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Analysis of the effectiveness of an instructional strategy to teach selected problem-solving skills to nursing students

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Rebecca B. Rice

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TO TEACH SELECTED PROBLEM-SOLVING SKILLS

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Rebecca B. Rice

Approved September 1984 by

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Dedication

This paper is dedicated to the memory of Terry Dagrosa, R.N., M.S.N.: friend, confidante, colleague.

ACKNOWLEDGMENT

This project has involved many people to whom I owe a debt of gratitude. Special thanks are extended to the members of my committee: Dr. Roger Ries, Dr. John Thelin, and Dr. William Losito, who have worked diligently to assist me in bringing this project to fruition. In addition, I should also like to thank Dr. Mary Ann Sagaria, who worked with me during the embryonic stages of the project and through the defense of my proposal. Without her assistance I might still be wandering through the reams of literature on problem solving.

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Finally, my deepest gratitude is extended to my family. My husband, George, taught me how to use the computer, but beyond that, he lent his unswerving support daily without complaint. And to my children go many thanks for suffering through fast-food meals and sandwiches.

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CHAPTER 1

THE PROBLEM

Need

The nurse's activities in the clinical setting are complex. On the one hand, much of the nurse's activity can be viewed as being somewhat dependent upon the medical regimen prescribed for the patient. In this respect, the nurse is the person primarily responsible for carrying out the physician's orders. These activities in themselves require not only psychomotor skills but also such cognitive skills as comprehension of the pathophysiology of disease, pharmacokinetics, principles of nutrition, and knowledge of the basic humanities and natural sciences. On the other hand, the nurse's activities can be viewed from a more interdependent perspective; i.e., one in which she and the patient plan together for the restoration of health or a death with dignity (Henderson, 1966). From this interdependent perspective, the nurse and the patient together assess the patient's basic needs and determine where disease has interfered with these needs. She and the patient then plan approaches designed to assist the patient to cope with or overcome interferences with his basic needs.

Therefore, the nurse's problem-solving activities are related to both of her roles. Problem-solving activities in the clinical setting begin when the nurse identifies changes in the patient's behavior. The cues may be either verbal or nonverbal in character. If the nurse notes a change in the patient's behavior, she may take one of several approaches. First, she must know if the change in behavior is to be expected, based on previous health team interventions (e.g., a patient taking a diuretic begins to urinate in large amounts) and therefore requires no additional nursing intervention. Second, she must be able to determine if the changes in behavior are within the scope of her practice (e.g., the pre-operative patient is anxious) and therefore require a method of nursing assistance to correct (e.g., talking with the anxious patient). Finally, she must possess sufficient knowledge of disease to know if the changes are medically oriented (e g. the patient complains of chest pain) and therefore require her to implement a medical order (e g., give the patient nitroglycerine) or notify the physician if no order exists.

Unfortunately, most problems within nursing are not well defined. Any of the instances mentioned above may require different courses of action under different circumstances. For example, anxiety in a patient with lung disease may mean that he is emotionally upset or that he suffers from lack of oxygen (hypoxia). A nurse who chooses to assist the patient in talking out his problems because she believes that the cause of his being upset is emotionally based may have failed to recall that anxiety is a sign of hypoxia. Her action would be inappropriate. In fact, failure to give him oxygen may actually cause a decline in his condition.

Because the same cues may be present in different problems, the cognitive processes underpinning problem identification are not simple processes. In order to consider multiple alternatives in the process of problem solving, the nurse must possess a vast amount of information related to the meaning of clinical cues. The way this knowledge is stored in memory may influence whether or not it is recalled at the appropriate time. Aspinall and Tanner state, "The problem identification phase is probably the most complex, and, at the same time, the most critical component of the entire nursing process" (1981, p. 5).

Identifying problems begins with the detection and encoding of verbal and nonverbal cues from the patient. Detection of cues refers to the act of discovering the existence of meaningful behaviors or bits of data from the patient. Once the cues are detected, the nurse encodes them or attempts to represent them cognitively. These mental acts are performed so that the nurse is able to develop hypotheses relating to the meaning of the cues presented by the patient. In the initial phase of this process, the hypotheses formed are tentative at best because the cues presented may be vague and ill-defined. Once the nurse has formed tentative hypotheses, she is then able to implement nursing measures designed to achieve one of the following outcomes: (1) to gather more information to clarify ill-defined patient problems, or (2) to assist the patient in solving the problem.

How nurses detect and encode cues and form tentative hypotheses is largely unknown. Selected nursing problem-solving research findings have suggested the following: (1) that nurses use certain types of cues to predict states of patients, (2) that nurses use specific strategies or heuristics to form hypotheses about patients, and (3) that expert and novice nurses alike share similar cognitive structures about cues stored in long-term memory, but that experts are more adept at knowing which cues are important and at translating the meaning of cues (Gordon, 1972; Kelly & Hammond, 1968; Broderick & Ammentorp, 1979).

Since these cognitive skills of detecting and encoding cues and forming tentative hypotheses are integral components of the practice of nursing, it is incumbent on the teachers of nurses to provide learning experiences that will enhance the acquisition of these skills. Traditional curricular approaches, such as lecture and small group discussion, may not provide sufficient learning opportunities for students to acquire these problem-solving skills. An alternative method of teaching these skills would be to examine the cognitive skills of experienced nurses and to develop an instructional strategy based upon this examination. Students would then be given the opportunity to compare their own problem-solving strategies with those of experienced nurses.

Purpose

The purpose of this study, therefore, was two-fold. The first part related to developing the instructional strategy employed in the experimental phase of the study. Since this study was based on the premise that students' learning of selected cognitive skills could be enhanced by teaching them how experienced nurses solve problems, this part of the study investigated the cognitive processes of experienced nurses as they solved six simulations of patient situations. Specifically, this part of the study was concerned with answering the following questions: (1) how is a set of tentative problem formulations or hypotheses structured; and (2) what cognitive process are involved in the generation of tentative problem formulations?

After analyzing the experienced nurses' problem solving processes, the instructional strategy was developed. The second part of the study was concerned with testing whether the strategy thus developed would enhance selected problem-solving skills of freshmen nursing students. This part of the study addressed the following questions: (1) does an instructional strategy developed from an analysis of the problem-solving processes of experienced nurses enhance selected problem-solving skills of freshmen nursing students; and (2) will the problem-solving skills be more greatly enhanced in nursing students who receive process and outcome feedback from experienced nurses than in nursing students who receive outcome feedback only from experienced nurses?

Hypotheses

The major purpose of this study, therefore, was to test experimentally the following hypotheses:

Hypothesis 1: The problem solving skills of detecting and encoding cues and generating tentative problem formulations will be significantly increased in freshmen nursing students who receive feedback based on data obtained from experienced nurses;

Hypothesis 2: The problem solving skills will be significantly greater in freshmen nursing students who receive both outcome and process feedback than in those who receive outcome feedback only.

Theory

The theoretical construct for this study was based on the information-processing approach to cognition (Newell & Simon, 1972). This theory of problem solving includes two fundamental propositions: (1) that the task environment, the problem, is represented internally as a problem space; and (2) that the structure of the problem space determines the information-processing activities to be used in search of solutions. An individual, when presented with a problem, uses the cues in the environment to form an internal representation of the task. The internal use of these cues makes up the problem space, which is represented in the short-term or working memory. Having defined the problem space, the individual selects a problem-solving method to solve the problem. The method is selected by searching through the long-term memory for routines that may be relevant to the problem. At any time the particular method may be halted and another method attempted. The individual may also reformulate a different problem space and select another method to solution. According to this theory, the potential of an individual as a problem solver is a function of three things: (1) competence in task-specific subskills which are needed to solve the problem; (2) general strategies of information processing such as problem detection, memory search methods, and analysis of the components of the problem; and (3) the features of the particular task environment (Resnick & Glaser, 1976). Therefore, to improve the ability of the person as a problem solver, according to this theory, one would seek to accomplish three things: (1) to increase competence in the task-specific subskills necessary to solve the problem, (2) to teach general strategies of information processing, and (3) to promote the individual's ability to perceive features in the task environment.

Overview of the study

Rationale for the instructional strategy. An ideal instructional strategy to enhance problem solving skills of nursing students would be one that assists students in all phases of the problem-solving process; that is, from the detection and encoding of cues through the development of hypotheses to the testing and evaluation of the hypotheses. In an effort to limit the scope of the study, it was decided to focus on two components of this process: (1) the detection and encoding of cues (i.e., elements of data that have relevance in the generation of problem formulations) and (2) the use of these cues to generate an initial set of tentative problem formulations.

Although these components were selected for instructional purposes, it should be recognized that the adoption of an instructional strategy to teach "problem-solving" skills does not necessarily mean that students are taught to generate problem formulations solely from this instructional strategy. Contemporary nursing curricula already emphasize the problem-solving approach to nursing practice. In fact, problem solving has assumed such importance in nursing that it is called the "nursing process." LaMonica (1979, p. xiii) defines the nursing process as ". . . the scientific method that is used to assist . . . practitioners to systematically assess, plan, implement, and evaluate quality, individualized professional nursing care." She further states that the nursing process is ". . .the foundation for nursing practice" (p. xiii). In teaching the nursing process, nurse educators usually emphasize the sequential nature of the process. That is, students should gather relevant data prior to developing hypotheses or nursing diagnoses. However, both classical (Dewey, 1938) and contemporary (Newell & Simon, 1972) theories of problem solving advocate the early generation of some form of conceptual framework in the problem-solving process. Dewey labeled this conceptual framework the *hypothesis*; for Newell and Simon, this construct is called the *problem space*. A major feature of the present experimental study was compatible with both of these theoretical approaches to problem solving since the instructional strategy was designed to teach nursing students to generate problem formulations early, based on incomplete data. Thus, the initial hypotheses developed by the problem solver would be used for two purposes: (1) to guide the search for alternatives to solution or (2) to provide a framework for search for more cues.

Development of the instructional strategy. The instructional strategy developed and tested in this study combined two components: (1) having the student practice the task of generating tentative problem formulations under conditions that simulate a nurse-patient encounter, and (2) providing the student with feedback based on the performance of this task by a group of experienced nurses.

The first component of the model, simulated situations, was based on the educational principle that problem-solving skills can best be taught by providing the student with opportunities to experience situations that closely approximate the problems he encounters in the real world (Bruner, 1966; Dewey, 1963; and Gagne, 1971). In the present instructional strategy, the student's encounter with a series of patients was simulated by means of videotaped situations which present, as closely as possible, a "nurse's eye view" of the nurse-patient encounter.

The second component of the model, that of providing feedback on the performance of the task by experienced nurses, was designed to assist the student to evaluate his own performance in a given situation, and across the full range of situations, to increase his skill in attaining problem formulation outcomes similar to those of the experienced nurses. Two types of feedback were employed in this experiment: (1) feedback on the outcomes of nurses' problem formulation activity and (2) feedback on the processes by which the nurses arrived at these outcomes. Both types of feedback are based on data obtained from a sample of experienced nurses who participated in viewing the simulated situations. The first type of feedback presented, in written form, the tentative problem formulations (and cues associated with each) generated by the experienced nurses. This type of feedback, therefore, was an outcome feedback and was designed to indicate both the commonalities and the range of diversity which were found in the problem formulations produced by the experienced nurses. The second type of feedback consisted of an audiotape recording that was superimposed on a silent version of the videotape. In this feedback the nurse "thought aloud" her mental processes as she interacted with the patient. The purpose of this "process" feedback was to provide the student with a simulated portrayal of the predominant cognitive processes used by the experienced nurses.

The feedback employed in this study had several characteristic features that distinguished it from most traditional types of feedback. First, the use of "process" feedback differed from the behaviorist perception of feedback, which has traditionally been outcome-based feedback. Second, the type of outcome feedback was closer to what has been termed "cognitive" feedback (Hammond & Summers, 1972) than to the classical types of outcome feedback used in learning experiments or programmed instruction. A major feature of the feedback was that it did not provide the student with a single "correct" model of either outcomes or proceses. Rather it indicated both the convergent and the divergent aspects of the performance of experienced nurses. This was thought to be congruent with the usual type of clinical problems to which nurses are continually exposed; i.e., ill-defined problems having the potential for diverse outcomes. Thus, in using the feedback to evaluate his own performance, the student would engage in a series of relatively complex cognitive activities, including examining, synthesizing, and drawing inferences from the sample of the performance of experienced nurses.

Design of the study. The study involved both a developmental and an experimental phase. The developmental phase consisted of: (1) production of the set of videotapes depicting nurse-patient encounters, and (2) collection of data on problem formulation outcomes and processes from a sample of nine experienced nurses. These data were then used as a basis for the development of the instructional model and evaluation materials employed in the experimental phase of the study.

The second phase of the study consisted of field experiment involving 41 freshmen nursing students, randomly assigned to three conditions:

Treatment I	Instructional model with outcome feedback; Posttest
Treatment II	Instructional model with outcome and process feedback; Posttest
Control	Posttest

Both treatment conditions involved application of the simulations plus feedback. The conditions differed, however, with respect to the feedback provided. In Treatment I, the subject was provided with outcome feedback only, while in Treatment II, the subject received both outcome and process feedback. The control group participated in the posttest only.

In designing the experiment there were a number of researchable questions of potential interest with respect to the instructional model. In the interests of time and availability of subjects, not all of the questions could be investigated. For instance, is the instructional model more effective when used in group discussions or indivdually? Would the model be more effective on nursing students at a different level? What would be the difference in problem-solving ability if a group were to receive the instruction without feedback? In choosing the particular treatment conditions, it was decided to replicate the instructional model employed by Allal (1974) in her study of problem solving. By replicating the study, the results could be used for comparison with Allal's work and for contributing to the body of knowledge in educational psychology relative to this particular type of instructional approach. In her discussion of the use of this experimental approach, Allal cited three research priorities: (1) to determine the effectiveness of the best instructional package one can devise, as compared to the results already obtained from other research in medical problem solving (see Elstein, Shulman, & Sprafka, 1978); (2) to investigate those manipulations of the package likely to have the greatest educational relevance; and (3) to determine the effects of separate components in the package (1974, p.13).

The following format has been used in writing the results of this study. In Chapter 2, a review of the relevant research is discussed. Included in this chapter is a synopsis of the research on problem-solving underpinning the theory for this study. Also included in this chapter is a review of the nursing research examining the problem-solving activities of nurses. Finally, the literature in educational psychology that supports the development of the instructional strategy is summarized.

In Chapter 3, the methodology of the research is discussed. This chapter includes the following: production of the set of videotapes, collection of the data from the experienced nurses, and an in-depth presentation of the design of the experiment.

In Chapter 4, the results of the developmental phase of the study are presented. This includes an analysis and discussion of the data obtained from the experienced nurses.

In Chapter 5 the results of the experiment are presented. This includes an analysis of the results of the tests of the experimental hypotheses and supplemental analysis of the data.

Finally, in Chapter 6 the conclusions and implications of the experiment are discussed and summarized. Included in this chapter are the implications for future research and suggestions for the educational applications of the instructional strategy.

CHAPTER 2

REVIEW OF THE LITERATURE

In this chapter, three areas of research are reviewed. The first section of the chapter pertains to the information processing theory of problem solving, which forms the conceptual framework for this study. The second section consists of a literature review of those studies investigating the nature and teaching of problem solving in nursing. The third section consists of a review of the research underpinning the development of the instructional strategy.

