference in nursing experience. Therefore, if the test is a valid indicator of nursing decision-making, the responses given by members of the expert group will agree with each other while disagreeing with responses by the novice group.

Table 4.2

Expert Opinion Responses

ITEM	NUMBER AGREEING	PERCENT AGREEING
1. The assessment data received is representative of the assessment data needed to care for a client who:		
A. is third day postop.	21	84
B. has Peripheral Vascular Disease.	24	96
C. had an Aorto-Femoral Bypass Graft.	21	84
D. has Diabetes Mellitus.	16	64
E. is an adult married male with two children.	12	48
2. Nursing actions are present for the care of a client who:		
A. is third day postop.	19	76
B. has Peripheral Vascular Disease.	20	80
C. had an Aorto-Femoral Bypass Graft.	19	76
D. has Diabetes Mellitus.	16	64
E. is an adult married male with two children.	15	60
3. Options are given for the decisions you would make in the care of a client who:		
A. is third day postop.	18	72
B. has Peripheral Vascular Disease.	17	68
C. had an Aorto-Femoral Bypass Graft.	15	60
D. has Diabetes Mellitus.	14	56
E. is an adult married male with two children.	17	68
4. The time spent for each activity chosen is realistic.	11	44
5. In general, the simulated client is representative of a client that you might expect to assign.	25	100

A masters-prepared medical-surgical nursing faculty member was asked to code the computer recorded responses. Inter-rater reliability was relatively high between this individual's coding and the investigator's coding (r=.86). Reliability in coding of responses was used to increase the value of reliability coefficients for the scores developed from the coded responses.

In order to compare the performances of the two groups, responses were compiled into three scores for each individual as described in Chapter III. Each individual received a usefulness (U) score which was based on the proportion of experts selecting each option. A proficiency index (PI) representing the total of useful actions which have been selected was calculated for each individual. An efficiency index (EI) or the average usefulness of actions was also calculated for each individual. These three scores were used to compare the two groups of participants.

Agreement among the experts on three sections of the computerized simulation examination was derived and is summarized in Table 4.1. The degree of agreement among experts is discussed as reliability which is necessary to support validity. To support criterion-related validity, three comparisons were made using the SPSS-X version 2.2 statistical program.

Table 4.3 summarizes the statistics describing the three scores of both groups. The standard deviation for PI and U scores are about equal for both groups. The range within each set of PI and U scores and the means clearly indicate higher usefulness and proficiency scores for the experts.

Table 4.3

Statistics for All Scores

GROUP	n	MEAN	STANDARD DEVIATION	STANDARD ERROR	MINIMUM	MAXIMUM
U						
Experts	25	10.6772	2.8029	.560	5.0	16.08
Novices	25	4.4784	2.6366	.5273	.8	11.80
PI						
Experts	25	.3164	.0828	.0166	.148	.476
Novices	25	.1326	.0782	.0156	.024	.350
EI						
Experts	25	.3360	.0701	.0140	.156	.455
Novices	25	.3080	.1149	.0230	.105	.540

Novices and experts were each compared on the usefulness (U) scores, the proficiency index (PI), and the efficiency index (EI) using a one way analysis of variance (ANOVA) to get an overall idea of how similar or how different the two groups were (Table 4.4). Since the three scores represented interval level data the ANOVA was appropriate for mean differences between the two groups (Hays, 1973). The F ratio on both the PI and the U scores indicated significant differences between the groups, while the EI score had a minimal difference. Experts differ from novices significantly on two of the three computed scores for the computerized simulation examination.

Following the ANOVA, a discriminant analysis was performed to see if the group (level of performance) could be predicted by the three

Table 4.4

ANOVA's for All Scores

SOURCE	df	SS	MS	F RATIO	F PROBABILITY
U					
Between Groups	1	480.3140	480.3140	64.8733	.00001*
Within Groups	48	355.3862	7.4039		
Total	49	835.7003			
PI					
Between Groups	1	.4219	.4219	65.0750	.00001*
Within Groups	48	.3112	.0065		
Total	49	.7331			
EI					
Between Groups	1	.0098	.0098	1.0799	.3039
Within Groups	48	.4344	.0090		
Total	49	.4441			

scores. The PI and U scores contributed most to the ability to predict group membership (Table 4.5) using the classification function coefficients shown in Table 4.6. The PI and U scores predicted the group significantly greater than chance (F=33.43; df=1, 47; p=.0001).

Table 4.5

Group Predictions Using PI and U Scores

ACTUAL GROUP	NUMBER OF CASES	PREDICTED GROUP MEMBERSHIP EXPERT	NOVICE
Expert	25	24 (96%)	1 (4%)
Novice	25	3 (12%)	22 (88%)

Table 4.6

Classification Function Coefficients

GROUP =	EXPERT ,	NOVICE
EI	38.46024	34.61027
U	-49.43444	-21.22415
PI	1720.101	738.3984
(CONSTANT)	-15.32934	-7.46929

Based on the assumption that different performances by experts and novices would indicate validity, the data support the criterion-related validity of the computerized simulation examination. Scores on the test are estimated to have the ability to differentiate experts from novices based on computerized simulation examination scores.

Practical Considerations

Research question number four asked whether all individuals were able to initiate and complete the computerized simulation examination. This question focused on the practical aspects of the program's usefulness. Data relating to this question were collected by observation and then noting difficulties demonstrated by the participants. Other practical considerations were the cost of developing and administering the examination and the time required to complete the examination.

Cost

The costs of administering the computerized simulation examination fall into three categories: the initial hardware investment, the ongoing costs of supplies and maintenance, and the time to develop the program. The initial cost of hardware is decreasing as technology improves. At this time, a computer system which will run the computerized simulation examination costs approximately $1000. The NEWDOS-80 operating system is an additional $75 and a printer costs about $350.

Ongoing costs include five-and-a-quarter inch floppy discs, electricity, and repairs. Discs can be purchased for less than $3.00 and will hold the responses of about fifteen students. Such discs may be reused. Electrical costs of running the computer are less than one dollar per day. Except for repairs, ongoing costs are minimal. A microcomputer, which is cared for, requires few repairs (but those that are needed are relatively expensive).

Development of the computerized simulation examination required about 400 hours to write, code into the computer, debug, and test for clarity. Without question, the heaviest cost of this simulation was the development of the program.

Time

The objective or regular clock time required to complete an examination was an important factor to consider. All participants were interested in the amount of time required. Three individuals were known to have declined to participate because of the time that taking the examination would require them to be away from other activities. The time utilized by each participant was recorded. The beginning time was recorded immediately after the introductory instructions and the ending time was recorded when the participant locked the keyboard.

Times for the expert group ranged from fifteen minutes to three hours and ten minutes (Table 4.7). The novice group times were between fifteen minutes and forty-eight minutes. All of the novices completed the exam in less than one hour. The majority (64%) of the experts finished in one hour or less. The time required by the participants was less than the originally estimated time of one to one and one-half hours.

Table 4.7

Objective Time Required in Minutes

Group	Longest	Shortest	Mean	Median
Experts	190	15	58.48	59
Novices	48	15	31.28	33

User-Friendliness

A computer program that is user-friendly indicates that it can be easily used by individuals with little or no computer experience. User-friendliness is a very practical consideration for the usefulness of a computer program. The ease with which participants completed the program, the questions they asked, and the comments the made were indicators of how user-friendly the computerized simulation examination was.

All fifty participants were able to complete the examination. Twenty-two novices and eleven experts asked no additional questions, completing the computerized simulation examination with only the written and verbal instructions provided (Appendixes E & N). Questions asked by three novices and nine experts related to clarification of demographic items. Thirteen experts asked questions or made comments related to program content (Table 4.8).

Table 4.8

Expert Questions/Comments During Examination

Question/Comment	Frequency
How do I change the diet?	1
I can't find the FBS.	2
How do I show more than one etiology/diagnosis?	3
Can diagnoses have more than one etiology?	4
How do I get history (assessment) information?	4
What is the drip rate for IV tubing used?	6
Can I make more than one selection at a time?	8
It takes too long to go back to each order/diagnosis?	10

The computerized simulation examination was shown to be usable as indicated by all subjects completing the exam. Novices asked fewer questions and required less time to complete the examination than experts. More questions asked by experts were related to the content of the program rather than demographic items or computer use. Program-related comments and questions by the expert group may indicate potential problems in the program needing correction. Overall, however, the computerized simulation examination appears to be usable.

Results of data analysis have been discussed in Chapter IV. Statistical analyses would seem to support reliability and validity of the computerized simulation examination in answer to research questions one, two, and three. There also appears to be support for the usability of the program (i.e., the focus of research question number four). Chapter V will conclude the report with a discussion of conclusions reached, implications of the research, and recommendations.

CHAPTER V

DISCUSSION AND SUMMARY

Chapter V concludes and summarizes the research report. Chapter IV presented an analysis of the research findings. In this chapter, conclusions derived from those findings are discussed in relation to reliability, validity, and practicality. Also presented are implications and recommendations arising from the research findings.

Conclusions

The statistical conclusions reported for this study were based on the assumption that the sample population was selected to have known characteristics. The characteristics of interest were nursing knowledge and experience. The expert group was chosen from a population expected to have a high degree of nursing and teaching experience. The novice group was chosen from a population expected to have a low degree of nursing and teaching experience. Demographic data were collected to ensure that the selected sample did indeed meet the expected criteria. Appendix G summarizes the data which show that the groups were divided as planned in relation to the stated criteria. Therefore, the comparisons indicated by the research questions were completed.

Reliability

The results reported in Chapter IV appeared to support reliability of the computerized simulation examination. Coefficient alphas indicated significant positive relationships for the responses given by members of the expert group on three major decision sets of the computerized simulation examination. The high alphas indicate that the experts' responses agreed more frequently than chance would indicate.

Test-retest has been the most commonly reported method for establishing reliability of simulation examinations (Dincher & Stidger, 1976; McIntyre, McDonald, Bailey, & Claus, 1972; Shuman, 1979). As described in Chapter II, simulations are not necessarily the same test when given to another individual or to the same individual a second time. This leaves some question about test-retest reliability when applied to a simulation examination. However, some degree of information was provided. McGuire, Solomon, and Bashook (1976) recommended establishment of two sets of scores, by changing weights, as a way to determine reliability of simulations. This method assumed that weights for each item were predetermined and, therefore, could not be used for scores based on the proportion of experts selecting each item. Hills (1976) suggested that the correlation of "miniature tests" derived from portions of a test could be used for test reliability.

This study used a variation of Hills' method in which three major decision sets (data, diagnosis, and implementation) were treated as "miniature tests" in a form of split-half comparison calculated by coefficient alphas. Coefficient alphas make use of all possible split-halves giving an internal reliability coefficient for the test (Allen & Yen, 1979). The resultant coefficient alphas supported reliabilities that were highly significant in comparison with the reliability coefficients reported by the above studies. Therefore, the answer to research question number three appears to be yes, indicating reliability of the computerized simulation examination.

Validity

The literature showed no proven procedures for establishing validity of computer simulation examinations. Use of current literature and an expert panel were the most frequently reported ways to establish content validity (de Tornyay, 1968; McGuire, Solomon, & Bashook, 1976; McIntyre, McDonald, Bailey, & Claus, 1972; Sedlacek & Natress, 1972; Shaw-Nickerson & Kisker, 1985; Sherman, Miller, Farrand, & Holzemer, 1979; Sumida, 1972). Lynn (1986) recommended at least three members for panels of experts to improve content validity. Chapter III described the use of current literature and peer review in development of valid content for the computerized simulation examination. Table 4.2, p. 70, shows agreement from a panel of twenty-five experts that the content of the computerized simulation examination was representative of a possible client situation. The entire expert group served as a panel of experts.

The answer to research question number one would appear to be "yes" with content validity highly supported. Comments and questions during and after the examination lead the investigator to believe that this area could be improved. Table 4.8 lists several content-related comments that could be corrected. For example the fasting blood sugar (FBS) and the intravenous drip rate were not available to individuals taking the test.

Research reports of criterion-related validity have been most frequently based on comparisons of simulation scores with another test or evaluation score assumed to be testing the same content (Farrand, Holzemer, & Schleuterman, 1982; Holzemer, Resnik, & Slichter, 1986; Holzemer, Schleuterman, & Miller, 1981; Shuman, 1979). Support for criterion-related validity was minimal in most of these reports. Berven (1985) and Berven and Scofield (1980) had slightly significant validity results for computerized simulation examinations with a minimal amount of branching. Having a criterion group of experts take the test and then basing scores on the proportion of experts choosing each option was the major difference in Berven's approach. Others had the criterion group indicate values for each option prior to administration of the test.

Scores for this study were derived by Berven's method after clarification of the differences in test options between Berven's simulation and this one (Berven, 1987). Scores of experts and novices were derived using the proportion of experts choosing each option as the criterion base. The time limit specified by the subjective time clock provided a penalty for "wrong" choices and no negative values were indicated.

Comparisons of mean differences on scores of experts and novices were made using the one way ANOVA. Comparisons for PI and U scores indicated significant differences in the means of the two groups (Tables 4.2, p. 70, and 4.4, p. 73). Summary statistics (Table 4.3, p. 72) indicated higher means for the expert group. These results would appear to indicate that the computerized simulation examination measures a factor found more frequently in the expert group. The two groups were selected so that the expert group had a higher degree of nursing and teaching experience. The computerized simulation examination was shown to have a relatively high degree of validity for nursing content. Thus, the differences in the means of the two groups plus the higher means of the expert group appears to indicate a high degree of criterion validity for nursing content. A discriminant analysis, which showed an ability to predict group membership using PI and U scores (Tables 4.5, p. 73, and 4.6, p. 74) followed the ANOVAs. The ability to predict nurse versus non-nurse group membership supported the validity of the computerized simulation examination for nursing decisions. The resultant answer to research question number two appears to be "yes", supporting criterion-related validity for the computerized simulation examination.

Practicality

Research question number four asked about the practical aspects of using the computerized simulation examination. The demographic data summarized in Appendix G indicate relative inexperience with computers for both groups. Therefore, the ability of all participants to complete the examination indicates a degree of usability for the program and answers research question number four positively.

Other practical aspects (time and cost) are mentioned in Chapter IV. While there was no specific hypotheses related to these factors, they are major considerations in development and selection of any examination, especially computer simulation examinations. Costs, including time costs, were documented in Chapter IV. Current trends in computer technology and availability of qualified computer personnel are rapidly reducing the cost of using computer simulations of any type. Use of computerized simulation examinations in nursing appears to be becoming a more practical consideration.

Implications

Implications for nursing education and for testing theory resulted from this study. The computerized simulation examination introduced another way to evaluate decision-making for improved nursing care. The examination was developed for a rather narrow area of content but the structure lends itself to substitution of specific data for use in other areas of nursing care. Currently, the computerized simulation examination adds to the choices nursing faculty have for evaluating nursing students and for validating prior knowledge of registered nurse students. In the future, computer simulation examinations may provide a way to evaluate nursing students' care for infrequently seen client situations. The computerized patient management simulation provides a possible solution to measuring clinical performance as indicated by decision-making.

This simulation has potential use for nursing students during a basic program, for registered nurses completing a baccalaureate degree, and for continuing education. The validity data in this study are significant for beginning level decisions, not for a type of educational program. The opportunity to practice the nursing process on a client simulation could decrease the beginning student's anxiety when caring for a similar client later on a clinical unit. The nursing faculty would have access to the student's ability to make decisions relating too this type of client and could then facilitate the student's learning more effectively.

This simulation or similar ones could be used to provide advanced placement for registered nurses desiring a baccalaureate degree. The information obtained from testing registered nurse students would be similar to that obtained by the videotaped simulations produced by Worcester College (Alexander & Lovering, 1984) and used in several nursing programs for validation testing.

Availability of computerized simulations for independent study would add another facet to continuing education and would increase the effectiveness of available inservice staff. Computerized simulation can be available to staff around the clock and even for relatively few individuals. This kind of availability is not always possible using inservice personnel.

Advancing technology is putting microcomputers in our lives. By establishing reliable, valid programs to be used in nursing education we can make use of that ever increasing technology. Introduction of computers in educational settings allows nurses to be more familiar with them and less anxious when confronted with computers in the service setting.