Information Processing Theory of Problem Solving

In this theory, man, as a problem solver, is viewed as an information processor (Newell & Simon, 1972). His information processing system consists of the following: receptors, or sensory apparati that perceive cues in the environment; memory, which is capable of storing and retaining symbol structures; a processor, which consists of (1) a set of elementary information processes (eip's) or methods of problem solving, (2) a short-term memory (STM) that holds the input and output symbol structures of the eip's, and (3) an interpreter that determines the sequence of eip's to be executed; and effectors, which are the behaviors that reflect the outcome of the problem-solving process.

According to this theory, problem solving begins when the person is confronted with a problematic situation, in which a desired object exists, but the person does not know immediately what series of actions he can perform to get to the solution. The desired object may be tangible or abstract. It may be physical or a set of symbols. The environment in which the problem is situated is called the task environment. How the individual represents the problem internally is called the problem space, which consists of encoding the problem components, ". . . defining goals, rules, and other aspects of the situation--in some kind of space that represents the initial situation presented to him, the desired goal situation, various intermediate states, . . . as well as any concepts he uses to describe these situations to himself" (Newell & Simon, 1972, p. 59). The actions involved in obtaining the desired object may be physical, perceptual (e.g., looking, listening), or purely mental. However, the crucial activities in human problem solving of any complexity are symbol-manipulating activities that take place within the STM.

In proposing this theory of problem solving, Newell and Simon emphasize the importance of these two aspects of the problem solving process; i.e., the task environment and the problem space. The structure of the task environment determines the possible structures of the problem space. In turn, the structure of the problem space determines the possible programs that can be used for problem solving (pp. 788-789). Problem solving can be effective only if significant and relevant information about the environment is encoded in the problem space.

Encoding information about the environment is part of problem solving. How information is encoded, retrieved and used is dependent upon its storage in the LTM and the manner in which it is processed in the STM. The STM consists of bits of information from the sensory experience and from the memory that are in a person's awareness at any particular time. Miller's (1956) research indicates that humans can hold simultaneously only 7±2 items of information in the STM. How the problem space is developed is dependent upon several factors, which include attention to cues, the availability and allocation of processing resources, and knowledge in the relevant domains or the content area in which the problems are to be solved.

Knowledge of the relevant domains is one aspect that research has shown to be a factor in determining quality of problem solving. DeGroot (1965) found that chess grand masters were not distinguishable from weaker players in planning further ahead or in knowing proper moves. The only differences he could identify were in memory and perception, since chess skill depends in large part upon ". . . a vast organized long-term memory of specific information about chess board patterns. . . . Hence, the overriding factor in chess skill is practice" (Chase & Simon, 1973, p. 279). Similar results were obtained in studies of diagnostic problem solving in medicine and nursing (Broderick & Ammentorp, 1979; Elstein, Shulman, & Sprafka, 1978). In both of these studies, the most important distinguishing variable in diagnostic problem solving was found to be experience or practice, which is thought to increase in the LTM the linkages of relations among symbol structures and the consolidation of cues into larger symbol structures called chunks.

In addition to experience, other variables which affect problem solving include attention to information and energy for processing resources. Attention to environmental information is limited and selective. Therefore, the amount of information that enters into the short-term memory is dependent upon what the person perceives. Second, processing resources require energy to hold items in the STM and to enter and retrieve from the LTM. If more than 7+2 items are to be stored in the STM, research indicates that some items will be lost. Allal (1974) found that physicians never exceeded the number 7+2 when developing functional problem spaces in diagnostic exercises.

To reach a solution, the individual must process information in the problem space. Various theorists have proposed explanations of the actual processing of the information to achieve solution. Newell and Simon (1972) argue that humans process nonmathematical information primarily with the use of heuristics or rules of thumb. These are selective or restricted solution methods which serve to reduce cognitive strain. Some heuristics commonly employed include: (1) the creation of a simplified problem space by ignoring some of the information; (2) means-end analysis or the process of testing for the difference between what currently exists and what is desired; and (3) working backward from the desired state toward the existing state. Allal (1974) found that physicians performing diagnostic exercises did not adhere to a specific initial routine when first confronted with a problematic situation, but that task environment variables determined the approaches they initially employed. Gordon (1972) found that nurses typically employ multiple hypothesis scanning strategies in the initial phases of problem-solving situations.

Hypothesis generation occurs in the problem space within the STM. Allal (1974) found that physicians performing diagnostic exercises developed functional problem spaces that contained one or more of the following features: (1) hierarchical organization; (2) competing formulations: (3) multiple subspaces; and (4) functional relationships. Each of these features is described as follows:

1. Hierarchical organization. A set of problem formulations may include formulations organized in a general-to-specific hierarchy pertaining to a particular diagnostic category. A hierarchical organization indicates the degree to which the problem space is elaborated on a vertical dimension and may serve a dual purpose. By storing problems in a vertical fashion, there is more parsimonious use of space in the problem space. In her research, Allal (1974) found that physicians use this feature a high proportion of the time in their functional problem spaces.

2. Competing formulations. A set of initial problem formulations may include those that attempt to alternatively explain some group of signs or symptoms. Allal (1974) found that physicians use this feature consistently in their problem spaces when performing diagnostic exercises.

3. Multiple subspaces. A set of initial problem formulations may include subsets of formulations that

pertain to different diagnostic categories. Each such category designates a subspace within the functional problem space. In her research, Allal (1974) found that physicians use this feature, but not consistently across all diagnostic exercises. Rather, task environment variables seem to determine when this feature is used.

4. Functional relationships. A set of problem formulations may include relationships hypothesized to exist among certain problem formulations. In her study, Allal (1974) found that this feature was more likely to be absent from the set of problem formulations than any of the other three features. Allal concluded that the use of this feature was somewhat dependent upon the individual problem solver and also somewhat dependent upon the task environment.

In summary, the theory underpinning the instructional strategy developed in this study is the information-processing theory of problem solving. It states that the human problem solver can be viewed as an information processor, who gathers input from the environment in which a problem is presented (task environment). This problem is internalized as a problem space. The problem solver uses various elementary information processes to process the information in the STM. It is within the STM that tentative hypotheses toward solution of the problem are generated. The generation of solutions seems to be heuristic in nature. All problem solvers use the same internal processes. Those factors that seem to differentiate expert problem-solvers from novices are: (1) the ability to attend to cues in the environment; (2) the amount of relevant knowledge stored in the LTM; (3) the associative linkages between these chunks of knowledge; and (4) the availability and allocation of processing resources. Knowledge skills and memory storage are directly related to the experience of the individual as a problem solver in the content area of the problem to be solved.

Implications for research in nursing education

Using information processing as the theory underpinning the teaching of problem-solving in nursing nurse educators might determine how instructional design could be used to enhance each of the structures in the information-processing paradigm. Resnick and Glaser (1976) argue that the potential of an individual as a problem solver is a function of three things: (1) competence in task-specific subskills which are needed to solve the problem; (2) general strategies of information-processing such as problem detection, memory search methods, and analysis of the components of the problem; and (3) the features of the particular task environment Therefore to improve the ability of the person as a problem solver one would seek to accomplish three things: (1) to increase competence in the task-specific subskills necessary to solve the problem (2) to teach general strategies of information processing, and (3) to promote the individual's ability to perceive cues in the task environment.

Task-specific subskills include the body of knowledge needed to solve problems in a particular domain. The importance of possessing this body of knowledge cannot be underestimated. Ausubel, Novak, and Hanesian state that ". . . the availability in cognitive structure of concepts and principles that are relevant to the particular problem at hand is one of the most important variables influencing problem-solving outcomes" (1968, p. 565). The body of knowledge in nursing includes not only nursing theory and skills but also concepts and principles related to disease, pharmacology nutrition, and the social and natural sciences. This body of knowledge, stored in the LTM, provides the framework for the task-specific subskills critical to problem solving in nursing. Increasing the body of content knowledge has always been a major goal of the nursing curriculum.

If task-specific subskills are fundamental for problem solving, learning how to problem-solve could be additionally facilitated by teaching information-processing strategies. These include problem detection, analysis of the components of the problem, and memory search methods. Problem detection and analysis involve locating, encoding, and retrieval of cues and generating hypotheses or forming the problem space. Newell and Simon (1972) argue that expert problem solvers use specific heuristics in the problem-solving process depending upon the task environment. Farnham-Diggory writes that educators can teach heuristics by teaching ". . . students how to use the heuristic processes of experts , and we can teach them this by letting them begin with their own inexpert heuristic systems and then educating the systems" (1972, p. 83). Allal (1974) found that the ability of medical students to formulate problems was significantly increased when the students were provided with feedback based on the outcomes of diagnostic exercises performed by experienced physicians.

Finally, the potential of an individual as a problem solver is also a function of the features of the particular task environment. Newell and Simon (1972) postulate that the task environment is the major determinant of the problem space. In everyday situations educators cannot manipulate the task environment. However, in educational settings, the task environment could be manipulated so that all students could be exposed to the same task environment--for example, by simulation.

In summary, the implications for educational research point to designing instructional strategies to enhance problem-solving skills by teaching students to improve their task-specific subskills, to sharpen their perception of the task environment, and to learn general strategies of information processing.

Review of Research in Problem Solving in Nursing

One of the first studies investigating problem solving was conducted by Kelly and Hammond (1964), who found that nurses were able to make decisions about patient states from written descriptions of patient situations, even though the working environment is probabilistic and uncertain. They also found that the information transmitted by a single cue is negligible and that nurses find utilization of textbook patterns of cues inappropriate (the researchers were unable to determine how nurses represent cues in memory). Finally, Kelly and Hammond found that nurses have their own unique inference systems and that they are highly consistent in their use of these systems. This last finding is compatible with the theoretical assumption that the problem space is determined primarily by the task environment.

Two other studies investigating problem-solving behaviors of nurses and nursing students were conducted by Verhonick, Nichols, Glor, and McCarthy (1968) and Nichols (1968). In these studies, the subjects were shown filmed simulations of patient situations and were asked to relate what they saw and to state what action they would take. The investigators found that the subjects were able to identify cues from the simulations and to state what actions they would take. Generally speaking, the number of reported therapeutic actions and cues identified increased with educational preparation and experience, but all levels of nurses and students were able to select appropriate cues and state therapeutic actions. Although cognitive processes were not investigated, it could be inferred from the nurses' stated actions that they were able to construct some types of hypotheses about the problem situations.

In the above studies, the investigators found no significant differences in the cue identification and action statements made by novice versus experienced nurses. These findings, however, have not been supported by other studies on problem solving. Newell and Simon (1972) indicated that experts are able to observe and process more cues and generate more hypotheses than novices. This assumption formed the basis of a study by Broderick and Ammentorp

(1979), who used simulations to investigate how novices and experts organize initial information in a problem situation and to determine the relationships between emerging information categories or concepts and problem solving behavior.

Broderick and Ammentorp found that both novices (associate degree nursing students) and experts (associate degree graduate nurses) tended to classify data into similar categories, although the experts' categories contained more depth than those of the novices. The researchers surmised that since the entire sample of subjects agreed as to the structure of the problem data elements, there was a basic intellectual structure of this sample of content matter shared by practitioners and newcomers to the profession. The investigators postulated that, if experts and novices differ in their information processing behaviors, the difference might be in the ways the information is used to arrive at problem solutions, since experts emphasized certain data elements over others, while novices tended to sample many categories indiscriminately. One variable that appeared to differentiate experts from novices was the amount of experience among the experts. This finding supports Newell and Simon's (1972) assumption that practice in specific problems creates better problem solvers.

Experience in working with certain types of patients may promote hypothesis generation about patient states prior to encounter with patients. Kraus (1976) investigated the effects of giving certain information to nurses prior to their encounter with patients in simulated situations. She found that preinformation influenced the nurses to direct their observations toward patient characteristics which were associated with the patient state each nurse received in the preinformation. Her findings indicated that nurses may develop tentative hypotheses about patients very early in their relationship with patients. These tentative hypotheses may be developed on the basis of certain contextual and/or state attributes available to nurses prior to their contact with patients. The tentative hypotheses may consequently provide structure to the manner in which the nurses encode cues presented by patients. An unfortunate side effect of this early hypothesis generation would be premature closure. The nurses' observations might become too biased in favor of their initial hypotheses that they would fail to interpret cues indicating other states of the patient.

Gordon (1972) investigated types of hypothesis-testing strategies and cues used by nurses as they attempt to reach a solution about the states of patients. She found that nurses systematically used both multiple and single hypothesis testing strategies as they sought to identify problems in written simulations. In the early stages of problem identification, nurses favored multiple hypotheses using historical state data (i.e. baseline information) about the patient. As they approached solution, they tended to switch to single hypothesis testing and current state data to identify the patient's problem state.

In discussing the implications of her research on nursing education, Gordon suggested that different concepts may have different heuristic rules of attainment. "For example, it may be that the rule for atelectasis [one of the patient states in the study] is 'obtain historical information of the patient's previous behavior and his current respiratory status,' whereas in hemorrhagic shock the rule may be 'assess current physiological variables.' If the teacher examines concepts from this perspective, the student's attention could be directed to the type of information to be collected, as well as to the specific cues. This may give an organizing framework for both concept utilization and memory retrieval" (p. 204). Based upon this belief, instructional methods ". . . to promote student's learning of strategies will have to be developed" (p. 205).

Frederickson and Mayer (1975) also investigated the problem solving behaviors of two groups of graduating student nurses. The investigators developed a problem-solving paradigm, which operationalized problem solving into four phases: (1) definition of the problem; (2) collection of data; (3) postulation of solutions; and (4) solution evaluation. The researchers found that there were no generalizable patterns of problem solving. For the most part, subjects did not use the same pattern in each of the three filmed simulations. Most of the subjects employed the first three steps of the problem-solving process, but few used the fourth step (evaluation) in any of the simulations. In addition, use of the four steps did not occur in any specific order, and consequently, the researchers were unable to determine if a systematic process of problem-solving could be identified. In the same manner, the researchers found that the subjects related nonspecific rationales for their decisions and that the rationales depended upon the type of patient and the situation depicted in the simulation. What Frederickson and Mayer may have failed to consider were the task environment variables for each of the patient situations. Since the task environment determines the problem space, the heuristics employed to reach solution may have varied in each simulation due to this and not to individual variables.

Tanner (1977) designed an instructional strategy that sought to teach novices how to store and retrieve information. She based her instructional design on the research indicating that storage of knowledge in the LTM is facilitated by chunking, i.e., consolidating multiple cues under diagnostic labels. To increase the subjects' abilities in forming linkages between chunks, she developed an instructional method that presented new information by cues (signs and symptoms) rather than in diagnostic categories. The instructional strategy also was designed to facilitate cue linkage from disease to disease. She hypothesized that if the instructional method taught strategies of early hypothesis generation and systematic hypothesis testing by developing cue linkages, it would improve nursing students' storage in the long-term memory and thus improve their diagnostic abilities and subsequent patient care management decisions.

In evaluating her results, Tanner found that there was no significant increase in the subject's ability to generate multiple hypotheses regarding diagnosis. In addition, she found that there was a moderately low relationship between the number of early hypotheses and diagnostic accuracy. Tanner suggested that the research hypotheses may not have been confirmed due to scoring considerations. However, she also indicated that the primary reason for students' not gaining diagnostic accuracy was that unless a correct diagnosis was present in the initial set of diagnostic formulations, subjects were unable to gain accuracy as their search continued.