The computerized simulation examination used technology that may not be comfortable for all students and faculty. Unstructured observations of faculty and student reactions when faced with the examination provided some indication of possible responses to use this type of testing. Students were anxious about lack of nursing knowledge affecting school standings. When assured that for this study they were not expected to have specific nursing knowledge, students were more relaxed throughout the examination. Faculty stated a variety of reasons for anxiety. Some needed reassurance that answers were confidential. A few expressed concern that their deans or their peers would see how poorly they did. This was after assurances of confidentiality and that there were no "right" or "wrong" answers identified. Some faculty members were upset when options were not structured in a familiar form, stating that if "such and such were here I'd know what to do". A few indicated uncertainty about responding in a way that "the computer would know what I meant". All of these reactions could be envisioned from students asked to use the computerized simulation examination as a part of their grade.

Introduction to computer technology and specifically computerized simulation testing would free nursing educators for more individualized instruction and student support. Alternately, technology could be an excuse for faculty to avoid student contact. Computer simulation could allow experience and validation of competence in situations no longer easily available for students. Obstetric abnormalities, for example, are no longer available in large enough numbers in many areas of the United States. Faculty need to be aware of possible negative student responses and implement more supportive contact. As many other professions are learning, the more high tech the area the greater the need for human contact.

Implications for testing theory are related to the use of simulation as well as to the use of computers for testing. Simulation testing is a relatively unstructured test form, especially branched computer simulations. Students familiar with studying for memory and recall types of tests may have difficulty studying for the amount of synthesis necessary in a branching simulation. Simulations appear to be a way of testing higher level objectives more consistently. The challenge for faculty is to develop realistic tests at the appropriate level for different levels of students. Simulations are more time consuming and difficult to develop than the tests frequently seen in classrooms. Assuring validity and reliability for the computerized simulation examinations was more difficult than it would have been for a more commonly used type of test. Current methods of validating test items are not effective for simulations and validated simulation formats may need to be used more frequently.

Computerized testing includes use of test banks, drill and practice sessions, and other methods of increasing time efficiency for both student and faculty. These are valid uses of computers but do not utilize the full capabilities of the computer as an evaluation tool. The computerized simulation examination is seen as a small step into exploiting the full use of computers in evaluation.

Recommendations

Although reported results support reliability and validity for the computerized simulation examination, additions to the design could strengthen the study. The high numerical support for validity shown was probably related to the planned differences in the two groups. Adding a third group with intermediate levels of nursing experience and knowledge, such as students who have completed medical-surgical nursing, might elicit a finer level of distinction. Adding a group of nursing students would also make available additional criteria for comparison such as clinical performance evaluations, test results, GPA, etc. Such criteria would add another dimension to the validity of the computerized simulation examination. Effectiveness for a specific type of nursing program could be established by validating the test with a specific group of students, such as baccalaureate students. Sampling from a wider geographical area would improve the ability to generalize the results to a larger population.

Current methods of establishing reliability appear to be inadequate for use with simulation examinations, especially the heavily branched simulations that can be developed for computers. Time and cost were impediments to use of additional approches for strengthening reliability in this study. However, administration of the test a second time might have added some information even though the validity of test-retest as a means of reliability for simulations has been questioned. Development of an alternate form would add additional information but is extremely costly, especially in the time required.

Berven and Scofield (1980) reported use of the quadratic assignment (Q/A) procedure to compare the consistency of answers in a relatively simple computerized simulation. This statistical tool appears to be a possibility for advancing reliability studies of simulation examinations. Further evidence of its effectiveness and wider availability of the Q/A procedure for simulation studies are needed at this time. Development of other statistical tools appropriate for simulations would be helpful.

Practical aspects of the computerized simulation examination could be improved in several areas. Conversion of the program to either APPLE or IBM-PC compatibility would have shortened the time spent in data collection. Since APPLE and IBM-PC computers are more prevalent in nursing programs, availability of more computers would have allowed testing of more individuals at the same time. Conversion of the program to more frequently used systems would also increase the usability of the program in schools of nursing.

A large number of experts did not find the times allowed for nursing actions realistic. A panel of experts indicating the average time spent accomplishing the actions listed could have improved this aspect of the program.

Several recommendations related to development of computerized simulations resulted from this study. Simulations dealing with one or two concepts can be developed by one individual familiar with computer programming and the content area desired. However complex simulations, such as the computerized simulation examination used in this study, could be more efficiently developed by a team effort.

Prolonged periods spent developing a test carries the danger of having an obsolete result as more sophisticated software tools are becoming available. BASIC appears to be a workable language for simulation development. LISP is an example of a language which should be explored as more effective for realistic simulations because it allows more efficient use of computer memory and faster actions. Use of a popular (frequently used) computer and operating system is recommended if the result is to be widely used. For nursing that system would be APPLE-DOS or PC-DOS.

Incorporation of computers into nursing programs requires availability of computers and of the software to use them. Since computers are becoming more available, the current need is for nurses (faculty and practitioners) to develop the needed software. Many programs are underway to increase faculty awareness and skill in computer use. This is the first step in having individuals capable of developing and/or using computer software to full advantage. The National League for Nursing and the American Nurses Association have special interest groups supporting and expanding computer use in nursing. The stage is set for rapid expansion of computer use in nursing as more interest is generated and more quality programs are being developed. The computerized simulation examination developed for this study is one contribution to nursing oriented simulation software. Others are needed.

Research will be necessary to ensure that new simulations are reliable and valid for the designated purpose. As new tools are developed they should be validated. Existing tools need replication studies using different population groups and different comparison criterion. A followup study using external criteria (GPA and clinical performance scores) would further validate this study. Studies clarifying unique nursing content are encouraged as a basis for simulation development. Also recommended as a base for simulations are additional studies showing effectiveness of nursing actions and client responses to those actions. Studies presenting reliability and validity design methods and effective statistical tools for use with simulations are also needed since the currently used methods and tools do not seem as usable with simulations as with more frequently used types of testing.

Chapter V dealt with the results of reliability and validity studies for the computerized simulation examination as well as the implications and recommendations arising from the study. Reliability, validity, and practicality of the computerized simulation examination are supported. An additional tool, the computerized simulation examination, has been developed for evaluating decision-making in nursing at a beginning level.

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APPENDIXES

APPENDIX A

DEFINITIONS

ACUTE SETTING: The location for nursing usually found within institutions such as hospitals. The usual setting for medical-surgical nursing.

BRANCHING: A computer program that contains more than one way to progress through it. The path taken depends upon a decision each time a new path veers from the old.

CLINICAL PERFORMANCE: Behaviors demonstrated in the care of clients.

COMPUTER: A machine that computes, especially an electronic machine that either solves problems when given certain coded data or otherwise processes those data.

COMPUTER ASSISTED INSTRUCTION: Refers to applications in which a computing system is used to assist in the instruction of students.

COMPUTER ASSISTED TESTING: Use of a computer and computer program to select, administer, and/or score an evaluation procedure.

COMPUTER MANAGED INSTRUCTION: Involves the generation and scoring of educationally diagnostic tests, generation of study prescriptions, keeping of records, scheduling, and generation of reports.

DECISION POINT: The place in a computer program that a decision must be made.

DECISION SET: The group of decisions following each selection from the "main menu".

DISC: A thin, flexible platter (floppy disk) used as storage medium for data.

DISC FILE: Information stored by means of a computer program on a magnetic disc to be retrieved and used later.

EXPERT GROUP: Nursing faculty currently teaching in a Tennessee State Board approved nursing program who hold a Master's degree in nursing with a focus on medical-surgical nursing.

HARDWARE: The metallic or "hard" components of a computer system, in contrast to the "software" or programming components of the systems.

MAINFRAME: A large computer capable of supporting many different users at one time and costing several hundred thousand dollars.

MAIN MENU: The first and central list of options presented to students in the computerized simulation examination.

MEDICAL-SURGICAL NURSING: The area of nursing dealing with ill patients, either having a disease pathology or requiring surgery and usually found in institutional settings.

MENU: Instructions, prompts, and messages that are displayed whenever special conditions exist or operator decisions are required.

MICROCOMPUTER: A complete individual computing system, consisting of hardware that usually sells for less than $3000 and can be set on a desktop.

MINICOMPUTER: A computing system that can support up to 20 terminals and sells for around $30,000.

NOVICE GROUP: College students with no prior formal nursing experience or education.

NURSING PROCESS: A method of problem-solving used in nursing and consisting of five steps; assessment, diagnosis, planning, implementation and evaluation.

OPERATING SYSTEM: A computer program which provides computer instructions for reading and writing to the disc.

PROGRAM: A set of instructions arranged in proper sequence for directing a computer in performance of desired operations.

REGISTERED NURSE: An individual who has completed a program of study approved by the state board of nursing and who has successfully completed the state licensure exam for registered nurses.

SIMULATION: An artificial representation or model of a real life situation. A representation of a client care situation.

SOFTWARE: Programs, languages, and procedures of a computer system.

SUBJECTIVE TIME: The computer displayed time indicating the total number of minutes used out of the alloted four hours. Subjective time is a part of the computer program and not an indication of the actual time.

USER-FRIENDLY: A computer program that can be easily used by individuals with little or no computer experience.

APPENDIX B

NANDA NURSING DIAGNOSIS LIST (1985)

1. Activity intolerance
   a. Actual
   b. Potential
      1. Disease process
      2. Poor nutritional status
      3. Immobility
      4. Aging
      5. Psychotic or neurotic states
      6. Increased demand

2. Ineffective airway clearance
   a. Actual
   b. Potential
      1. Disease process
      2. Anesthesia
      3. Foreign object
      4. Increased mucous
      5. Allergic reaction
      6. Sedation
      7. Anxiety reaction

3. Anxiety
   a. Actual
   b. Potential
      1. Sudden changes in life-style
      2. Death of significant other
      3. Loss of support systems
      4. History of past anxiety states
      5. Unknown or fatal prognosis
      6. Change in role function
      7. Disruptive family life

4. Constipation
   a. Actual
   b. Potential
      1. Immobility
      2. Decreased fluid intake
      3. Decreased bulk
      4. Barium
      5. Emotional status
      6. Medications
      7. Disease process
      8. Lack of facilities/ privacy
      9. Environmental changes

5. Diarrhea
   a. Actual
   b. Potential
      1. Medications
      2. Tube feedings
      3. Disease process
      4. Contaminated food/ water

6. Incontinence
   a. Actual
   b. Potential
      1. Colostomy/ ileostomy
      2. Disease process
      3. Environmental changes
      4. Medications
      5. Confusion
      6. Available facilities

7. Ineffective breathing pattern
   a. Actual
   b. Potential
      1. Injury
      2. Medications
      3. Anxiety
      4. CNS pathology
      5. Depression

8. Decreased cardiac output
   a. Actual
   b. Potential
      1. Disease process
      2. Medications
      3. Pacemaker
      4. Smoking
      5. Stressful life-style
      6. Family history of cardiac illness

9. Pain
   a. Actual
   b. Potential
      1. Disease process
      2. Surgery
      3. Injury
      4. Dental hygiene

10. Impaired verbal communication
   a. Actual
   b. Potential
      1. Facial, oral surgery/ disease
      2. Social/ cultural environment change
      3. Low educational attainment
      4. Respiratory distress
      5. CNS trauma
      6. Psychotic/ neurotic states

11. Ineffective family coping
    a. Actual
    b. Potential
        1. Age
        2. Major life events
        3. Communication patterns
        4. Single parent family
        5. Absence of family support
        6. Death in family
        7. Major illness in family
        8. Sudden economic loss
        9. Change in social/ cultural environment

12. Ineffective individual coping
    a. Actual
    b. Potential
        1. Low self-esteem
        2. Illness
        3. Major life style changes
        4. Disruptive life events
        5. Separation from significant other
        6. Loss of social support

13. Deficit in diversional activity
    a. Actual
    b. Potential
        1. Chronic illness
        2. Prolonged hospitalization
        3. Change in living environment
        4. Decreased economic resources
        5. Overachievement orientation
        6. No group membership
        7. Recent retirement

14. Alteration in family process
    a. Actual
    b. Potential
        1. Early marriage
        2. Number of family members
        3. Single parent family
        4. Family roles
        5. Income
        6. Role models
        7. Illness

15. Fear
    a. Actual
    b. Potential
        1. Impending treatments/ surgery
        2. Terminal illness
        3. Fear behavior in parents
        4. Past negative experience
        5. Anticipation of threat
        6. Negative self-concept
        7. Life-style change

16. Excess fluid volume
    a. Actual
    b. Potential
        1. IV's
        2. NG irrigation
        3. Renal disease
        4. Heart disease
        5. Head injury
        6. Tap water enemas
        7. Age
        8. Excessive intake

17. Fluid volume deficit
    a. Actual
    b. Potential
        1. Age
        2. Decreased LOC
        3. Swallowing difficulties
        4. Tube feedings
        5. Diarrhea
        6. Diabetes
        7. Burns
        8. Draining fistulas
        9. Excessive sweating
        10. Blood loss
        11. NG suction
        12. Kidney disease

18. Impaired gas exchange
    a. Actual
    b. Potential
        1. Disease process
        2. Aspiration
        3. Allergic reaction
        4. Medications
        5. Oxygen toxicity
        6. Burns

19. Dysfunctional grieving
    a. Actual
    b. Potential
        1. Shy, oversensitive personality
        2. Perfectionist
        3. Sudden, unexpected loss
        4. Ambivalent feelings toward dead/ dying person
        5. Prolonged absence/separation from bereavement situation

20. Alteration in health maintenance
    a. Actual
    b. Potential
        1. Change in occupation, environment, role, life-style
        2. Change in health status
        3. Lack of health knowledge
        4. Inadequate support system
        5. Financial status
        6. Physical diasability

21. Impaired home maintenance management
    a. Actual
    b. Potential
        1. Chronic fatigue
        2. Depression
        3. Personal/ family crisis
        4. Weakness
        5. Anxiety
        6. Decline in income

22. Injury
    a. Actual
    b. Potential
        1. Siderails
        2. Medications
        3. Weakness
        4. Decreased vision
        5. Environmental hazards
        6. Communication
        7. Smoking
        8. Decreased sensation
        9. Overexposure
        10. Safety precautions
        11. Lack of knowledge
        12. Emotional difficulties

23. Knowledge deficit
    a. Actual
    b. Potential
        1. Lack of external resources
        2. Lack of readiness, motivation, interest
        3. Inattention
        4. Inadequate economic resources
        5. Cognitive difficulties
        6. Emotional difficulties
        7. Need for complex home care
        8. Low level of formal education

24. Impaired physical mobility
    a. Actual
    b. Potential
        1. Architectural barriers
        2. Depression devices
        3. Medication
        4. Disease process immobilization
        5. Lack of assistive devices
        6. Therapeutic

25. Noncomplience
    a. Actual
    b. Potential
        1. Disinterest
        2. Inadequate economic resources
        3. Dependency
        4. Age
        5. Denial of illness

26. Nutrition less than body requirements
    a. Actual
    b. Potential
        1. Altered taste
        2. Diarrhea
        3. Economic resources
        4. Emotional disturbances
        7. Abdominal pain
        8. Nausea/ vomiting
        9. Eating habits
        10. Trauma/ surgery

27. Nutrition more than body requirements
    a. Actual
    b. Potential
        1. Overfeeding infants
        2. Decreased physical activity

3. Stress, anxiety, frustration
4. Use of food as expression of affection or hospitality
5. Decreased metabolic energy needs
6. Endomorphic body build
7. Eating habits
8. Disorganization in family eating

28. Alteration in oral mucous membrane
    a. Actual
    b. Potential
        1. Nutrition
        2. Disease process
        3. Dentures
        4. Mechanical ventilation
        5. Trauma/ injury
        6. Dental care
        7. Altered LOC
        8. Medication

29. Alteration in parenting
    a. Actual
    b. Potential
        1. Inadequate support system
        2. Short anticipatory phase of parenthood
        3. Role models
        4. Lack of knowledge
        5. Period of separation after birth
        6. Self-centered motivation

30. Powerlessness
    a. Actual
    b. Potential
        1. Major change in life-style
        2. Immobility
        3. Dependent loss
        4. Finances
        5. Major illness
        6. Sensory function

31. Rape trauma syndrome
    a. Actual
    b. Potential
        1. Low social class
        2. Age
        3. Self-concept
        4. Minority
        5. Support system

32. Self care deficit
    a. Actual
    b. Potential
        1. Weakness
        2. Cardiac/respiratory disease
        3. Altered LOC
        4. Retarded development
        5. Paralysis
        6. Coordination
        7. Therapeutic immobility
        8. Psychotic states
        9. Visual disabilities
        10. Environmental barriers