Tanner's research clearly used information processing as the framework for her research. Her failure to find significant results may also have been due to methodological considerations in the development of her instructional materials. She based her materials on developing cue linkages, which should have fostered associative retrieval patterns in the diagnostic search process. However, in the development of her materials, she did not analyze the hypothesis generation strategies of experienced nurses. Consequently, she may not have fostered the learning of cue linkages used by experienced nurses.

In summary, this section has reviewed several studies investigating the nature of problem solving in nursing. These studies have found that nurses are able to develop tentative hypotheses about patient states based on probabilistic and incomplete information (Kelly & Hammond, 1964, and Kraus, 1976). Nurses do not usually depend on single, isolated cues to arrive at tentative hypotheses, but rather a cluster of cues that may indicate one or more states of the patient (Broderick & Ammentorp, 1979; Gordon, 1972; and Kelly & Hammond, 1968). All of the studies reviewed found that the nature of the information determines the types of hypotheses generated. Gordon (1972) found that, in the process of arriving at solutions to problems, nurses may employ a variety of hypothesis-scanning strategies, probably using multiple hypothesis-testing strategies early in the process and switching to a single hypothesis testing as they approach solution.

The studies have found various results relative to the effect of experience and education upon the ability to generate hypotheses In one study, nurses with 13-18 years of experience were able to list more observations (Verhonick, Nichols, Glor, & McCarthy, 1968). The number of observations decreased, however, in subjects with more than 18 years of experience. Nurses with more education were generally able to list more observations than those with less education. In a related study, Nichols (1968) found that student nurses made similar numbers and proportions of observations to experienced nurses. These results were not completely substantiated by Broderick and Ammentorp (1979), who found that while novices and experts alike asked for the same types of data, the experienced nurses used more pertinent information than novices in arriving at solutions.

Frederickson and Mayer (1975) found that most subjects failed to "think through" each problem in a logical progression.

These studies have shown fairly consistently that nurses are able to make decisions based on various types of data from the patient and his environment. In addition, these studies have indicated that novices learn early how to gather cues and make inferences based on the cues.

The results have not consistently shown that there is a difference in the inference systems between novices and experts. However, cognitive theorists have found in other problem-solving studies that experts are able to solve problems more quickly and accurately than novices. If there is a difference in abilities between novices and experts, it may be in how clinical data are stored and retrieved in the LTM. None of the studies reviewed investigated memory storage and retrieval among experienced nurses, although Tanner's study was based on the assumption that nurses form chunks of knowledge in their LTM's and depend on cue linkages for associative retrieval. Perhaps one reason why Tanner's study may have failed to show significant results was that she did not investigate the nature of the nurses' problem-solving processes. If it could be determined how cues are stored and retrieved, more information would be available relative to the heuristics applicable for various patient problems. Thus, an instructional strategy could be developed to teach novices how the experts store and retrieve information.

Development of the Instructional Strategy

In this section the following issues in teaching problem solving will be addressed: (1) application of simulations, (2) use of experts, and (3) provision of feedback as instructional tools.

Simulations

In this study, problem solving was investigated by using experts to examine simulated patient situations. Subsequent analysis of the experts' use of cues and tentative hypothesis formation led to the development of the instructional strategy. In the experimental phase of the study, the same simulations were administered to the subjects. This section addresses the use of simulations as an instructional strategy.

Simulation consists of placing an individual in a realistic setting where he is confronted by a problematic situation that requires his active participation in initiating and carrying through a sequence of activities. Several modalities have been used in nursing education: a paper-and-pencil format employing latent images for feedback

(Kissinger & Munjas, 1981), slides and films (Curtis & Rothert, 1972), and role playing (DeTornyay, 1971).

McGuire (1976) lists several advantages to the use of simulations. First, they can be designed to closely approximate real-life situations. The use of authentic-appearing documents such as nurses' notes adds a certain measure of realism that cannot be gleaned from textbooks. Second, simulation makes it possible to predetermine precisely the tasks students will be required to perform. Consequently, extraneous variables can be controlled so that the student focuses precisely on the elements of primary concern. Third, simulation permits standardization of the task so that all students are exposed to the same situation, an occurrence that rarely happens in the clinical setting. Finally, one of the most important advantages to simulation is that students can be allowed full responsibility to make decisions without fear of causing injury to their patients.

Some simulation formats offer more fidelity to real life than others. For this experiment, it was decided to use videotaped simulations. Videotaped scenarios allow the student to examine both the verbal and nonverbal behaviors of the patient. These are skills that are essential to the development of tentative problem formulations (Aspinall & Tanner, 1981; LaMonica, 1979; Yura & Walsh, 1978).

Therefore, this type of high-fidelity simulation would enable the student to sharpen his skills of observation to detect cues.

However, high-fidelity simulations are not without their disadvantages. Elstein, Shulman, and Sprafka (1978) list two. First, simulations provide a wealth of data. Consequently, other variables such as interpersonal (i.e. communicative techniques) and psychomotor behaviors (i.e., routine technical skills) of the nurse in the simulation could be examined in addition to cognitive skills. All of this information could act as a distractor for the novice problem solver. To achieve a focus solely on cognitive issues, in this study the nurse is seen minimally or not at all. This in itself creates a somewhat artificial situation. The second disadvantage pertains to the areas of generalizability and content validity. It could be argued that the six videotaped simulations are not representative and consequently not generalizable to the universe of inpatient situations that pose problems for nurses. However, the use of small samples of problems has precedents in psychological research. Newell and Simon's theory was posited after carefully analyzing the introspective thought processes of a selected few individuals. Content validity remains a chief concern. In this study, content validity was achieved by adhering to common inpatient situations and consulting with a group of experienced nurses for the development of the simulations.

Experts

In their study of problem solving using the information-processing approach to cognition, Newell and Simon (1972) investigated the problem-solving techniques of experts. Their approach was based on the assumption that well-defined sets of cognitive operators underlie the observed problem-solving behavior of experts and that these operations can be discovered by analysis of expert use of information in problem environments and by expert reports of problem-solving behavior. DeGroot (1956) extensively studied the problem solving characteristics of master chess players to determine the cognitive processes underlying their problem-solving behaviors. Thus, the use of experts is consistent with previous descriptive studies in problem solving using the information-processing theory of cognition.

Feedback component

In developing the simulations, the intent was to present a problematic situation that could generate in the subject several hypotheses. There was no right or wrong answer to each simulation. Consequently, the type of feedback developed could not determine if the subjects in the experimental phase were "right" or "wrong." The feedback was based upon the data collected from the sample of experienced nurses who viewed the videotapes and carried out the basic tasks of cue utilization and tentative problem formulation. Since one of the goals of the project was to enhance problem-solving skills, the data collected from the nurses were of two types: outcomes from the basic task and processes used to determine outcomes. Both types of feedback were incorporated into the experimental conditions.

The use of process feedback is relatively new in teaching problem solving. Hammond and Summers (1972) conducted a number of experiments in which they found that the classical type of outcome feedback (i.e., telling a subject if he was right or wrong) was an impediment to improving the subject's performance on complex tasks in which the subject was asked to apply cognitive skills. An alternative approach to feedback, one that contributed to the subject's ability to exercise control over cognitive skills, consisted of providing the subject with the rationale for correct and incorrect answers. This type of feedback enabled the subject to compare the properties of his cognitive system with the properties of the task system with which he was trying to cope. Consequently, he could gain more cognitive control over the task.

The outcome feedback used in this study included not only the problems formulated by the experienced nurses but also a list of cues they considered to be relevant to each formulation. The first objective of this feedback enabled the subject to evaluate the appropriateness of his outcomes (by comparing his results with those of experienced nurses). The second objective enabled the subject to discover some of the reasons why his outcomes deviated or coincided with the nurses (by providing him with a list of cues). Thus, this type of outcome feedback was closer to the cognitive feedback described by Hammond and Summers than to the classical outcome feedback used in other types of instruction (e.g., programmed instruction).

Also a type of cognitive feedback, the process feedback used in this study was intended to further assist the subject in determining why his outcomes coincided or deviated from those of the experienced nurses. These materials were developed according to a protocol used by Allal (1974). They attempted to portray the types of information processing activities that were conducted in the nurses' minds while they performed each simulated activity. Therefore, the feedback enabled the subject to compare his thought processes with those of the experienced nurses.

In summary, this section reviewed some of the theoretical issues underpinning the development of the instructional strategy. High-fidelity simulations were developed and placed on videotape. As instructional tools, simulations immerse subjects in hypothetical but realistic situations. They provide uniformity across subjects and can be used without fear of danger to the patient. However, because they are simulations, there is an element of gaming to which subjects may react less seriously than in the real situation. In addition, a simulation is just that; it cannot provide with complete fidelity a real situation.

The simulations were administered to experienced nurses, who were selected for their expertise in clinical situations. Experts have formed the basis for experimental approaches in the information-processing mode of cognitive psychology. It is assumed that the experts possess well-developed mechanisms to process and retrieve information from their long-term memories and to develop hypotheses from these processes and structures held in memory.

The tentative hypotheses and cues utilized in developing them provided the basis for the type of feedback given to the subjects in the experimental phases. Two types of feedback were employed: outcome feedback, which provided subjects with the tentative hypotheses developed and cues used by the experienced nurses, and process feedback, which provided subjects with information relative to the cognitive mechanisms employed by the experienced nurses as they attempted to solve the problems. Providing feedback was described as a method to permit the subjects to achieve cognitive control over the task.

CHAPTER 3

METHOD

This chapter consists of three sections, each describing portions of the methodology used in this study. The sections are as follows: (1) production of the videotapes used in developing the simulation exercises, (2) collection of the problem-solving data from the experienced nurses, and (3) design of the experiment conducted with second-semester freshmen nursing students.

Production of the videotapes

The first part of the project involved production of the videotapes representing simulated patient situations. The videotaped simulations were then used in the next two phases of the project, which were: (1) the developmental phase consisting of the construction of the instructional strategy based on data obtained from the sample of experienced nurses who performed the videotaped simulation exercises and (2) the experimental phase consisting of the administration of the instructional strategy to the sample of freshmen nursing students.

Before production of the videotapes began, two criteria had to be considered. First, although the situations were to depict nurse-patient encounters, the primary focus had to be placed on the patient, since the students were to direct their observations on the behavior of the patient, not of the nurse. Thus, situations had to be developed in which the actual physical contact of patient and nurse was minimal. Second, the situations had to present sufficient data to generate multiple hypotheses, yet the data had to be within the knowledge realm of the students. To accomplish this, the curriculum was analyzed for theoretical content and patient behaviors with which the students would be familiar at this level. These content areas included simple alterations in the basic needs for fluid and electrolyte balance, nutrition, elimination, rest and activity, comfort, safety, and security. Selected patient behaviors were anxiety, refusal to comply to treatment, grief and mourning, thirst, chills, coughing, pain, epigastric distress, inappropriate movements, and alterations in levels of alertness and orientation.

With these criteria in mind, five registered nurses volunteered to assist in generating ideas and developing the scenarios for the simulations. These nurses were selected on the basis of their being employed in a service setting as staff nurses working with adult patients. Two of the nurses had bachelor's degrees in nursing. Three had earned associate degrees in nursing in addition to other postsecondary education. The number of years of experience as registered nurses for this group ranged from 1.5 to 4 years.

As a result of the ideas generated from these nurses, six videotapes were produced according to the following procedure. For each tape, a case outline was developed, consisting of the following: (1) written information to accompany each tape, (2) nonverbal cues to be represented by the patient, and (3) a description of the verbal dialogue (Appendix A). Table 3.1 contains a list of each videotape, according to selected demographic characteristics of the simulated patient and the primary problem-producing patient behavior.

Table 3.1: Title and Primary Problem in Each Videotape

Number	Title	Problem Behavior
1	A 55-year-old insurance salesman	cannot remember name of operation
2	A 65-year-old retired librarian	refuses to take medication
3	A 50-year-old high school teacher	experiences chest pain
4	A 70-year-old retired engineer	waving arms in air
5	A 67-year-old retired teacher	difficult to wake up
6	A 32-year-old homemaker	temperature of 103^{o}

Following the development of the case outlines, six people were asked to portray the patients. All but two had had some type of amateur acting experience. Four of the five nurses who assisted in developing the case outlines portrayed the nurses in the simulations. For each situation, scripts were developed and used as guides for the simulations. In an attempt to preserve naturalness of the the simulations, the actors and nurses were encouraged to generate their own conversations. The actors were guided by the overall description of the nature of the behaviors to be portrayed.

The nurses and actors met the week prior to the taping sessions to rehearse their simulations. Videotaping of the simulations was conducted in the campus laboratory of the department of nursing in which the investigator is a faculty member. The taping was accomplished with the assistance of the personnel in the Department of Mass Communications at the same university.

Each videotape began by showing the patient engaged in some type of activity. For example, in Situation 1, the patient was seen entering the hospital room, cigar clenched between his teeth, a suitcase in one hand, and a briefcase in the other hand. He threw his briefcase onto the chair and set his cigar on the edge of the bedside stand. After dropping his suitcase onto the bed, he took out his shaving kit and a magazine, checked out the water pitcher, and picked up the telephone. At that point the nurse initiated a dialogue with the patient. During the interview, the patient disclosed that he was about to have an operation on his neck. He stated that he was not sure of the name of the operation. The nurse-patient interview proceeded with the patient's nonverbal behavior indicating characteristics of anxiety and fear (rubbing hands through hair, slicing across his neck, etc.) and his verbal statements reflecting denial or lack of knowledge ("I don't know the name of the operation," and "The doctor says I have a lump. . . I can't feel it.").

The completed videotaped simulations ranged in length from 30 seconds to 4 min 4 sec. Since the videotape was only a portion of the entire simulation (which also included the written materials), the variations in length were not considered to be critical. What was considered to be most important was that there was sufficient opportunity for the subjects to be exposed to the patient's verbal and nonverbal behaviors characterizing the problem situation.

After the videotapes were produced and the written materials developed, the written material was reviewed and critiqued by two nurse educators with master's degrees in nursing. Based on their suggestions, various modifications were made in the materials.

In summary, each videotape portrayed verbal and nonverbal information. Information presented in the verbal mode included statements made by the patient and the nurse and also written background information on the patient situation sheet and various other appropriate documents. The types of nonverbal information included: (1) the physical appearance of the patient (i.e., his build, age, clothes, etc.); (2) indicators of the psychological state of the patient (e.g., his gestures, mannerisms, facial expression, etc.); and (3) nonverbal cues of particular relevance to the patient's alterations in basic needs (e.g., dry, smacking lips; cough; scratching; clutching at the chest, etc.).

Finally, the objectives of the study influenced the development of the videotapes in several ways. First, each tape was intended to provide the subject with opportunity to select cues to use in formulating tentative hypotheses. Consequently, each tape contained many nonverbal and verbal cues. A second intent of the study was to promote development of tentative problem formulations. Each tape provided a brief portrayal of a nurse-patient encounter, on the basis of which the subject was to generate a list of tentative hypotheses which he would want to investigate in greater depth by subsequently gathering more information. The videotapes were deliberately structured so as to incorporate a limited amount of data and thus be relatively ambiguous. Third, since the study dealt with information-processing skills associated with patient problems, the tapes were not designed to focus on the affective, interpersonal aspects of the nurse-patient interaction. In each case, however, the nurse's interaction was designed to be appropriate.

Collection of the Nurse Data

The purpose of this phase of the study was to obtain data on nurse performance to be used in designing the instructional strategy used in the experimental phase of the study. The six videotapes described in the previous section were shown to a group of experienced nurses. For each tape, two types of data were collected: (1) data on the outcome of the nurses' information processing (i.e., the set of problem formulations and the cues associated with each), and (2) data on the processes by which the nurses generated their sets of problem formulations. The following sections describe the sample and method of data collection.

Experienced Nurses

In using data from a group of practitioners in a field as a basis for developing materials to use in educating and evaluating students in that field, it would be desirable to obtain a sample of practitioners with proven expertise. In the present study, the ideal nurse group would be nurses specializing in adult nursing who were known to have outstanding problem-solving skills. Unfortunately, there were no tests or other evaluative criteria available to measure problem-solving skills in practicing nurses. Consequently, it was decided to use nurses who were currently practicing within hospital settings. Since the major criterion was to be known problem-solving ability, this group was obtained primarily by two methods: (1) personal contact with practicing nurses and (2) recommendations by nurse administrators.

Based on these two methods, nine nurses were selected to participate in the developmental phase of the study. All of the nurses were currently practicing in adult nursing. The number of nurses used was believed to be sufficient to accomplish two goals: (1) permit identification of commonalities of problem formulation outcomes and processes and (2) provide an indication of the range of diversity that would be characteristic of practicing nurses. Using small numbers of experts in problem solving is not without precedent in information processing studies (Newell & Simon, 1972). Of course, a larger sample would probably have given more information, but since each session lasted approximately four hours, time constraints limited the number of nurses available for this phase. Demographic data describing the nurse sample are included in Table 3.2.

TABLE 3.2.--Characteristics of the Nurse Sample

n	Highest Degree Held	Current Area of Specialization	Average Number of Years Experience
2	diploma	Coronary Care	6.5
2	bachelor	Coronary Care	7.0
2	associate	Medical-Surgical	4.25
2	bachelor	Medical-Surgical	7.0
1	bachelor	Intensive Care	7.0

Materials

Two types of materials were used in collecting the nurse data. These were the Tentative Problem Formulation and Summarizing Assessment response sheets and a Process Checklist.

The response sheets were used by the nurses to record their tentative problem formulations and summarizing assessments generated after viewing each videotape (Appendix B). The nurses were directed to use one sheet for each tentative problem, to label the problem, and to list the cues they used in arriving at that problem formulation. After completion of this portion of the exercise, they were asked to write a summarizing assessment on the sheet so named. While doing this part of the task, they were instructed to list the problems in order of their priority with data supporting their decisions.

In addition to filling out the response sheets, the nurses were given the Process Checklist to complete. This checklist was developed from Allal (1974) and from the contributions of two master's prepared nurses who critiqued the material. It consisted of 29 items (Appendix C) pertaining to four aspects of the act of generating problem formulations: (1) modes of mental representation; (2) strategies of problem formulation, including initial routines and general strategies; (3) associative processes of problem formulation; and (4) cue utilization. The classification of checklist items according to these categories is listed in Table 4.4.

Procedure

Data from the experienced nurses were collected in individual sessions. Guidelines for completing the response sheets and a hypothetical situation are contained in the first section of Appendix D. For each videotape, the same procedure was executed as follows.

Collection of the outcome data. These four steps were taken for each nurse:

1. The subject was first shown the written information pertaining to each videotape (a sample situation is found Appendix E). She was then asked to comment on any tentative problem formulations she might consider based on what she had read. She was asked to relate why she had developed these formulations. Her comments were tape recorded.

2. The subject was then shown the initial segment of each videotape. The subject was asked to comment on her initial impressions of the patient and to state any additional problems the patient might have or to revise her initial problem formulations. If there were any additions or revisions, each subject was asked to explain what led her to make these. Again, her comments were tape recorded.

3. The entire videotape was shown. A subject could elect to view the videotape again if necessary. Once the subject had seen the tape, she was asked to fill out a response sheet for each problem she had formulated.

4. The subject was then asked to write a summarizing assessment of the simulation. In this exercise, she was asked to complete the following directions:

In writing your tentative assessment, indicate:

--how well substantiated you consider each of your formulations to be, based on the data obtained;

--which of the tentative problems is(are) the most important in your own mind

Collection of the process data. The following steps were taken to collect the data pertaining to the ongoing information processing activities as the nurses completed the exercises.

1. The subject was asked to reconstruct her thinking while viewing each videotape, including when she first began to formulate the tentative problems, the cues that she considered to be significant, and any revisions in her initial formulations as the videotape progressed. Her comments were tape recorded.

2. The Process Checklist was administered. After the checklist was completed, it was reviewed and clarified if necessary. The subject's responses were tape recorded.

Although the checklist was administered after each simulation, it was believed that the length of the list and the number of activities that intervened between each administration of the list were sufficient to minimize any effect that exposure to the checklist might have had on subsequent problem formulation activities.

Analysis

There were two purposes for analyzing these data. The primary purpose was to obtain information to develop the two components of the experimental phase: (1) the design of the feedback materials on outcomes and processes and (2) the dependent variable scoring keys used to evaluate student performance on the posttest. Analysis of the nurse data was also conducted to specify the nature of the problem formulation phase in these simulation exercises. The results obtained from this small sample were compared to those obtained from other studies of problem solving in nursing. This analysis was designed to address two questions: (1) what is the structure of a set of tentative problem formulations; and (2) what information processing activities are involved in the generation of tentative problem formulations?

In summary, a sample of experienced nurses was selected to participate in the developmental phase of the study. The data obtained from these nurses were used for two purposes: (1) to develop the feedback for the instructional component of the experimental phase and dependent variable scoring keys of the posttest, and (2) to compare the results of the information processing activities of these experienced nurses with results of previous studies of problem-solving in nursing. A description of the methods of analysis, including a discussion of the results pertaining to each of these questions, is presented in Chapter 4.

The Experimental Phase

Population and Sample

The sample included volunteer freshmen nursing students enrolled in the first clinical nursing course of an associate degree curriculum. The setting was a traditionally black public four-year-institution in southeastern Virginia. There were 44 students enrolled in the course at the beginning of the experimental phase. A total of 41 students participated in the study.

Freshmen nursing students were chosen for this study for several reasons. First, content in this course included a description of the steps of the nursing process (the problem-solving approach in nursing). Consequently, the students were familiar with the concepts involved in the basic experimental task. Second, the students had limited experience in clinical situations during the previous nursing course. Since the instructional strategy involved the use of simulations, it was thought that the students would benefit from early exposure to realistic situations without the risks associated with direct patient contact. Third, other simulations, especially of psychomotor tasks, were already used as instructional strategies throughout the nursing curriculum. Thus, students were familiar with the concept. It was thought that simulating patient situations requiring cognitive skills rather than psychomotor skills would underscore the importance of this type of activity in the clinical area.

The list of students enrolled in the first clinical nursing course was obtained and time arranged to introduce the nature of the study to the prospective subjects during the first week of the semester. As an incentive to participate, students were told that they would receive a copy of a manual on nursing diagnosis (Gordon, 1982) upon completion of the experimental phase. It was believed that without some incentive, participation in the study would be minimal. Since the enrollment in the class was 44, all students were asked to participate. Three students were unable to participate, one due to lack of interest and two due to time constraints. Consequently, 41 of 44 (93.2%) students participated in the study.

One other problem existed with the participation of subjects. Not all students were available to participate in the scheduled experimental sessions. However, since the primary mode of teaching was self-instructional, alternative times for these subjects were selected. All of the experimental tasks were completed during a three week period. It was thought that there would be no adverse effect from students not participating at identical time periods.

Although the sample consisted of 41 freshmen nursing students in an associate degree program in Virginia, the real target population of interest extended to all freshmen nursing students in associate degree programs throughout the U.S. In order to generalize the results to this hypothetical target population, it was necessary to take into consideration the characteristics of the sample at the individual and institutional levels.

At the individual level, the sample was compared to several demographic characteristics that were available nationally (Table 3.3). By age the sample closely resembled the national statistics, with the exception of the larger percentage of students in the 19 and below bracket. However, the national sample represented the ages of newly licensed nurses, who would be one year older than the students in the sample. By the time the subjects would take the licensing examination, only one (2.4%) would be 19 or under.

Perhaps the largest difference in demographic descriptors could be found in the racial composition of the sample. Since the program was housed within a traditionally black institution, it was expected that the sample would differ in racial characteristics from the national sample. This difference was believed to be insignificant, however, because of the characteristics of the nursing program, as described below.

In comparison with other nursing programs, there were two primary areas of concern: (1) similarity in curricula and (2) passage rates for the national licensing

Table 3.3.--Selected Characteristics of the Student Sample Compared with National Demographic Data

Characteristic		Sample (%)	National (%)
Age	19 and under	7.3	0.2*
	20-24	29.3	36.0
	25-29	22.0	25.4
	30-34	17.1	17.0
	35-39	14.6	10.4
	40-49	9.8	8.8
	50 and over	0	2.2
Sex	Males	4.9	6.4**
	Females	95.1	93.4
Race	White	29.3	90.95
	Black	58.5	6.73
	Hispanic	2.4	1.55
	American Indian/ Oriental	9.8	0.77

*Data are taken from the NLN Nursing Data Book, 1981 (National League for Nursing, 1982). Age data represent a national sample of newly licensed nurses; therefore, this distribution would represent students approximately one year older than the student sample.

**Data on race and sex represent the Southern region of the U.S. (NLN, 1982).

examination. Regarding the curriculum, the subjects were enrolled in a nationally accredited nursing program that employed a curriculum addressing a common core of science, humanities, and nursing content. Second, the success rate for graduates of the program was comparable to that of associate-degree programs nationally (approximately 85%). Thus, these characteristics were similar to other associate degree programs nationally.

Pilot Testing

The experimental procedure and materials were pilot tested with nine volunteer students from the second-year student population. Second-year students were chosen for several reasons. First, these students had recently completed a course in which the investigator was an instructor. Consequently, the students were available. Second, the students were able to assist over the Christmas break, the time selected for pilot testing.

One problem emerged as a result of using these students. Since they had progressed further in the curriculum, their academic experience was not comparable to that of the target group. During the course of the pilot testing, these students were asked if they believed that they would have benefited from the study nine months previously. All indicated that they believed that the freshmen nursing students would be able to participate.

During the pilot testing, each subject participated in at least one simulation using outcome feedback (Treatment I), one simulation with process and outcome feedback (Treatment II), and the posttest.

The pilot testing served two purposes. First, based on comments made by participants in the pilot study, some items were modified in the instructions and posttest. Second, on the basis of the students' performance, it was believed that the instructional strategy would be appropriate for freshmen nursing students. The students' posttest scores (listed in Table 3.4) indicated that scores on the dependent variables were low enough to ascertain if the instructional strategy could make a difference in treatment group scores.

TABLE 3.4.--Results of the Pilot Test

Subject	PF Score (Max = 36)	CUE score (Max = 75)	CUE-PF Score (Max = 298)
1	12	38	21
2	19	33	46
3	20	54	35
4	20	30	46
5	20	35	39
6	20	29	45
7	12	27	20
8	20	45	51
9	13	42	38

Design

The experimental phase used a posttest control group design, with each subject assigned randomly to one of three experimental conditions as follows:

1. Treatment I: Instructional sequence using outcome feedback; Posttest
2. Treatment II: Instructional sequence using

outcome and process feedback;

Posttest

3. Control: Posttest

Both treatment conditions had a number of features in common. First, both consisted of the same number of experimental sessions. The general format for each session was the same. Second, all experimental subjects carried out the same general tasks, which included reading the written materials, viewing the videotape, and filling out the response sheets to indicate tentative problem formulations and summarizing assessments. Third, the subjects in both conditions were provided with feedback materials developed from the experienced nurse data.

The two experimental conditions differed, however, with respect to the type of feedback provided. Under Treatment I, the feedback materials furnished the subject with outcome feedback only; i.e., problem formulations with respective cues and summarizing assessments made by the nurses. Under Treatment II, the feedback materials not only included outcome feedback, but also process feedback, which portrayed some of the information processing activities the nurses used to arrive at their problem formulations.

The control condition involved the same number of sessions as the experimental conditions. Four of the sessions consisted of videotaped presentations concerning common health problems. The fifth session involved the control subjects in the same basic task as the experimental groups but without the feedback. This was done to familiarize the subjects with the instructional sequence so that any novelty effect of the basic task would be reduced during the posttest. The sixth session consisted of the posttest task.

Experimental procedure. Under both treatment conditions, instruction was conducted in five one-hour sessions, with one simulation presented at each session. The order in which the simulations were presented was the same for both conditions. The simulations progressed in order of complexity by virture of the number of problem formulations generated by the nurses and by virtue of the content involved in each. Under both conditions, the instructional sequence was the same. The posttest session involving the sixth simulation also followed the same procedure as the instructional sessions.

All experimental manipulations were administered by means of individual booklets in self-instructional format. At the beginning of the first instructional session, the booklet provided the subjects with a set of orientation materials designed to acquaint them with the problem formulation task. At each subsequent session, subjects were permitted to review the orientation materials. The session was then conducted using the videotape and self-instructional booklet. Consequently, the role of the investigator was limited to a brief set of preliminary verbal instructions.

As mentioned above, the subjects in the control condition were involved in two sessions using the experimental materials. There were two reasons for doing this. First, since the control group would need orientation materials prior to the posttest, a single session for the posttest would be longer than the experimental conditions' posttest sessions. Thus, the notion of differences in intrasession history would be violated. Second, because of the very nature of the instructional materials, a single exposure to the task might depress the control group's results.

In order to make the posttest sessions identical for all three groups, the control group was involved in an orientation session similar to that administered in the first treatment sessions. In other words, the control group was given an instructional booklet containing an abridged orientation (deleting the sections on feedback) to the instructional materials. Subsequent to reading the orientation materials, the control group participated in the fifth simulation by carrying out the same basic task as the experimental groups without feedback. The second control group session involved the review of orientation materials and the administration of the posttest simulation. Therefore, all three groups experienced identical posttest sessions. The schedule for the experimental sessions is outlined in Table 3.5.

Table 3.5--Schedule for the Experimental Procedure

Week	Treatments I and II	Control
1	Pretest	Pretest
2	Session 1 Orientation Simulation 1	Control session 1
	Session 2 Review of orientation materials Simulation 2	Control session 2
	Session 3 Review of orientation materials Simulation 3	Control session 3
3	Session 4 Review of orientation materials Simulation 4	Control session 4
	Session 5 Review of orientation materials Simulation 5	Control session 5 Orientation Simulation 5
3	Session 6 Review of orientation materials Simulation 6 (Posttest)	Control session 6 Review of orientation materials Simulation 6 (Posttest)
4	Posttest	Posttest

The Problem Formulation Task. For each of the simulations, subjects were confronted with the same basic task. At the beginning of each session, the following instructions were given:

> While performing this exercise, you should generate a set of tentative problem formulations you would want to investigate more thoroughly if you were the nurse in this actual situation.

The subjects then read the patient situation and accompanying written materials. During this phase of the task, subjects were permitted to jot down tentative problem formulations generated solely on the basis of reading the material. They then viewed the videotape twice so that sufficient opportunity was given to look for cues. After viewing the videotape, the subjects recorded tentative problem formulations on the response sheets, one sheet per problem formulation. The subjects concluded the basic task by writing their summarizing assessments.

The Instructional Sequence. Under both treatment conditions, the same instructional sequence was followed. This sequence is summarized below:

Step 1: The subject read the patient situation and other accompanying materials.

Step 2: The subject viewed the videotape twice.