33. Disturbance in self concept
    a. Actual
    b. Potential
        1. Physical deformity or deforming procedure
        2. Relationships
        3. Death/injury/illness of significant other
        4. Developmental crises
        5. Terminal or chronic illness
        6. Personal expectations

34. Sensory-perceptual alteration
    a. Actual
    b. Potential
        1. Blocked orifices
        2. Excessive noise
        3. Medications
        4. Disease process
        5. Restricted head/ neck motion
        6. Safety habits
        7. Corrective equipment
        8. Injury
        9. Age
        10. Circulation
        11. Nutrition

35. Sexual dysfunction
    a. Actual
    b. Potential
        1. Knowledge deficit
        2. Sexual punishment in childhood
        3. Fear of pregnancy
        4. Medication/ chemicals
        5. Performance anxiety
        6. Neurologic/ vascular pathology
        7. Failure to identify with same sex parent
        8. Extreme fatigue
        9. Altered self-concept
        10. Rape/ incest

36. Impaired skin integrity
    a. Actual
    b. Potential
        1. Changes in sensation
        2. Age
        3. Nutrition
        4. Decreased mobility
        5. Disease process
        6. Changes in secretions
        7. Decreased circulation
        8. Thickened or fragile skin
        9. Injury
        10. Medication

37. Sleep pattern disturbance
    a. Actual
    b. Potential
        1. Pain
        2. Changes in life-style
        3. Emotional states
        4. Temperature changes
        5. Unfamiliar surroundings
        6. Medications
        7. Urinary frequency

38. Social isolation
    a. Actual
    b. Potential
        1. Living alone
        2. Change of residence
        3. Minority
        4. Recent retirement
        5. Low socioeconomic status
        6. Physical disability

39. Spiritual distress
    a. Actual
    b. Potential
        1. Disruption in usual religious activity
        2. Disasters
        3. Loss of significant other
        4. Behaviors contrary to society/ cultural norms

40. Alteration in thought process
    a. Actual
    b. Potential
        1. Decreased sensory stimuli
        2. Sensory overload
        3. Senesence
        4. Rapidly changing environments
        5. Medication
        6. Disease process

41. Alteration in tissue perfusion
    a. Actual
    b. Potential
        1. Restricted mobility
        2. Hypovolemia
        3. Edema
        4. Medication
        5. Restricted clothing
        6. Hypervolemia
        7. Disease process

42. Alterations in patterns of urinary elimination
    a. Actual
    b. Potential
        1. Strength of sphincters
        2. Pain/ spasm
        3. Fatigue
        4. Dehydration
        5. Perspiration, diarrhea, vomiting
        6. Catheter
        7. Bed rest
        8. Medication
        9. Anxiety

43. Violence
    a. Actual
    b. Potential
        1. Chemical abuse
        2. Abuse
        3. Personality
        4. Anger
        5. Tendency to release hostility through violence
        6. Stress
        7. Isolation
        8. Aggression
        9. Anxiety

44. Family coping, potential for growth

45. Anticipatory grieving

APPENDIX C

NURSING CARE OPTIONS

1. VERBAL REPORTS OF CARE
   a. Listen to change of shift report
   b. Give ongoing report to staff
   c. Give end of shift report
   d. Rounds with MD

2. TALK WITH CLIENT
   a. Social distraction
   b. Counseling/ support
   c. Assessment
   d. Teaching

3. TALK WITH NURSES
   a. Social
   b. Reports
   c. Delegation

4. CLIENT TEACHING
   a. Medications
   b. Procedures
   c. Disease process
   d. Discharge planning

5. CHART
   a. Observations
   b. Medications
   c. Procedures

6. COMFORT MEASURES
   a. Total bath
   b. Partial bath
   c. Occupied bed
   d. Unoccupied bed
   e. Back rub

7. SKIN CARE
   a. Back rub
   b. Bath
   c. Position change
   d. Special beds/ equipment

8. AMBULATION
   a. Rocking chair
   b. Straight chair
   c. Sitting on side of bed
   d. Head elevated
   e. Side to side
   f. Walk

9. RANGE OF MOTION
   a. Active
   b. Passive
   c. Resistive

10. ANTIEMBOLIC STOCKINGS
    a. Measuring
    b. Applying
    c. Daily care

11. BREATHING EXERCISES
    a. Cough
    b. Deep breathe
    c. Triflow
    d. Blow bottles
    e. IPPB

12. NUTRITION ASSISTANCE
    a. Serve tray
    b. Set up tray
    c. Feed
    d. Change diet

13. ELIMINATION
    a. BM
    b. Voiding
    c. I & O
    d. Catheter

14. DRESSINGS
    a. Change, clean
    b. Change, sterile
    c. Suture removal

15. MEDICATIONS
    a. Routine
    b. PRN
    c. Emergency

16. IV
    a. Rate
    b. Site care
    c. Bottle change
    d. Tubing change

17. REST/ SLEEP

18. EMERGENCY MEASURES

19. GATHER SUPPLIES

20. COFFEE BREAK

21. OTHER

22. FINISHED

APPENDIX D

FACULTY COMPUTER INSTRUCTIONS

This test is in the form of a computerized simulation examination. The examination is presented as a client simulation with a written chart, the computer serves as the source of all information during care, and the student is the nurse. Only feedback in the form of observable results are presented.

The simulation presents a 50 year old male client who is three days post arterial graft surgery. Medical diagnoses are Atherosclerosis and Diabetes Mellitus. The Nursing Process is the basis for decision-making.

Target Population

This examination is designed for nursing students who have completed basic medical-surgical nursing content in an approved school of nursing. Students should be familiar with both nursing process and nursing diagnosis. No computer experience is needed.

Suggested Uses

1. Unit or final exam in medical-surgical nursing.
2. Validation of prior nursing knowledge in medical-surgical nursing.
3. Review of medical-surgical nursing.

Hardware Requirements

1. TRS-80 Model 3, 4, or 4D
2. 64K memory
3. Two (2) disc drives
4. NEWDOS-80 operating system
5. Extra 5 1/4 inch floppy discs
6. Printer

Preparation of Computer System

1. Copy (see system manual) Simulation Examination Program onto NEWDOS-80 system disc. Have a copy for each available computer.

2. Format (see system manual) an extra data disc for each 15 students taking the test.

3. Duplicate "Student Instruction Manual" for each available computer.

4. Provide a nursing dictionary and a regular dictionary for each student's use.

Administration

1. Schedule students for a minimum of one hour computer time to take the test. Give students a copy of the Student Instruction Manual".

2. Turn the computer on (the switch is under the right side of keyboard).

3. Insert system disc with simulation program into Drive 0 (the lower drive) and the data disc in Drive 1.

4. Boot the system by pressing the orange button on the right side of the keyboard.

5. Provide any further instructions desired for students.

6. When the student completes the program, the keyboard will lock and instructions to notify the proctor will appear on the screen.

7. Remind the student to leave the materials for the next student.

8. Reboot the system if another student is to take the exam. Up to 15 students' responses can be safely put onto one data disc.

9. If there are no other students remove both the data disc and the program disc, then turn the computer off.

Printing Student Responses

1. Turn on computer.

2. Insert NEWDOS-80 system disc into Drive 0 and the data disc containing student responses into Drive 1.

3. Boot the system.

4. Turn on the printer (see printer manual for specific instructions).

5. Type in PRINT,STUDNT/TST.

6. After the printer has stopped, remove both discs and turn both printer and computer off.

Scoring

The printout will provide all student responses and an indication of the option chosen. Faculty bay form their own scoring system or may use the following system based on responses by masters prepared nursing faculty.

Based on responses made by faculty members, there is a total of 33.75 points on the examination. To get an individual student's score, use the decision list and add the points indicated for each choice selected by the student. Scores may be used as points earned out of 33.75 or converted to percents.

APPENDIX E

STUDENT INSTRUCTIONS

You are preparing to take a simulation test using a micro-computer and this booklet. The micro-computer will answer questions and provide reactions to your choice of nursing actions. It will serve as the "patient" and/or family. This booklet contains all portions of a patient chart that would normally be available for this particular patient at this time. You will be evaluated on your ability to use the nursing process and decision making skills to indicate the correct nursing action.

You may read the chart before you begin and/or use it as a reference throughout. Blank space is available for you to chart as you normally would during a 7-11am clinical experience. Blank pages are clipped to the origional chart page. Plese remember to chart and sign the entries. The charting constitutes a part of the test.