Step 3: The subject recorded his tentative problem formulations on response sheets and wrote his summarizing assessment.

Step 4: The subject was provided with feedback based on the performance of experienced nurses.

a. Treatment I: Outcome Feedback Sheet 1 was presented. The videotape was played again.

   Outcome Feedback Sheet 2 was presented.

b. Treatment II: Outcome Feedback Sheet 1 was presented. Process feedback was administered while the videotape was played again.

   Outcome Feedback Sheet 2 was presented.

Step 5: The subject filled out a self-evaluation checklist.

The first three steps constituted the basic experimental task and were identical for both groups. The only variation occurred in Step 4, which contained the experimental manipulation of feedback. For Treatment I, step 4 consisted of reading Feedback Sheet 1, viewing the videotape a third time, and reading Feedback Sheet 2. Feedback Sheet 1 provided feedback relative to the major problem formulations generated by the majority of the experienced nurses. This feedback enabled the subjects to determine whether they generated problems that experienced nurses considered to be the most important. The subjects in Treatment I also received Feedback Sheet 2 (after viewing the videotape again). This sheet provided the subjects with additional problems formulated by the experienced nurses. It thus gave feedback relative to the range of diversity of outcomes generated by the nurses. In addition, Feedback Sheet 2 contained a second section that recapitulated the comments included in the nurses' summarizing assessments.

For Treatment II, step 4 consisted of the same basic format as Treatment I, with the addition of process feedback. The subjects in Treatment II also read Feedback Sheets 1 and 2. While the subjects viewed the videotape a third time, however, they received process feedback, which consisted of an audiotape recording superimposed over a silent version of the videotape. This audiotape recording consisted of the nurse's voice portraying her thoughts as she approached and interacted with the patient. The monologues were developed from analyzing the information processing activities of the experienced nurses. In these monologues the subjects heard several patterns of thought processes. First, they heard the most important cues used at arriving at problem formulations. Second, they heard representative heuristics the majority of the nurses used to arrive at tentative hypotheses. Third, they listened to the nurse's deliberations related to priorities of hypotheses identified. Table 3.6 summarizes the types of feedback that were given to each treatment condition.

Table 3.6.--Types of Feedback Presented in Two Treatment Conditions

Feedback Materials	Treatment I	Treatment II
Outcome Feedback Sheet 1	PF outcomes	PF outcomes
Process Feedback Tape		PF processes
Outcome Feedback Sheet 2	PF outcomes	PF outcomes

Key: PF = problem formulation

The fifth step of the instructional sequence consisted of the subject's filling out a self-evaluation checklist. This checklist was designed to accomplish two purposes: (1) to ensure that the subject carried out the process of comparing his performance with that of the experienced nurses, and (2) to achieve closure at the completion of the instructional sequence. Hence, this checklist contained two sections. The first listed the problem formulations generated by the experienced nurses. The second instructed the student to rate his outcomes with those of the experienced nurses.

Materials. Each subject received two booklets for the experimental phase, one containing the instructions and feedback materials and the other containing the response sheets and self-evaluation checklists. The instructional and response formats were adopted from Allal (1974).

The instructional materials were divided into six sections, one for orientation and the rest for each simulation. The first section, the introduction, consisted of the following sections: (1) description of the process of developing tentative problem formulations; (2) components of a tentative problem formulation; (3) how to write a summarizing statement; (4) description of the instructional materials, including the patient situation (written materials accompanying each simulation), the videotapes, the response booklet, and feedback materials; (5) a description of each step in the instructional sequence (described above); (6) guidelines for completion of the response sheets; and (7) a hypothetical situation containing sample cues, problem formulation sheets, and a summarizing assessment sheet.

The subsequent five sections of the instructional booklet were identical in format. Each contained itemized instructions for the steps to be followed during the instructional sequence and also the written materials for the simulation. All simulations began with a description of the patient situation, which consisted of background information needed for viewing the simulation. In addition, some simulations contained other appropriate materials to enhance the realistic aspects of the simulation. For example, Situation 2 included the patient's medication administration record and nurses' notes. These materials would ordinarily be on hand for the nurse to examine prior to her contact with the patient. Also included in each section of the instructional booklet were the feedback sheets developed from the experienced nurse performance data.

Finally, each instructional booklet contained supplementary feedback added during the course of the experimental phase. This feedback was derived from the subjects' responses to the previous session. Each of these supplementary feedback materials adhered to a similar format, consisting of the following: (1) how well the subjects as a whole compared with the experienced nurses in listing problem formulations and cues; (2) additional problem formulations that were considered by the investigator to be appropriate but not generated by the experienced nurses; and (3) areas of concern in problem formulation and cue listing (Appendix F).

The control group also received a booklet divided into five sections. Each section contained a posttest based on the videotapes shown in four of the control sessions. These posttests were corrected between sessions so that control subjects would receive some type of feedback for their efforts. No problem-solving activities were included in these control sessions. The fifth control session was used to orient the control subjects to the nature of the experimental task. It contained introductory materials identical to those received by the experimental groups without the sections on feedback.

The response booklets were also divided into sections, one for each simulation. Each section was identical, consisting of three problem formulation sheets, one summarizing assessment sheet, and a self-evaluation checklist. Extra problem formulation and summarizing assessment sheets were available if subjects required more.

The materials for the posttest were similar to those used during the instructional sessions. Each step was delineated with some alterations, including the deletion of the feedback portion in the instructional sequence. In addition to the basic posttest task, subjects completed three other tasks. After the subjects had written their problem formulations and summarizing assessments, they were asked to complete a sheet entitled, "Recognition of Cues." Subsequent to this activity, subjects completed "Additions to Problem Formulation Sheets." Finally, the subjects in the treatment groups completed questionnaires. These materials are discussed in the next section.

Posttest Tasks

The basic posttest task. This consisted of writing tentative problem formulations with associated cues and writing summarizing assessments. One videotaped simulation (Situation 6) was used for the posttest. This simulation depicted the early postoperative nursing assessment of a patient who had a temperature of 103^{o}F. This simulation was selected on the basis of two criteria. First, it was believed that the subjects would have had sufficient content knowledge to generate several tentative problem formulations. Second, data collected from the experienced nurse sample indicated that there were several tentative problem formulations that could be developed based on well-defined cues. Thus, it was felt that evaluation of the cues and problems would be most objective in this particular simulation. Third, there was a hierarchy of problem formulations based on data and probability of occurrence.

Additional Posttest Tasks. After the subjects completed the basic posttest task, they completed two additional tasks modified from Allal (1974). The purpose of these tasks was to determine the extent to which perceptual and memory factors may have affected the subjects' performance on the basic posttest task. Perceptual and memory factors included the detection, encoding, and retrieval of cues. Since these cognitive skills were prerequisite to generating problem formulations, a high level of performance on the basic posttest task would imply that this prerequisite was met. On the other hand, a low level of performance might have three interpretations: (1) failure to generate problem formulations; (2) failure of detection, encoding, and retrieval of cues; or (3) failure in both. In order to more precisely assess between-group differences on the basic posttest task, two additional posttest tasks were devised.

The first additional task (Recognition of Cues sheet, Appendix G) required the subject to indicate on a checklist those cues which he recalled from the simulation. The checklist consisted of 34 items, 16 of which were valid cues. The remaining 18 included three types of distractors: (1) consistent distractors (not presented in the simulation but consistent with the cues presented, n=8); (2) contradictory distractors (contradictory to cues presented in the simulation, n=5); and (3) inconsistent distractors (not present and inconsistent with cues that were presented, n=5).

The second additional posttest task (Appendix G), Additions to Problem Formulation Sheets, was related to generation of tentative problems. For this task the subject was provided with a list of the cues that were present in the simulation. After reading the list, the subject was instructed to make any additions to his problem formulation sheets. The additions could have been either in adding cues to already existing problem formulations or in adding new problem formulations derived after reading the "Additions to Problem Formulation Sheets."

Before concluding this section, several comments are in order relative to the interpretation of these data. During the presentation of the simulation, subjects were permitted to take notes, and most of them did so. Thus, the primary cognitive skill at issue here was the detection and/or encoding of cues. A secondary issue was the retrieval of cues. Performance on the additions-to-problem-formulations task did not provide a pure measure of what the subject's performance would have been in the absence of perceptual-memory constraints, since a subject may have been able to generate additional problem formulations on this task by simply having another exposure to the cues. Thus, in interpreting the performance of subjects on this task, other sources of data (e.g., items checked on the recognition task) had to be taken into consideration in order to determine whether subjects were able to detect and encode cues.

In summary, the two additional posttest tasks were administered to further discriminate subjects' attainment of selected cognitive skills. The first additional task (Recognition of Cues) was designed to determine whether failure to detect, encode and recall cues placed constraints on the subjects' performance of the basic posttest task. The second additional posttest task (Additions to Problem Formulations) was designed to determine whether the removal of potential perceptual-memory constraints would permit the subjects to improve their problem formulation performance.

The Questionnaire. After completion of the two additional posttest tasks, the treatment groups also completed a questionnaire (modified from Allal, 1974) designed to gather subjects' opinions about the basic experimental task and to provide selected demographic information. The questionnaire was divided into four sections. The first part contained 20 statements pertaining to features of the experimental task. Each statement was followed by a five-point Likert-type scale, which asked for the subjects' opinions about the instructional strategy. This section was identical for both treatment groups with the exception of items 14 and 15, which pertained to the feedback variations. The second part of the questionnaire sought information about subjects' interest in discussing or finding out more information about the simulations after each one was completed. This section was included to ascertain the degree of interest subjects had in the simulations. The third section was designed to gather comments from the subjects about the experimental task. Subjects were also asked to include suggestions for possible future use of the simulations. Finally, in the fourth section subjects were asked to list the types of clinical experiences they had prior to the experimental phase. These data were collected for sample description and to determine the degree to which prior experience might affect the experimental outcome. A copy of the questionnaire is presented in Appendix H.

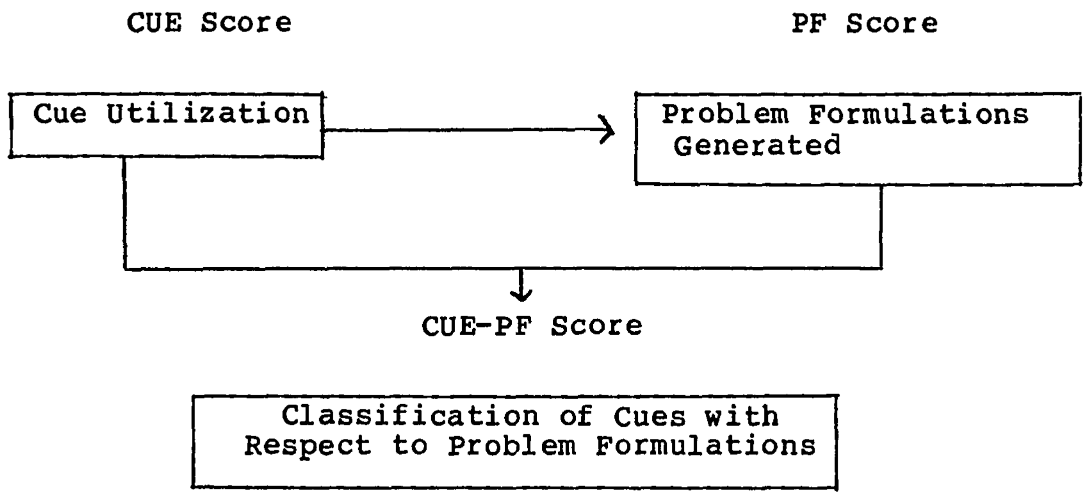
Dependent Variables

A subject's performance on the posttest tasks was evaluated in terms of three dependent variables: (1) a problem formulation score (PF); (2) a cue utilization score (CUE); and (3) a classification of cues with respect to problem formulation score (CUE-PF). For each variable, the adequacy of the subject's performance was measured by means of a scoring key derived from the experienced nurse data and modified from Allal (1974).

Each scoring key was designed to measure the degree to which the subject's performance on a given variable approximated that of the experienced nurses. Each key contained a list of various potential responses, with points assigned to each. The number of points assigned to a response was a function of the relative frequency with which the experienced nurses used that response in their problem formulation activities. Validation of certain weightings of responses was performed by consulting with another master's prepared nurse, who was not part of the sample.

The three variables were derived from the information the subjects recorded on their response sheets. Each of these variables pertained to one component of the cognitive outcomes which resulted from the subjects' simulated encounter with the patient. As depicted in Figure 3.1, the

Figure 3.1.--Relationships between Cognitive Outcomes and the Dependent Variable Scores CUE, PF, and CUE-PF



CUE score pertained to the set of cues which the subjects extracted from the simulation. The PF score related to the set of problem formulations the subjects generated. The CUE-PF score gave information about the way the subjects classified their cues with respect to the problem formulations they generated. The remainder of this section will be devoted to a discussion of the properties of each score and of the general principles underlying the construction of the scoring keys. For more detail, the keys and instructions for usage are located in Appendix I.

CUE score. This score was designed to measure the adequacy of a subject's ability to select cues from the simulation. Modified from Allal's (1974) approach, it was based on the cues which the subject listed on his response sheets, without regard for the problem formulation title(s) under which he listed them. The key consisted of two listings: (1) a list of all the cues identified by the experienced nurses, and (2) a point designation for each cue listed. Points were allocated to each cue as follows:

Number of Nurses Using the Cue	Points
7-9	4
5-6	3
3-4	2
1-2	1

A subject's CUE score consisted of the sum of points earned for each cue he used. The CUE scoring key included 24 items (16 from the videotape and 8 from the written materials) and yielded a maximum of 75 points.

PF score. This score measured the appropriateness and thoroughness of a subject's set of tentative problem formulations. The scoring key contained a list of all tentative problems generated by the experienced nurses. In addition, problem formulation titles listed by the subjects and judged by the investigator and another nurse consultant were included in this score. Like the CUE scoring key, each formulation was assigned points weighted according to the number of experienced nurses who identified the problem. Points were allocated to each problem as follows:

Number of Nurses Listing the Problem	Points
7-9	6
5-6	4
3-4	2
1-2 (or judged acceptable)	1

A subject's PF score consisted of the sum of points obtained for each tentative problem formulation title he listed. The PF scoring key for the posttest contained eight titles yielding a maximum total of 36 points. Since the key contained all the titles generated by the experienced nurses and did not exclude opportunities for inclusion of additional titles judged to be appropriate, it was believed that this score would reflect the thoroughness of a subject's ability to generate problems.

The second dimension of a subject's performance on this task, that of appropriateness, was incorporated into the key in two ways. First, the points assigned to each title were weighted, thus reflecting the relative frequency with which they were generated by the experienced nurses. Second, in order to control for inflation of the PF score due to a tendency on the part of any subject to catalogue every conceivable problem formulation, a title was not scored if there were no cues listed under it.

CUE-PF score. The CUE-PF score was designed to measure a subject's ability to classify cues with respect to the problem formulations generated by the experienced nurses. This score served two purposes. First, it rewarded the subject for listing relevant cues under a problem formulation title. Second, it penalized him for listing clearly irrelevant cues. In addition, rules were incorporated into the scoring key to penalize a subject for listing cues that were contradictory to evidence (e.g., listing cool skin when the nurse identified the skin as warm) or for failing to list a disconfirmatory cue (i.e., "negative," as required in the instructions for the basic task).

In designing this key, each problem formulation title was listed across the top of the key; each cue was listed along the left side. A grid was then constructed with cells aligned on a horizontal and vertical axis. The entry in each cell of the grid was the number of positive or negative points which the subject would obtain for listing a particular cue under a specified problem formulation. The rationale for the use of negative points was that if only positive points were awarded, a subject could easily attain an inflated score simply by placing similar lists of cues under every problem formulation title. Determination of the number of negative or positive points assigned to each cell was based on two sources of data: (1) the experienced nurses' responses, and (2) ratings of the cues by the investigator, using textbook descriptions of cues as the rating criterion. These latter ratings were used to reduce the effect of sampling error on the classification of cues. The primary concern was that negative points be assigned to a cell only if the cue was clearly irrelevant and not because the experienced nurses had omitted a relevant cue. The following criteria were used to determine the entries in each cue x title cell of the scoring grid:

Cell Entry	Criteria
+ (CUE points)	Cue listed as relevant to titles by at least two nurses (or the investigator)
- (CUE points)	Cue not listed as relevant to titles by any of the nurses or the investigator

NOTE: CUE points = the number of points allocated to the cue in the CUE scoring key

A subject's CUE-PF score consisted of the sum of points he obtained for each cue he listed under any title included in any of the problem formulation scoring categories. The scoring key for the posttest consisted of 24 cues x 8 problem formulation titles grid. It yielded a score range of -353 to +298 points.

The CUE-PF score differed from the PF and CUE score in several ways. First, each of the latter two scores measured a single aspect of the subject's performance: his problem formulation titles (without regard to the cues listed under them) and his cue utilization (without regard to the titles under which the cues are listed). The CUE-PF score, on the other hand, measured the way in which the cues were classified with respect to the problem formulations. Second, while the CUE and PF scores were designed to measure both the relevance and thoroughness of the subject's performance, the CUE-PF score focused primarily on relevance, since the CUE-PF key permitted the scoring of cues which fell under the major problem formulation titles.

Additional Measures

In addition to the three major dependent variables defined above, a variety of other measures were determined. These included:

1. The PF scores of the experimental subjects on the five instructional simulations to determine if a trend of superiority of an experimental condition could be identified;

2. The number of items of each type (cues, consistent distractors, contradictory distractors, inconsistent distractors) checked on the "Recognition of Cues" task in the posttest, for subjects in all three conditions, to determine if perceptual or memory factors influenced the subjects' recognition of cues;

3. The PF, CUE, and CUE-PF scores based on the subject's total responses after carrying out the "Additions to Response Sheets" task in the posttest, for subjects in all three conditions, to ascertain if there was an improvement in these scores when the information on appropriate cues was given to the subjects;

4. The experimental subjects' responses to the questionnaire summarized in terms of three areas: evaluation of the videotapes, evaluation of the feedback materials, and evaluation of the general effectiveness of the experimental task in part to determine if there were any between-group differences in opinions about the instructional strategy.

The primary purpose of obtaining these measures was to aid in interpretation of the experimental outcomes regarding between-group differences on the basic posttest tasks (i.e., PF, CUE, and CUE-PF scores). Thus, the above measures should be regarded primarily as supplementary sources of data, of interest as they contribute to an understanding of the experimental outcomes on the three major dependent variables.

The Covariate

The results of a number of studies on problem solving (Elstein, Shulman, & Sprafka, 1978; Frederickson & Mayer, 1975; Gordon, 1972) have indicated a high degree of variability on the dependent measures. Therefore, it was considered important to obtain a measure on an appropriate covariable to increase the precision of the statistical analysis.

Probably the best measure would have been a pretest in which the subjects carried out the same basic task as the experimental task. This possibility was rejected for the following reasons. First, to have the subjects pretest on a videotaped simulation would require the use of two simulations for the same reasons that the control group was exposed to two simulations. This would have reduced the number of simulations available for instruction from five to three. Consequently, if no differences were found following the experimental phase, it would not be known if this were due to lack of treatment effect or lack of precision. In addition, a nonsignificant outcome due to failure to execute an adequate test of the treatment would be a more serious experimental failure than the occurrence of a Type II error due to lack of precision.

To increase the precision of the results, therefore, the final grade in the previous nursing course was used as a covariate. It was deemed appropriate to use a summary grade in a related content course for the following two reasons taken from research of the literature. First, the studies of information processing have indicated that expert problem solvers possess greater stores of knowledge in the long-term memory and greater capacity to form linkages between symbol structures in memory. Part of these facilities has been shown to be due to experience but part has also been postulated to be due to that abstraction known as intelligence (Glaser, Pellegrino, & Lesgold, 1978). Intelligence in research studies has often measured by tests of cognitive ability and grade point average. Second, many previous studies researching success in nursing education have found that the major factor responsible for success has been the grade point average, which of course is a compendium of final course grades (Bell & Martindill, 1976; Bell & Sanchez, 1980; Deardoff, Denner, & Miller, 1976; Dickerson, McKnight, Murdock, & Thompson, 1980; Melcolm, Venn, & Bausell, 1981; Mueller & Lyman, 1969; Muhlenkamp, 1971; Outtz, 1979; Papcum, 1971;

Reed & Feldhusen, 1982; and Shelley, Kennamer, & Raile, 1976). It was decided for this study, therefore, that the final grade from the fundamentals of nursing course, taken the semester prior to the experimental phase, would serve as an effective covariate, rather than the grade point average. This decision was based on past research (Rice, Note 1) in which success in the nursing curriculum positively correlated with success in the fundamentals of nursing course.

Reliability and Validity

In this study there was one major aspect of reliability of concern. This was the inter-scorer reliability; i.e., the stability of posttest scores obtained by independent scoring of subjects' responses.

Inter-scorer reliability was obtained by blind analysis of each set of dependent variable scoring keys by the investigator and a nurse consultant. After scoring was completed, scores were compared and agreement on each score was obtained by consensus.

In any research design, two types of validity need to be addressed: internal validity and external validity. Internal validity is concerned with the question: did the experiment really make a difference? The following are common sources of internal invalidity that may be violated by this experimental design: history, instrumentation, and testing (Campbell & Stanley, 1963).

The experimental design used in this study attempted to minimize these threats to validity in the following manners. First, the effects of history were controlled for by using a control group, since historical events influencing the treatment groups would also influence the control group. In addition to external historical events acting as a source of internal invalidity, _intrasession historical events_ were also a concern. To minimize these, all three conditions were scheduled to meet simultaneously. However, due to subject scheduling difficulties, not everyone could meet simultaneously. Nevertheless, the instructional strategy was designed to be self-administered. Because of this, it is thought that intrasession historical events were minimized, although perhaps not eliminated.

A second source of invalidity revolved around _instrumentation_, or differences in results due to inconsistent scoring. This was minimized by establishing a scoring code prior to the administration of the posttest. The reliability of the scorers was established by consensus of both judges.

The third source of invalidity was the effect of testing. This threat to internal validity might have been present if the control group had not been exposed to the basic task prior to testing. By exposing the control group to the basic task prior to the posttest, this threat to validity was thought to be minimized.

The second type of validity, external validity, is concerned with whether the results of this project can be generalized to other populations of nursing students. Campbell & Stanley (1963) list the following as threats to external validity: the interactive effects of selection biases and the experimental variable, and reactive arrangements. First, the interactive effects of selection biases and the experimental variable might jeopardize generalization of the research results. In other words, it may be entirely impossible to generalize the results of the research because the sample was not representative of the population of freshmen associate degree nursing students. In Table 3.3 selected demographic characteristics of the subjects were compared with the national population of associate degree students. In most categories, the groups were similar. However, the racial composition of the subjects varied from the national sample. It may be possible that the results of this study can be generalized only to other programs having students with similar demographic characteristics. On the other hand, the passage rate on the national licensing examination is virtually identical for both the sample and the population (85%) (NLN, 1982). Since success in the nursing curriculum is ultimately reflected in becoming licensed to practice nursing, it was thought that given the sampling limitations, the results could be generalized to similar types of associate-degree programs.

Second, reactive arrangements (i.e., subject knowledge of participation in a study) may have interacted with the experimental variable to influence the results of the experiment. Although it was difficult to control for these arrangements, one way to decrease the effect was to inform the subjects only generally of the nature of the experimental study. Subjects were told they were participating in a study to examine the use of videotaped simulations in solving nursing problems. If there were reactive arrangements, they should have affected the entire sample, including the control group.

Hypotheses

Operational definitions of the two hypotheses presented in Chapter 1 are as follows:

Hypothesis 1:

The average performance of freshmen nursing students who have undergone instruction in cue detection and problem formulation (Treatment I and Treatment II) will be superior to that of students who have not received instruction, as measured by three dependent variables: (1) CUE score, (2) PF score, and (3) CUE-PF score.

Hypothesis 2:

The average performance of freshmen nursing students who have undergone instruction in cue detection and problem formulation involving outcome and process feedback (Treatment II) will be superior to that of students who have received instruction in cue detection and problem formulation involving outcome feedback only (Treatment I), as measured by the three dependent variables (1) CUE score, (2) PF score, and (3) CUE-PF score.

Analysis

The two experimental hypotheses were tested using a multivariate analysis of covariance entering each dependent variable in a stepdown procedure described in Chapter 5. When significant F ratios were found, univariate analyses of covariance were conducted on each dependent variable in order to identify the dependent variable(s) on which a significant treatment occurred. For each variable having a significant univariate F ratio, the Scheffe post-hoc confidence interval procedures was used to test for significant differences between each pair of experimental conditions.

In addition, a number of supplemental analyses were conducted in order to address questions that have been raised in these chapters or that were suggested as a result of the outcomes of the hypotheses tests. In Chapter 4, the analysis of the results obtained from the experienced nurses is presented. In Chapter 5, the results of the experimental phase are analyzed.

CHAPTER 4

ANALYSIS AND DISCUSSION OF THE NURSE DATA

This chapter presents an analysis and discussion of the data that were collected from the sample of nine experienced nurses. The chapter consists of three sections, each dealing with one of the research questions relevant to the developmental phase of this project. These are:

1. How early in the simulated nurse-patient situation does the experienced nurse begin to generate tentative problem formulations?
2. What is the structure of a set of tentative problem formulations?
3. What cognitive processes are involved in the generation of tentative problem formulations?

The primary reason for collecting the nurse data was to obtain information concerning the selected problem solving processes and outcomes used by the nurses. These data were then incorporated in the development of the instructional materials used during the experimental phase of the project. Nevertheless, an analysis of these data is of interest in itself as it may contribute to the research investigating the nature of problem solving in nursing. Since the size of the sample of nurses was small. the findings reported in this chapter should be regarded as tentative. However, because the procedure used in this study permitted an in-depth appraisal of problem solving processes and outcomes, the findings may be of value in suggesting hypotheses and questions for further research.

For each of the six simulated situations, data were obtained from at least eight nurses. Two nurses were unable to view five situations. Thus, each analysis reported in this chapter is based on a total of 52 responses. Because of the limited size of the sample, only descriptive statistical analyses were conducted.

Generation of Initial Problem Formulations

During the nurse data collecting phase, each nurse was asked to generate tentative problem formulations at three intervals: (a) after reading the written materials accompanying each situation, (b) after viewing the initial segment (for those tapes showing the patient prior to the nurse's entering the room), and (c) after viewing the videotape. Since all of the videotapes did not have initial segments, the tentative problems that the nurses identified prior to the verbal interaction depicted in the videotape were categorized together. These included those problems identified from the written material and from observing the patient prior to the nurse's interaction.

On the basis of a frequency distribution of these data, the following results were obtained (Table 4.1 summarizes these data).

In 51 out of 52 instances, nurses generated problems based on the written information and/or the initial segment

Table 4.1.--Generation of Initial Problem Formulations

Video-tape # (n nurses)	Total # Prob. Gener.	Range # Prob. Gener.	Mean # Prob. Gener.	Mode # Prob. Gener.	Source of Data*	Problems Listed	n Listing Problem
1 (9)	31	3-4	3.44	3	MRx	Anxiety	9
					MRx	Role change	5
					MRx	Communication	5
					MRx	Anger	4
					PB	Smoker	3
					PB	H'lth teaching	2
					MRx	Body image	2
					PB	Grief	1
						Total	31
2 (8)	25	2-4	3.13	3	PB	Anxiety	8
					MRx	BP	6
					MRx	Safety	5
					DD	Love	3
					DD	Body image	1
					MRx	Hypoglycemia	1
					MRx	Fluids & lytes	1
						Total	25
3 (9)	24	1-4	2.67	3	PB	Pain	8
					PB	Epigastric dis.	4
					PB	Anxiety	3
					PB	Mobility	3
					MRx	Level of consc.	2
					DD	Life style	1
					DD	H'lth teaching	1
					MRx	Circulation	1
					PB	Safety	1
						Total	24

Table 4.1 continued

Video-tape # (n nurses)	Total # Prob. Gener.	Range # Prob. Gener.	Mean # Prob. Gener.	Mode # Prob. Gener.	Source of Data*	Problems Listed	n Listing Problem
4	15	0-3	1.67	2	PB	Pain	7
(9)					MRx	Fever	4
					DD	Adaptation	1
					MRx	BP	1
					MRx	Hemorrhage	1
					MRx	Medication probl	
						Total	15
5	16	1-3	2	2	MRx	Blood sugar	8
(8)				114	MRx	Fluids & lytes	
4							
					MRx	BP	2
					PB	Mental status	2
						Total	16
6	18	1-3	2	tri-modal	DD	Respiratory	6
(9)					MRx	Infection	4
					MRx	Hemorrhage	4
					MRx	Health teachingl	
					MRx	Pain	1
						Total	18

*Source of Data: DD = demographic data
PB = patient behavior in written material or initial segment
MRx = medical diagnosis or treatment

of the videotape. The generations were primarily of three types: (1) inferences based on the patient's medical diagnosis and/or treatment; (2) inferences based on the patient's behavior, whether described in the written materials or depicted in the initial segment of the videotape; or (3) inferences based on demographic data (e.g., the patient's age, marital status, etc.). In Table 4.1, the first tentative problem formulations are listed, along with the frequency distribution for the sample of nurses.

As depicted in the table, there were 39 categories of initial problem formulations in the six situations. Of these, the majority (21 or 53.8%) were based on the patient's medical diagnosis or treatment. In Situation 6, for example, four of the first five problem formulations were based on the patient's medical diagnosis or treatment. The written material in this simulation (Appendix A) gave demographic data pertaining to a patient who had just had her gallbladder removed. The nurses' notes indicated a normal preoperative period. The situation began with the nurse's encounter with the patient on her return from the recovery room. Two of the first problems generated by four of the nine experienced nurses pertained to postoperative complications for which the nurse would look in the early postoperative period; i.e. infection and hemorrhage. When questioned about their rationale for listing these problems, the nurses stated that these would always be included in their observation protocols for all postoperative patients.