You will have a time limit based on approximate times required for nuring actions. The time will be indicated in the upper right of the screen throughout the simulation. Time is increased after each nursing action and will remain at that level until the next action is selected. The time shown indicates the simulation time between 7am and 11am on January 14 of Mr. Brown's care. The time is NOT related to the actual time that you have spent at the computer. The actual time required for the test is estimated to be one (1) to one and one-half (1 1/2) hours.

The computer will present a list of possible choices. To make a selection, type in the letter or number of the choice desired. After each selection it is necessary to press ENTER. Read all instructions appearing on the screen and follow carefully.

Computers only do what you ask them to do. Spelling must be accurate for you to get the requested response. Both a standard and a medical dictionary are provided to help you. If the computer doesm't seem to understand you, try checking spelling first then go on to other possible options. If you have other problems, ask the proctor. He/she will only provide help in regard to working the computer. Possible actions or questions will NOT be provided for each decision.

The following list of choices will be the first that you will encounter. This same list will frequently reappear during the program.

1. Obtain Data
2. Establish Nursing Diagnosis
3. Implement Nursing Care
4. Evaluate Outcome
5. Record on Chart

6. Other
7. Finished

The first selection will give you assessment data reflecting the client's status at that time. The number two (2) selection allows you to write nursing diagnoses for this client. You may either select from the approved North American Nursing Diagnosis Association (NANDA) list or write your own. A copy of the NANDA list, as it is found in the program, is included in this instruction manual. It will be necessary to continue through the listing on the computer until you find the diagnosis that you want. You will then be able to select the wording that you desire.

In order to implement nursing care select number three (3). You will be given a list of possible nursing actions that you can select. The list will always be presented in the same order. A copy of this list is found in this instruction manual.

Number four (4) will allow you to evaluate the outcome of your care. You will be asked to respond to each of your nursing diagnoses by indicating whether the client has improved, become worse, or did not change.

Selecting number five (5) gives you some time to write on the chart. Please make this selection each time that you chart.

The sixth selection of "Other" is an alternative way into the program and is to be used if you see no other response that you consider appropriate.

Selection of number seven (7) will automatically take you out of the program. You will be asked if you are sure that you are finished. A "yes" answer will prevent any further entries into the program. Be sure that you are finished before selecting number 7.

Ask the proctor to start the program when you are ready. After that you have only to type in the selections, questions or nursing actions that you want. After each selection, wait for the computer to respond before giving another response. DO NOT TOUCH THE ORANGE BUTTON.

If you have done everything that you feel you should, indicate that you are finished and follow the instructions which appear on the screen. Also, complete your chart entries and give this booklet to the proctor as you leave. Please leave the provided materials at the computer for the next student.

APPENDIX F

QUESTIONS FOR EXPERT REVIEW OF CONTENT VALIDITY

Based upon your opinion as an experienced individual in medical-surgical nursing please answer the following questions. Type "Y" for yes or "N" for no. Then press ENTER following each of your answers.

1. The assessment data received is representative of the assessment data needed to care for a client who:
   a. is third day postop.
   b. has Peripheral Vascular Disease.
   c. had an Aorto-Femoral Bypass Graft.
   d. has Diabetes Mellitus.
   e. is an adult married male with two children.

2. Nursing actions are present for the care of a client who:
   a. is third day postop.
   b. has Peripheral Vascular Disease.
   c. had an Aorto-Femoral Bypass Graft.
   d. has Diabetes Mellitus.
   e. is an adult married male with two children.

3. Options are given for the decisions you would make in the care of a client who:
   a. is third day postop.
   b. has Peripheral Vascular Disease.
   c. had an Aorto-Femoral Bypass Graft.
   d. has Diabetes Mellitus.
   e. is an adult married male with two children.

4. The time spent for each activity chosen is realistic.

5. In general, the simulated client is representative of a client that you might expect to assign.

APPENDIX G

DEMOGRAPHIC DATA

Table G.1

Demographic Data

		EXPERTS	NOVICE
AGE	<20	0	19
	20-29	4	5
	30-39	8	1
	40-49	8	0
	50-59	5	0
SEX	MALE	2	1
	FEMALE	23	24
TYPE OF SCHOOL	ASSOCIATE DEGREE	10	0
	DIPLOMA	3	2
	BACCALAUREATE	12	23
EDUCATION (terms)	<9	3	25
	10-19	11	0
	20-29	4	0
	30-39	3	0
	40-49	1	0
	No Response	3	0
COMPUTER EXPERIENCE (years)	0	11	17
	1	7	4
	2	5	4
	3	0	0
	4	1	0
	5	1	0
NURSING EXPERIENCE (years)	<10	8	0
	10-19	10	0
	20-29	5	0
	30-39	1	0
	No Response	1	0
TEACHING EXPERIENCE (years)	<4	6	0
	5- 9	8	0
	10-14	4	0
	15-19	4	0
	20-24	2	0
	No Response	1	0

APPENDIX H

LETTER FOR DEANS AND DIRECTORS

Dear

As a part of my dissertation requirements in Educational Psychology, I have developed a Model Computerized Simulation Test. This test is designed to establish decision making and problem solving abilities of student nurses in medical- surgical nursing. The nursing process and current medical- surgical practice levels in the Southeast are used as the basis for making decisions.

Nursing faculty members prepared at the master of science in nursing level with a specialty in medical-surgical nursing and college students (not registered nurses) are needed to begin establishing validity and reliability for this model. Collection of data is tentatively scheduled to start in March and end by August 30, 1986. Identities of participants will be known only to the researcher.

Volunteers among your faculty and students are requested to participate in this study. Enclosed are copies of an information and consent form to explain the study's purpose and requirements for potential participants. I would like to meet with your faculty and/or students to answer questions that they may have. However, individuals may participate without attending this explanatory meeting by leaving their name and phone number with a the contact person identified at your school so that a time to take the test can be scheduled.

Explanatory meetings will be scheduled prior to sitting up individual participant appointments at your school. Enclosed is a stamped, self-addressed return card. Please return within one week with at least the name and telephone number of an individual that I can contact to make additional arrangements.

The Model Computerized Simulation Test will be administered to the participants at a site convenient to your school, on campus if possible. The test requires one to one and one-half hours to complete. Therefore to obtain optimal scheduling, I would like to explore additional computer facilities which might be scheduled. The test is written for a TRS-80 Model III and will run on TRS-80 Models I, IV, and IVD. The test is being converted to run on an IBM clone. Please indicate on the return card the number of these computers which are available and/or an individual that I can contact for this information.

Sincerely yours,

APPENDIX I

CONSENT FOR PARTICIPATION IN A RESEARCH STUDY ESTABLISHING VALIDITY AND RELIABILITY OF A MODEL COMPUTERIZED TEST FOR NURSES

Evaluating the ability of student nurses to use the nursing process and make accurate decisions about client care is a challenge to nursing faculty. This research study is attempting to add another tool for use in evaluating the decisions made by student nurses. A computer program has been developed in which a client situation unfolds as the student makes decisions relating to the client's care. Responses made by the student are recorded on computer disk for later evaluation by nursing faculty.

The study will compare decisions made by individuals having knowledge and experience in nursing (faculty with masters level preparation in medical-surgical nursing) with decisions made by individuals inexperienced in nursing (college students with no nursing courses). The comparison will indicate whether decisions are similar among knowledgeable individuals and if knowledgeable individuals have different responses than inexperienced people.

Participants will spend approximately one to one and one-half hours completing the Model Computerized Simulation Test for Nurses. Appointments will be scheduled with individual participants. The test will be administered during a one to two day period at a site on or near participating schools campuses. Appointments are expected to be scheduled beginning March 1, 1986 and to end before August 30, 1986. Please contact Tippie Pollard by phone at (615) 945-2951 or (615) 475-9061 ext. 429 or by mail at Route 2 Box 320, Powell, TN 37849 if unable to meet a scheduled appointment or if further information is needed. Participation is voluntary. Any individual may decide not to take the test or to terminate the test at any time.

Instructions will be given before the test and the researcher will be available throughout the test for assistance. Questions and areas requiring assistance will be documented to help improve instructions for the test. A written manual will be available containing instructions for using the computer, the simulated client's chart and copies of the long lists used in the computer program for selecting activities.

Individual performance of participants will not be shared with anyone. Each participant will be given a five (5) digit random number for identification in the computer files. The researcher will keep a master list of names with these identification numbers which will be available only to the researcher. All comparisons and references to responses will use identification numbers.

Results of the study will be sent to each school participating and to any individual participant requesting a copy after the study is completed. A copy of the Model Computerized Simulation Test Program and Manual will be made available to those schools with faculty and students participating in the study.

I HAVE READ THE ABOVE INFORMATION AND AGREE TO TAKE THE DESCRIBED MODEL COMPUTERIZED SIMULATION TEST FOR NURSING.

Signature

Date

APPENDIX J

RETURN CARD

PLEASE COMPLETE AND RETURN

NAME OF SCHOOL

PARTICIPATION:
APPROXIMATE NUMBER: FACULTY ________ ; STUDENTS________
DESIRE MEETING: FACULTY___; STUDENTS___; BOTH___; NO___
CONTACT PERSON: ______________ PHONE:_________________

COMPUTER INFORMATION:
NUMBER AT COLLEGE: TRS-80 Model I, III, IV or IVD_____
COMPUTER AVAILABILITY: YES___; NO___; POSSIBLY ________
CONTACT TO SCHEDULE:_____________PHONE:________________

OTHER:

APPENDIX K

SECOND LETTER TO DEANS AND DIRECTORS

Dear

As a part of my dissertation requirements in Educational Psychology at the University of Tennessee in Knoxville, I have developed a Model Computerized Simulation Test. This test is designed to establish decision-making and problem-solving abilities of student nurses in medical-surgical nursing. The nursing process and current medical-surgical practice levels in the Southeast are used as the basis for making decisions.

Initial contact, with your school, was attempted in April 1986. I realize that this was near the end of many academic schedules and, therefore, am sending an additional query. I was given your name as a person to contact to make contact with the medical-surgical faculty. Since there are a limited number of nursing faculty in the East Tennessee area, I would greatly appreciate the participation of your faculty.

Nursing faculty members prepared at the masters level in nursing with a specialty in medical-surgical nursing and college students (not registered nurses) are needed to begin establishing validity and reliability for this model. Collection of data is tentatively scheduled to start in April and end by October 31, 1986. Identities of participants will be known only to the researcher. Volunteers among your faculty and students are requested to participate in this study. Enclosed are copies of an information and consent form to explain the study's purpose and requirements for potential participants.

The Model Computerized Simulation Test will be administered to the participants at a site convenient to your school, on campus if possible. The test requires one to one and one-half hours to complete. The test is written for a TRS-80 Model III and will run on TRS-80 Models I, IV, and IVD. I will provide the computer necessary for data collection. However, additional computers, if available, would allow more individuals to participate in a shorter period of time.

Please return the stamped, self-addressed card within one week if possible giving me a telephone number where you can be reached. I will then contact you to arrange for a meeting with the medical-surgical faculty. My number is listed above and you may call me collect if that is preferable. I look forward to talking with you. Thank you for your cooperation.

Sincerely yours,

APPENDIX L

HUMAN SUBJECTS REVIEW EXEMPTION

THE UNIVERSITY OF TENNESSEE, KNOXVILLE
KNOXVILLE, TENNESSEE 37996-0140
OFFICE OF RESEARCH COMPLIANCES

404 ANDY HOLT TOWER
TELEPHONE (615) 974-7697

March 4, 1986

Ms. Tippie Pollard
Route 2, Box 320
Powell, TN 37849

Dr. Schuyler Huck
Educational and Counseling Psychology
CAMPUS

Dear Ms. Pollard and Dr. Huck:

The project which you submitted entitled, "A Model Computerized Simulation Exam for Nursing," CRP #2026-A, has been reviewed and certified exempt from review by the Committee on Research Participation.

This approval is for a period ending March 4, 1987. Please make timely submission of renewal or prompt notification of project termination (see item #2 below).

The responsibility of the project director includes the following:

1. Obtain prior approval from the Director of Research Compliances before instituting any changes in the project (Form D).

2. A statement must be submitted (Form D) at 12-month intervals attesting to the current status of the project (protocol is still in effect, changes have been made, project is terminated, etc.).

The Committee wishes you success in your research endeavors.

Sincerely,

L. B. Cebik, Director
Office of Research Compliances

cc: Dr. Thomas C. Collins, Vice Provost for Research
Dr. Robert L. Williams

APPENDIX M

DECISION POINTS WITH SCORING VALUES

1. OBTAIN DATA (ASSESSMENT)

1. Chart (Meds)			= .56
2. Nursing Staff			= .44
3. Other Hospital Staff			= .2
4. Physician			= .16
5. Client Interaction			= .76
6. Family		1. Wife	= .16
		2. Daughter	= 0
		3. Son	= 0
7. Health Exam	1. General Appearance		= .4
	2. Mental Status		= .4
	3. Nutritional Status		= .32
	4. EENT		= .16
	5. Respiratory		= .6
	6. Cardiovascular		= .8
	7. Elimination		= .48
	8. Movement		= .4
	9. Sensation		= .48
	10. Communication		= .28
	11. Abdomen		= .4
	12. Reproductive/Sexual		= .08
	13. Develomental		= .08
	14. Full Health Exam		= .24
8. Equipment			= .28

2. ESTABLISH NURSING DIAGNOSIS

1. Activity intolerence	a. Actual	
	1. Disease process	= .12
	3. Immobility	= .12
	b. Potential	
	1. Disease process	= .12
	2. Poor nutritional state	= .04
2. Ineffective airway clearance	a. Actual	
	6. Sedation	= .04
	b. Potential	
	1. Disease process	= .04
	2. Anesthesia	= .24
	6. Sedation	= .08

3. Anxiety ______________ a. Actual
1. Sudden changes in life-style = .08
6. Change in role function = .04
7. Disruptive family life = .04
b. Potential
1. Sudden changes in life-style = .08
3. Loss of support systems = .04

4. Constipation __________ a. Actual
6. Medication = .04
b. Potential
1. Imobility = .32
3. Decreased bulk = .16
6. Medication = .12
7. Disease process = .08
8. Lack of facilities = .04
9. Environmental changes = .04

5. Diarrhea ______________ b. Potential
1. Medication = .04
2. Tube feedings = .04

6. Incontinence __________ b. Potential
6. Available facilities = .04

7. Ineffective breathing pattern _ a. Actual
2. Medication = .04
b. Potential
2. Medication = .08

8. Decreased Cardiac output _____ a. Actual
6. Family history of caridac illness = .04
b. Potential
1. Disease process = .08
4. Smoking = .08

9. Pain _________________ a. Actual
1. Disease process = .16
2. Surgery = .64
b. Potential
2. Surgery = .04

10. Impaired verbal communication ________ a. Actual
3. Low educational attainment = .04

11. Ineffective family coping	a. Actual	
	7. Major illness in family	= .04
	b. Potential	
	7. Major illness in family	= .08
	8. Sudden economic loss	= .08
12. Ineffective individual coping	a. Actual	
	5. Separation from siginificant other	= .04
	b. Potential	
	2. Illness	= .16
	3. Major life style changes	= .04
	4. Disruptive life events	= .04
	5. Separation from significant other	= .08
13. Deficit in diversional activity	b. Potential	
	1. Chronic illness	= .04
	3. Change in living environment	= .08
14. Alteration in family process	a. Actual	
	7. Illness	= .04
	b. Potential	
	7. Illness	= .08
15. Fear	a. Actual	
	1. Impending treatments/surgery	= .04
	7. Life-style change	= .04
	b. Potential	
	5. Anticipation of threat	= .08
	7. Life-style change	= .04
16. Excess fluid volume	a. Actual	
	1. IV's	= .08
	b. Potential	
	1. IV's	= .28
	2. NG irrigation	= .04
17. Fluid volume deficit	b. Potential	
	6. Diabetes	= .12
	10. Blood loss	= .04
18. Impaired gas exchange	b. Potential	
	1. Disease process	= .12
	4. Medication	= .04

20. Alteration in health maintenance
    a. Actual
    1. Change in occupation, environment, role, life-style = .04
    3. Lack of health knowledge = .04
    6. Physical disability = .04
    b. Potential
    1. Change in occupation, environment, role, life-style = .04
    2. Change in health status = .08
    3. Lack of health knowledge = .04