The second source of data for these initial problem formulations came from the patients' behavior, either that described in the written materials or observed in the initial segment of the videotape. In most of the instances in which the patient behavior was the source of data, however, the resulting problem formulation could be traced to the patient's medical diagnosis or treatment. For example, in Situation 3, of the nine categories listed, only two were directly related to the medical diagnosis. Five were based on the patient behavior depicted in the initial segment. However, the patient's behavior was perceived by the nurses to be medically related. This finding can be explained in the following manner. In this situation, the written material described an unremarkable hospital stay for a 50-year-old woman who had been admitted for evaluation of transient ischemic attacks (characterized by weakness and slurring of speech). She also had multiple medical problems, consisting of arthritis, hiatal hernia, and angina pectoris. She was being discharged to home. After reading this narrative, only three nurses identified problems relating to this patient's medical diagnoses. When asked about this, they stated that since the patient was being discharged, they assumed that the patient's medical problems would be under control. Most of them did not generate any problems based on the written material. They asked, instead, to see the initial segment of the videotape to generate problems. In this particular situation, the initial segment of the tape depicted the patient in obvious distress, clutching at her chest and walking hesitantly to her chair. Consequently, the nurses overwhelmingly generated problems based upon the patient's behavior, but in light of the medical diagnoses. They stated that clutching at the chest could represent pain from angina pectoris or epigastric distress from hiatal hernia.

The third source of data for initial problem formulations was from demographic information represented in the case. For example, in Situation 2, three nurses postulated that the patient might have a problem with meeting her need for love and belongingness. They based this problem formulation on the fact that the patient was a widow with children living away. In another example, in Situation 4, one nurse said that the patient might have difficulty adapting to the hospital environment because of his age (70) and the fact that he had never been in the hospital before.

Although these three sources of data have been separated for classifcation purposes, it should be noted that in actuality many of the nurses used all three simultaneously in developing initial problem formulations. Frequently the most important piece of demographic information pertained to the patient's age. The nurses linked the patients' ages with their developmental states and from there postulated how the effects of illness would impact on the patients. This type of associative process was present in each simulated situation by the majority of the nurses. For example, after reading the written material in Situation 1, one nurse said:

> I would just feel, oh, golly, what a terrible situation for this patient. . . . Here is a 55-year-old man who talks for a living, and he's going to have a laryngectomy. At 55, you ought to be at the height of your profession. . . . and here he's coming in for --ummm-- cancer of the larynx. I just--umm--how is he going to work? How is he gonna feel? I wonder what kind of supports he has.

From reading the above statement, one can perceive how these three sources of data interrelated to determine the initial set of problem formulations.

In attempting to generalize about these initial sets of problem formulations, several factors must be borne in mind. First, the demand characteristics of the experimental task may well have forced the nurses to develop tentative problems sooner than they would have actually done so in practice. Second, the fact that the nurses did not have to devote part of their attention to the task of data gathering and interacting with the patient may have facilitated more rapid generation of tentative problem formulations. Third, since there was a brief time interval from the actual reading of the material and viewing of the initial segment, there may have been some retrospective distortion that affected the number and types of problems generated by the nurses. Consequently, the findings probably overestimate the earliness with which tentative problems are formulated and the number of problems formulated. However, the fact that in 51 out of 52 instances, nurses were able to generate tentative problems indicates that, on the basis of these minimal data, generation of tentative problem formulations probably takes place very early in actual nursing practice.

These results about initial sets of problem formulations substantiate other research on problem solving in nursing. Kraus (1976) also found that nurses formed hypotheses based on preinformation about patients. Gordon (1972) found that nurses generate multiple hypotheses about patient states in the initial phases of the problem solving process. In addition, Gordon found that nurses use historical cues about the patient in the early phases of problem solving. The nurses in this study also used demographic data to develop their sets of problem formulations.

Structure of the Set of Tentative Problem Formulations

According to the information processing theory of problem solving, the task environment influences the problem space of the problem solver. It was proposed earlier in this study that the set of tentative problem formulations generated defines the dimensions of the functional problem space within which the nurse's search for problem formulations is conducted. The purpose of this section is to describe the manner in which a set of tentative problem formulations is structured. Two topics will be discussed: (1) the features characteristic of a set of problem formulations, and (2) the size and organization of a set of problem formulations.

Structural Features

In order to determine the structural features of each set of problem formulations generated by the nurses, the nurses' discussions of the tentative problems generated from each simulation were analyzed, using the four characteristics of the structure of the set of tentative problem formulations proposed by Allal (1974). The rationale for selecting Allal's model is based upon the following two considerations. First, there has been no research in problem solving in nursing that has identified the characteristics of the problem space constructed by nurses while performing problem-solving exercises. Gordon

(1972) found that nurses used multiple and single hypothesis scanning strategies while performing problem-solving exercises. However, in her research, the subjects were told that there was a correct patient state to be found, provided that they asked the right questions in seeking it. In constrast, the nurses in this study were instructed that there were no right or wrong answers to any simulation and that they were to generate as many problem formulations as they thought appropriate. Therefore, it was expected that nurses in this study would adopt multiple hypothesis scanning strategies from the outset. Consequently, a different approach to analyzing the data needed to be taken.

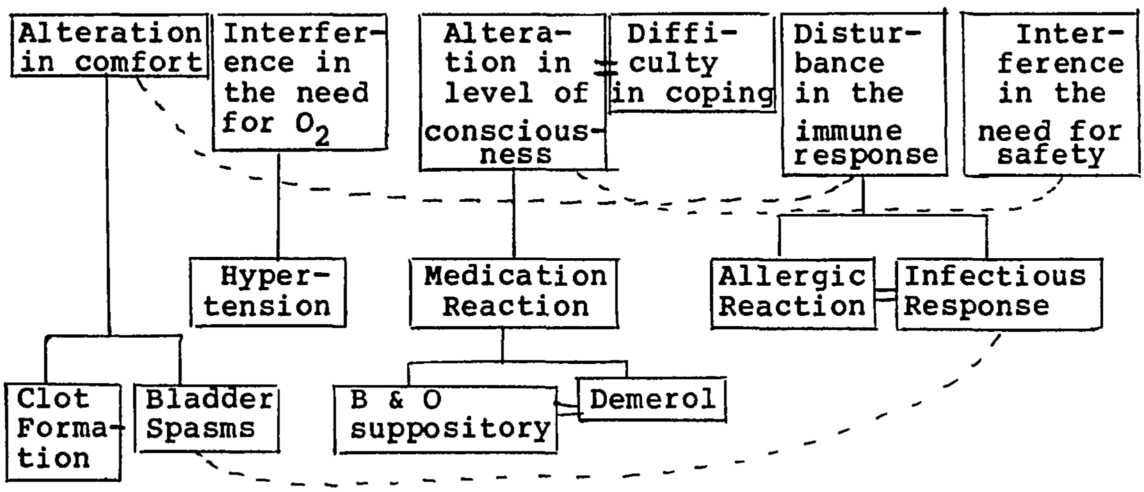
The second reason for adapting Allal's model of the functional problem space is based upon the similarity in the diagnostic activities of physicians and nurses in this particular type of task environment. In Allal's study, she developed simulations depicting the first few minutes of the clinical work-up; i.e., from the time the patient enters the physician's office until the first round of questions pertaining to the patient's symptomatology is completed. The types of cues presented were vague, as they would be in reality. The physicians were instructed to generate hypotheses that would structure their subsequent gathering of data to arrive at an accurate diagnosis. In the present study, the tasks were similar. The nurses were presented with background information about the patient and were then shown a videotape depicting a brief encounter with the patient. They were given sufficient information to generate multiple hypotheses, but not enough information to be able to determine the precise state of the patient. Consequently, the manner in which the hypotheses were generated might be similar to that of the physicians.

For these reasons, Allal's model of the structure of the functional problem space was used in this study. In her study, Allal hypothesized that physicians performing simulated exercises developed structured sets of problem formulations that included any or all of the following characteristics: (1) hierarchical organization; (2) competing formulations; (3) multiple subspaces; and (4) functional relationships (pp. 37-38).

In order to illustrate the manner in which the four features characterized the structure of a set of tentative problem formulations, a diagram depicting the composite set of problem formulations generated by the nurse sample for Situation 4 has been prepared (Figure 4.1). This diagram pictures a more extensive set of problem formulations than that generated by each individual nurse, but it does serve as an illustration for the following commentary on the four features.

In the diagram, the number of subspaces at the top of the diagram indicates the range of problem formulation

Figure 4.1.--Composite Set of Problem Formulations by the Nurse Sample for Situation 4



Key: Double lines = competing formulations
Individual boxes on first line = multiple subspaces
Broken lines = functional relationships
Vertical lines = hierarchical organization

categories included in the problem space. The subspaces may be competitors (e.g., "alteration in level of consciousness" versus "disturbance in coping mechanisms"); they may be compatible but unrelated (e.g., "disturbance in the immune response" and "interference in the need for oxygen"); or they may be functionally related (e.g., "alteration in comfort" and "disturbance in the immune response"). Some subspaces may consist of a hierarchy of formulations (e.g., the "alteration in comfort" hierarchy) while others may consist of a single formulation that is highly general ("interference in the need for safety"). The hierarchical formulation indicates the degree to which the problem space is structured on a vertical dimension. Competing formulations may exist between subspaces (e.g., "alteration in level of consciousness" versus "disturbance in coping mechanisms") or within subspaces (e.g., "B & O suppository" versus "Demerol"). Functional relationships may be hypothesized at the subspace level (e.g., "alteration in comfort" related to "disturbance in the immune response") or within the subspace level (e.g., "infectious response" related to "bladder spasms").

The set of tentative problem formulations generated by each nurse for each situation was developed. The results of this analysis are summarized in Table 4.2, by situation (percent of subjects whose sets of formulations exhibited each feature) and by subject (percent of situations for which a subject's set of formulations exhibited each feature).

The following discussion of each feature of the set of tentative problem formulations will consider: (1) the consistency of its occurrence across situations and across subjects, and (2) the types of factors which may influence its occurrence.

Table 4.2.--Features Characteristic of Individual Sets of Problem Formulations, by Situation and by Subject

	Feature			
	Hierarchical Organization	Competing Formulations	Multiple Subspaces	Functional Relationships
Situation	% of subjects whose sets of formulations exhibited each feature			
1	89	22	100	11
2 (n=8)	75	25	100	88
3	67	78	89	33
4	56	67	100	44
5 (n=8)	75	50	63	25
6	56	67	89	11
Subject	% of situations for which a subject's set of formulations exhibited each feature			
AD	50	50	100	17
JBa	67	67	83	17
BL	50	50	100	33
JBr (5 tapes)	40	20	80	60
SH	67	50	100	50
RL	83	17	83	33
LW	100	50	100	67
VM	50	33	83	33
AS (5 tapes)	40	80	100	0

Of the four features, the <u>multiple subspace</u> was the only consistent characteristic of the nurses' sets of problem formulations for the six situations. Thus, it appears that the multiple subspace is an essential feature of the experienced nurse's set of initial problem formulations and is least affected by task environment and personal difference variables. This is not surprising in that nurses working in hospital settings usually assist patients who have health problems affecting more than one of their basic needs.

Two other factors that may contribute to the generation of multiple subspaces are derived from the ambiguity of the cues obtained during the simulated presentation. The first factor is related to the relative nonspecificity of the cues. Many cues cross several patient needs areas. An example of such a type of cue would be the unsteady gait of the patient in Situation 3. Several nurses observed the patient having difficulty walking and generated the problem, "Interference in the need for mobility" (also based on the patient's past history of arthritis), while other nurses observing the same cue labeled it as a manifestation of "Alteration in comfort." The second factor is related to the fact that some cues may be quite specific but still be compatible with multiple patient needs. For example, in the same situation (#3), the patient was complaining of chest pain. These complaints, although characteristic of having a cardiac etiology, nevertheless are often present in gastrointestinal disorders and less frequently, in anxiety states.

While multiple subspaces were present consistently across situations and subjects, hierarchical organization was included in the set of tentative problem formulations a high proportion of the time for most situations and subjects. However, it also showed a good deal of variability across situations and subjects. Thus, the occurrence of this feature appeared to be influenced by both task environment and individual difference variables.

When nurses placed tentative problem formulations in a hierarchical organization, they tended to state in the recall protocol that they would want to collect more data with respect to the formulations that they had generated in the hierarchy. For example, in Situation 3, when stating that the patient had an alteration in comfort, one nurse said that she could be having chest pain due to anxiety or cardiac or epigastric distress; consequently, she would want to gather more data to determine the cause. In her analysis of the physician data, Allal (1974) stated that placing problem formulations in a hierarchical organization may serve two purposes. First, the early generation of specific formulations would help to guarantee that those cues having particular relevance to the establishment of that specific formulation are elicited and interpreted. Second, by continuing to hold a more general problem formulation category (subsuming the specific formulations), the problem solver is more likely to avoid premature closure on a formulation before more specific data are collected.

The third feature of the structure of the set of tentative problem formulations was that of *competing formulations*. This feature was present in a little less than half of the set of problem formulations by situation and 41% of the time by subject. These data would suggest that this feature appeared to be greatly influenced by both task environment and personal difference variables. The generation of competing formulations during the problem formulation task would indicate that the nurse entertained multiple competing hypotheses, a primary means by which the scientific thinker seeks to avoid the pitfall of becoming prematurely wedded to a favored, but possibly incorrect, hypothesis. The fact that this feature does not occur as often as multiple subspaces may be due to the following two factors.

First, the nature of the task environment (or the simulated simulation) may not have predisposed the use of this feature by the nurses. The simulations were developed along a fairly restricted set of patient needs, based on the target population for the experimental phase of the project. Thus, the cues presented may have been such that the nurses did not need to consistently generate competing problem formulations. Second, individual nurses may not use this strategy consistently in their generation of tentative problem formulations. According to Table 4.2, six of the nine nurses used this strategy at least half or more of the time. In comparing the experiential and educational background of those who used this strategy against those who did not, there is no one consistent factor that might account for the difference in the use of this feature.

The feature functional relationships was more likely to be absent from a set of tentative problem formulations than any of the other three features. This finding is consistent with Allal's (1974) findings. As with her findings, there was a great deal of variability across subjects with respect to this feature in that two subjects used this feature the majority of the time while one subject did not use it at all. Across the situations, this feature was consistently present for Situation 2 and used only rarely in all of the other situations. In situation 2, most of the nurses hypothesized that the patient's syncopal episode was related to at least one of her other basic needs (i.e., attention seeking behavior, hyper- or hypotensive episodes, anxiety, potassium deficit, etc.). In Situation 6, only one subject hypothesized a functional relationship among problem formulations. The fact that this feature was not used in this situation was probably related to the task environment created by the situation. Most nurses focused on one cue and hypothesized one or two problems related to that cue. In that situation, there was no functional relationship between the problems based on that cue (i.e., the patient had a temperature of 103^{o}, and the nurses stated that she had either an infectious or an allergic response).

Size and Organization

The size of a set of tentative problem formulations may be measured in two ways: (1) by the number of problem formulations it contains, and (2) by the number of subspaces it contains. Table 4.3 presents the mean and range on these variables, by situation (across subjects) and by subjects (across situations). For all situations, the average number of problem formulations ranged from 4.44 to 6.5, and the average number of subspaces from 2.63 to 3.38. For subjects, the average number of problem formulations ranged from 4.17 to 6.9, and the average number of subspaces from 2.5 to 3.67.

The two measures of the size of a set of tentative problem formulations were correlated: a product moment correlation coefficient of .44 with situations as the unit, and a coefficient of .42 with subjects as the unit. These correlations indicated that the two measures have a proportion of variance in common. Nevertheless, the two measures do not necessarily pertain to the same psychological entity. The rationale for stating that they are different is derived from an evaluation of the data in Table 4.3, and in terms of the research literature on the role of organization in memory.

Table 4.3.--Number of Problem Formulations, and Number of Subspaces: Average and Range by Situation, and by Subject.