21. Impaired home maintenance
    b. Potential
    4. Weakness = .04
    5. Anxiety = .04

22. Injury
    a. Actual
    2. Medication = .08
    3. Weakness = .08
    7. Smoking = .04
    8. Decreased sensation = .04
    11. Lack of knowledge = .04
    b. Potential
    1. Siderails = .04
    2. Medication = .04
    3. Weakness = .16
    7. Smoking = .04
    8. Decreased sensation = .04

23. Knowledge deficit
    a. Actual
    8. Low level of formal education = .04
    b. Potential
    1. Lack of external resources = .04
    2. Lack of readiness, motivation = .08
    7. Need for complex home care = .04

24. Impaired physical mobility
    a. Actual
    4. Disease process = .32
    6. Therapeutic immobilization = .24
    b. Potential
    6. Therapeutic immobilization = .04

25. Noncompliance
    a. Actual
    2. Inadequate economic resources = .04
    b. Potential
    1. Disinterest = .04
    2. Inadequate economic resources = .04
    5. Denial of illness = .04

26. Nutrition less than body requirements	a. Actual	
	10. Trauma/surgery	= .12
	b. Potential	
	6. Change in nutritional demands	= .12
	10. Trauma/surgery	= .12
27. Nutrition more than body requirements	a. Actual	
	2. Decreased physical activity	= .04
	7. Eating habits	= .12
30. Powerlessness	a. Actual	
	1. Major change in life-style	= .04
	2. Immobility	= .08
	3. Dependent	= .04
	5. Major illness	= .04
	b. Potential	
	1. Major change in life-style	= .04
	2. Immobility	= .04
	3. Dependent	= .08
	4. Finances	= .04
	5. Major illness	= .08
32. Self care deficit	a. Actual	
	1. Weakness	= .12
	7. Therapeutic immobility	= .16
	b. Potential	
	1. Weakness	= .12
33. Disturbance in self concept	b. Potential	
	1. Physical deformity	= .08
	6. Personal expectations	= .04
34. Sensory-perceptual alteration	a. Actual	
	10. Circulation	= .08
	b. Potential	
	3. Medication	= .04
	10. Circulation	= .08
35. Sexual dysfunction	b. Potential	
	6. Neurologic/vascular pathology	= .08
36. Impaired skin integrity	a. Actual	
	4. Decreased mobility	= .08
	5. Disease process	= .12
	7. Decreased circulation	= .08
	9. Injury	= .12
	b. Potential	
	1. Changes in sensation	= .08
	4. Decreased mobility	= .04
	5. Disease process	= .04

	7. Decreased circulation	= .12
	9. Injury	= .12
37. Sleep pattern disturbance	a. Actual	
	1. Pain	= .24
	3. Emotional states	= .04
	5. Unfamiliar surroundings	= .08
	b. Potential	
	1. Pain	= .08
	5. Unfamiliar surroundings	= .08
38. Social isolation	b. Potential	
	6. Physical disability	= .04
39. Spiritual distress	b. Potential	
	4. Behaviors contrary to society/ cultural norms	= .04
40. Alteration in thought process	b. Potential	
	6. Disease process	= .08
41. Alteration in tissue perfusion	a. Actual	
	1. Restricted mobility	= .08
	7. Disease process	= .28
	b. Potential	
	1. Restricted mobility	= .04
	2. Hypovolemia	= .04
	3. Edema	= .08
	7. Disease process	= .24
42. Alterations in patterns of urinary elimination	a. Actual	
	2. Pain/spasm	= .04
	b. Potential	
	4. Dehydration	= .04
44. Family coping, potential for growth		= .04
45. Anticipatory grieving		= .04

3. IMPLEMENT NURSING CARE

1. Verbal reports of care	a. Listen to change of shift report	= .44
	b. Give ongoing report to staff	= .12
	c. Give end of shift report	= .12
	d. Rounds with MD	= .28

2. Talk with client	b. Counseling/support		= .12
	c. Assessment		= .56
	d. Teaching		= .36
3. Talk with nurses	b. Reports		= .16
	c. Delegation		= .04
4. Client teaching	a. Medications	1. ASA	= .12
		2. Cyclospasmol	= .04
		4. Regular Insulin	= .08
		5. NPH Insulin	= .12
		6. Nicotinic Acid	= .04
	c. Disease process	1. DM	= .12
		2. Arteriosclerosis	= .04
		3. Bypass grafts	= .08
	d. Discharge planning	1. Care of diabetic condition	= .04
		2. Awareness of decreasing circulation	= .16
		5. When to seek help	= .04
5. Chart	a. Observations		= .36
	b. Medication		= .24
	c. Procedures		= .12
6. Comfort measures	a. Total bath		= .08
	b. Partial bath		= .68
	c. Occupied bed		= .08
	d. Unoccupied bed		= .32
	e. Back rub		= .2
7. Skin care	a. Back rub		= .16
	b. Bath		= .12
	c. Position change		= .24
8. Ambulation	a. Rocking chair		= .28
	b. Straight chair		= .08
	c. Sitting on side of bed		= .12
	e. Side to side		= .08
	f. Walk		= .4

9. Range of motion ________	a. Active		= .12
	c. Resistive		= .04
10. Antiembolic stockings _	a. Measuring		= .12
	b. Applying		= .2
	c. Daily care		= .36
11. Breathing exercises ___	a. Cough		= .36
	b. Deep breathe		= .32
	c. Triflow		= .52
12. Nutrition assistance ____	a. Serve tray		= .44
	b. Set up tray		= .24
	d. Change diet order		= .04
13. Elimination _	a. BM		= .16
	b. Voiding		= .2
	c. I & O		= .16
14. Dressings ___	b. Change, sterile		= .28
15. Medications __	a. Routine ____	1. Cyclospasmol	= .12
		2. Insulin	= .48
		4. ASA	= .28
		5. Nicotinic Acid	= .28
	b. PRN ________	6. Demerol	= .12
16. IV __________	a. Rate		= .6
	b. Site care		= .48
	c. Bottle change		= .24
	d. Tubing change		= .2

17. Rest/sleep ________________________ = .04
19. Gather supplies ________________________ = .08
20. Coffee break ________________________ = .04
21. Other ________________________ = .04

4. EVALUATE OUTCOME ____________ = .56

5.RECORD ____________ = .72

6. OTHER ____________ = .04

7.FINISHED

1. Indicates finished ________________________ = .6
2. Test aborted due to dangerous action ____________ = .36
3. Clock ran out ________________________ = .04

TOTAL POINTS ________ = 33.76

APPENDIX N

INSTRUCTIONS TO PARTICIPANTS

The examination you are about to take is in the form of a computer simulation. This means that information relating to the simulated client and your actions will be indicated via computer. The computer will serve as your client and as the means for implementing nursing actions. Information in the computer concerns the client on the day you are caring for him.

Information prior to that day is found in his chart. The chart is located in this notebook. The extra clipped on pages are for your use, if needed, for charting.

Before beginning with the comnputer, please read and sign the "Information/Consent Form" and read the "Student Instructions". Please use the number on the front of the notebook as your ID number. This will help to locate your responses without associating them with you.

The computer is ready when you are, just follow the instructions on the screen. Do you have any questions? If questions arise during the program, I'll be available at (a close location).

VITA

Tippie Denton Pollard was born in Sevierville, Tennessee on October 12, 1942. She attended elementary school in Blount County and graduated from Everett High School in 1960. She received a diploma in nursing from East Tennessee Baptist Hospital School of Nursing and was licensed as a registered nurse in 1963. For the next six years she practiced as a registered nurse in a variety of health care settings in East Tennessee. After marriage and the birth of two daughters, she entered The University of Tennessee, Knoxville to complete a Baccalaureate in Nursing degree in 1975. While teaching nursing at St. Mary's School of Nursing, she completed a Master of Science in Nursing degree at The University of Tennessee, Knoxville in 1978.

In 1979 she re-entered The University of Tennessee, Knoxville Graduate School. During the course of her doctoral studies, she taught nursing at East Tennessee Baptist Hospital School of Nursing and at Carson-Newman College. She received the Doctor of Education degree with a major in Educational Psychology in August 1987.

The author is a member of Sigma Theta Tau, Pi Lambda Theta, American Nurses Association, National League for Nursing, American Association of Neuroscience Nurses, American Association of Rehabilitation Nurses, American Association of Critical Care Nursing, and the National Forum on Computers in Health Care and Nursing. After graduation Mrs. Pollard will continue her present employment at Carson-Newman College.