	Number of Problem Formulations		Number of Subspaces	
	Average	Range	Average	Range
Situation				
1	5.44	4-6	2.89	2-4
2	6.5	4-10	3.38	2-5
3	5.44	3-8	2.89	1-5
4	4.89	3-8	3.11	2-5
5	5	2-9	2.63	1-4
6	4.44	1-8	3.11	1-4
Subject				
RL	4.17	2-6	2.67	1-4
JBr	5	1-8	3.2	1-4
AS	5	4-8	3.67	2-4
LW	6.9	5-10	3.5	2-5
BL	5	3-7	2.5	1-3
AD	5	4-6	2.67	2-4
SH	6.83	4-9	3.17	2-4
JBa	5.33	3-8	2.83	1-4
VM	4.5	2-7	3.17	2-4

Research by Mandler (1967) indicates that a subject typically organizes and stores items in terms of 5±2 categories. Allal (1974) found that this parameter applied to the information-processing behavior of physicians. An examination of Table 4.3 reveals that the number of tentative problem formulations generated by the nurses was in some instances considerably more than the storage capacity of the short-term memory (e.g., situations 2, 3, 5, and 6 and subjects, JBr, AS, LW, SH, and JBa). However, the number of subspaces generated for a given situation, or by a given subject, never exceeded five. Thus, it would appear that however many problem formulations a nurse generates, the maximum number of subspaces into which these formulations are grouped is consistent with the parameter that has been found to govern the storage of information in the short-term memory. This finding would seem to attest to the importance of the subspace as the superordinate unit in a set of problem formulations.

How many subspaces the nurses generated (within the limit imposed by memory capacity) was probably a function of both personal difference variables (e.g., her knowledge of the content) and task environment variables (e.g., the information presented in the situation). It was not possible to identify one task environment variable which was correlated with the minimum number of subspaces generated for each situation.

Organization of problem formulations into subspaces was not evenly distributed across subspaces. The set of problem formulations in Figure 4.1 consisted of six subspaces, two of which contained only one problem formulation. Four subspaces contained hierarchies of problem formulations. The subpaces that were hierarchically constructed included no more than three levels of specificity. Thus, the number of units included in a subspace did not exceed the 5 ± 2 parameter. There were two factors that may have accounted for this finding. First, in some instances, the subspace category may have been at a level of specificity which did not admit further hierarchical elaboration (such as difficulty in coping in Figure 4.1). Second, in other instances, it would be possible to generate a hierarchy of formulations, but the current data were so limited with respect to that subspace that further hierarchical elaboration would not be possible (alteration in comfort in figure 4.1).

Conclusions

On the basis of the preceding analyses, several tentative conclusions may be proposed regarding the set of tentative problem formulations:

1. The subspace is the superordinate unit in a set of tentative problem formulations. Typically, there are about 2-4 such units.

2. In the typical case, some subspaces contain 2-3 hierarchically organized formulations, while other subspaces, contain only single formulations.

3. The use of competing formulations and functional relationships is varied across subjects and situations. Therefore, these features are apparently dependent upon individual and task environment variables.

Processes Involved in Generating Tentative Problem Formulations

As described in Chapter 3, two types of data pertaining to problem formulation processes were collected: (1) retrospective recall data, and (2) process checklist data. This section will present findings that were derived from analyzing each type.

For each situation, the subjects' recall procedures were summarized and problem formulations noted by the investigator as they were expressed by each subject at specific points during the exercise. For each subject, data were collected at three intervals: (1) after reading the written material pertaining to the simulated simulation; (2) after viewing the initial segment in applicable cases, and (3) after the subject had filled out the problem formulation and summarizing assessment sheets. In addition, each subject's verbal statements were tape recorded and analyzed simultaneously with the investigator's notes.

A review of these notes for all six situations yielded several observations regarding the processes underlying the generation of tentative problem formulations. The discussion of these observations will be organized to indicate how problem formulation processes are related to each of the structural features described in the first section of this chapter.

Generation of Multiple Subspaces

In her analysis of recall data from physicians, Allal (1974) found that there were two processes underlying the generation of multiple subspaces: (1) generation of multiple subspaces at a single point in time on the basis of the same set of cues, and (2) generation of multiple subspaces at several points in time on the basis of different cues. Using this paradigm, the nurse data were analyzed. It was found that there were several task variables that appeared to govern the generation of multiple subspaces. The first process usually occurred under two circumstances: (a) when the patient's behavior was of a general or multi-need nature, and (b) when a specific behavior indicated that several basic needs might be disturbed. The second process usually was involved when the patient's behaviors, occurring at different points in the situation, indicated different needs. These generalizations may be illustrated by the following examples:

Example of process la:

In situation 3, the patient was viewed walking hesitantly to a chair while clutching at her chest. She took off her hat and sank slowly into the chair. While viewing this segment, several nurses generated two subspaces: "interference in the need for mobility" and "alteration in comfort."

Example of process 1b:

In situation 4, the patient was viewed staring at the ceiling while alternately waving his hands into the air and scratching at his chest. Several nurses indicated from these data that the patient had two tentative problems: "alteration in level of consciousness" and "interference in the need for safety."

Example of process 2:

While reading the written material for situation 2, most nurses generated multiple subspaces pertaining to the patient's history. The patient had fainted in church, was a widow whose children did not live nearby, and had a past medical history of hypertension. Based on these cues, many nurses generated the following multiple subspaces: "interference in the need for safety," "potential interference in the need for oxygen," and "disturbance in the need for love and belongingness."

In analyzing the structure of the sets of problem formulations, it was found that the generation of multiple subspaces occurred most frequently. Most multiple subspaces were generated by method 2 described above. Explanation for this is most likely derived from two sources: the nature of the written material and the nature of nursing. First, most patient situations contained background information relevant to the simulated simulation. In reading the patient situations all nurses generated at least one and sometimes as many as four tentative problems (See Table 4 3) Even in situation 1 in which the written information was only several sentences, all nurses generated at least three tentative problems, some of which were placed in multiple subspaces after analysis. Second, it is within the nature of nursing practice to view the patient in a holistic manner. Thus, when a nurse examines a patient situation, she enumerates the basic needs of the patient that may be disturbed or altered by the history given.

Generation of a hierarchy of problem formulations.

Kleinmuntz (1968) proposed that the diagnostic process is characterized by hierarchical search which proceeds from general problem formulation categories to increasingly specific diagnostic formulations. Gordon (1972) found that nurses typically employ multiple hypothesis scanning strategies at the beginning of their search for diagnosis and switch to single hypothesis scanning strategies as they approach solution. Allal (1974) found that a physician's problem formulations cannot be characterized as either highly general or highly specific. Depending upon the task environment, a physician's set of problem formulations may include hierarchies of formulations at different levels of specificity. Throughout her findings, hierarchies proceeded in three ways: (1) from general to specific; (2) from specific to general; (3) generation of general and specific formulations simultaneously.

Similar findings can be seen in the analysis of the nurse data. For example, the problem of "anxiety" was generated by seven out of the eight nurses who viewed Situation 2. However, the analysis of the structure of the problem formulations for each nurse revealed that anxiety occurred in various places in the set of problem formulations. In five out of the seven sets, anxiety was located at the multiple subspace level, and in four out of those five, anxiety was the top of a hierarchy. Of the four who placed anxiety at the multiple subspace level and at the top of a hierarchy, two proceeded to develop their hierarchies using method (1), and two used method (3). Analysis of the recall data indicated that those who used method (1) stated that the patient appeared to be anxious in the first segment of the videotape. After viewing the videotape, they classified the causes of the anxiety more specifically as "lack of control," "dysfunctional communication," "anger," or "mistrust of the staff." The two nurses who identified anxiety as a subspace but generated specific causes simultaneously did so while reading the patient situation. They thus generated their hierarchy prior to viewing the videotape. Finally, three nurses used method (2). Recall data indicated that these nurses discussed specific causes of anxiety first and then stated that the patient would have a general problem with anxiety. Analysis of the structure of problem formulations for the two nurses who identified anxiety as a problem but one within a hierarchy revealed that these nurses were using method (2). In these cases, the nurses stated that the patient was showing behaviors reflective of anxiety. One nurse stated that the patient's anxiety indicated an interference with the need for love and belongingness. The other nurses indicated that anxiety was part of a greater problem with an alteration in the patient's self-esteem.

In summary, there was a distinction between the processes of generating a problem formulation hierarchy and the product of these processes. While the product may be represented as a general-to-specific hierarchy of formulations, the process of generating the hierarchy may take one of three forms. Since the generation of hierarchies of problem formulations was present the majority of time across situations, it would appear that this feature was dependent upon the task environment. However, there was a considerable range of hierarchy generation among the subjects (40% to 100%). This would indicate that the utilization of this feature in a set of problem formulations was also dependent upon individual difference variables.

Generation of competing formulations

In analyzing the recall data in her study, Allal (1974) found that there were two types of processes underlying the generation of competing formulations: (1) generation of competing formulations at a single point in time on the basis of the same set of cues, and (2) generation of competing formulations over several points in time on the basis of different cues. Analysis of the nurse data revealed similar results. Examples from the recall material illustrates each of these processses as follows:

Example of process (1):

In situation 3, written information on the patient revealed that she had a past history of arthritis, hiatal hernia, transient ischemic attacks, and angina pectoris.

The patient was seen clutching her chest and burping simultaneously. Eight out of the nine subjects generated at least two competing formulations almost simultaneously upon viewing this videotape. These were "chest pain" versus "epigastric distress."

Example of process (2):

In situation 4, three nurses generated competing formulations under the subspace formulation, "alteration in level of consciousness." All three nurses postulated that the patient was having a reaction to medication based on the abnormal movement of his hands. Each of the three also postulated competing formulations under the same subspace based on differing cues. One nurse stated that the abnormal behavior could be based primarily on the patient's age. Another stated that the behavior could be based on a reaction to an infectious process since the patient had an elevated temperature. The third nurse stated that the behavior could be caused by dehydration, again based on the cue that the patient had a temperature elevation.

Allal (1974) hypothesized that the associative mechanisms underlying the above processes may be different. In the first case, she noted that there may be two underlying associative mechanisms: (1) association from cue(s) to a list of competing formulations; and (2) association from cue(s) to one formulation, and from this formulation to another competing formulation, etc.

In the second process, Allal postulated that an associative mechanism of the following sort might be present. In this process, the subject might associate from one set of cue(s) to a formulation, from another set of cue(s) to another formulation, and then from an associative link-up of the two formulations as competitors. As with the case of hierarchical formulations, different associative processes may result in the same product; i.e., a set of competing formulations to be stored in memory.

Generation of functional relationships

The subjects were least likely to use functional relationships as a feature of the structure of the set of problem formulations. This was thought to be the result of task environment variables rather than individual difference variables. In the recall data, most nurses routinely stated that they looked for functional relationships among the problems that they had generated in every situation except 1 and 6. However, the recall data were not congruent with the set of problem formulations developed from the data as noted in the following example.

When the subjects did use functional relationships, they were most likely to employ them in situation 2 (seven out of eight nurses who viewed this tape postulated functional relationships among the problem formulations). In this situation, many of the nurses indicated that since the patient had fainted, she had an interference in the need for safety. However, the patient's history also indicated that this interference could be related to her problems with her blood presssure, to side effects of medications she was taking to control her blood pressure, or to anxiety. Consequently, when functional relationships were used, they were most likely to be hypothesized after the nurse had generated at least two noncompeting formulations.

Analysis of the Process Checklist Data

As indicated in Chapter 3, the items in the process checklist pertained to the following aspects of the act of generating tentative problem formulations:

1. modes of mental representation;
2. strategies of problem formulation, including,
    a. initial routines,
    b. general strategies;
3. associative processes of problem formulation;
4. cue utilization.

The classification of items according to the above categories is presented in Table 4.4. The analysis of the checklist data was designed to determine, for each item:

(a) its overall importance as a characteristic of the act of generating tentative problem formulations, (b) its stability with respect to subjects (across situations), and (c) its stability with respect to situations (across subjects).

According to the procedure used by Allal (1974), the first step in the analysis was to construct a subject x situation data matrix for each item. In the 52 matrix cells for which data were available, a 1 was entered to indicate that the nth subject checked the item on the sth situation.

The analysis of the checklist data sought to determine, for each item: (a) its overall importance as a characteristic of the act of generating tentative problem formulations, (b) its stability with respect to usage by subjects (across situations), and (c) its stability with respect to being used with situations (across subjects). The method by which these data were analyzed is described in the following section.

Two measures were made for each item. One was the relative frequency with which the item was checked; i.e., the number of cells in the item matrix with an entry divided by the total number of available responses (52). The results of these calculations are presented in Table 4.4.

The second measure for each item was concerned with subject and situation stability; i.e., whether an item was

Table 4.4.--Categorization of Process Checklist Items

Category	Item # and Description	Rel. Freq.
I. Modes of Mental Representation	2. Mental image--previous pt	.56
	9. Mental image--anat. loc.	.23
	17. Mental list--med. dx.	.37
	18. Mental list--general	.38
	20. Mental image--textbook	.27
	29. Mental list--cues	.37
II. Strategies of Problem Formulation		
A. Initial routines	13. Life-threatening	.25
	22. Organic-vs-psychogenic	.13
	26. Assoc. med. diagnosis	.17
B. General	1. Convergence	.08
	3. Demographic data	.40
	6. Pathophysiological proc.	.71
	8. Incidence--uncommon	.13
	10. Divergence	.17
	12. Written information	.65
	14. Written information	.46
	16. Convergence	.06
	19. Combination of problems	.73
	25. Written information	.29
	27. Divergence	.63
	28. Medical diagnosis	.35
III. Associative processes of problem formulation	15. Combination of cues	.67
	24. Salient cue	.58
IV. Cue Utilization	4. Combination of cues	.71
	5. Focus on nonverbal cues	.50
	7. Relationship between verbal and nonverbal cues	.67
	11. Focus on verbal cues	.06
	21. Selective focus on cues	.13
	23. Interrelate cues progressively	.17

used with any consistency by subjects or in situations. The following criteria were adopted from Allal (1974) to measure the degree of stability:

1. Subject stability: an item was considered to be a stable characteristic of a subject's performance if it was checked for four out of the six situations (or four of the five situations in the case of the two subjects who saw five situations);

2. Situation stability: an item was considered to be a stable characteristic of performance on a given situation if it was checked by seven out of the eight or nine subjects who completed the situations.

In tabulating the subject or situation stability of an item, a 1 was entered in the margin(s) of the item matrix for each subject, or situation, which met the stability criteria defined above.

In order to determine the proportion of cell entries which could be accounted for by using the stability criteria defined above, the following formula was employed (Allal, 1974):

$$\frac{N_t - N_e}{N_t}$$

where N_t = the total number of cells in the item matrix, i.e., 52

N_e = the number of cells in the item matrix whose entries deviated from those that would be predicted on the basis of the entries in either matrix margin (i.e., a cell entry of 1, but no entry in either the subject or task margin; or conversely. no cell entry, but a 1 in either the subject or task margin).

The coefficients for each item calculated according to this formula ranged from .653 to .942, with an average of .810 across all 29 items. Therefore, in general, the criteria for measuring subject and situation stability accounted for a large percentage of the observed responses. In order to summarize the data on item stability with respect to subjects and situations, each item was categorized along these two dimensions as depicted in Table 4.5. The next section contains a discussion of these data.

Modes of Mental Representation. This topic was concerned with two modes of mental representation--verbal and figural. Five checklist items (numbers 2, 9, 17, 18, 20, and 29) pertained to this topic. The data in Tables 4.4 and 4.5 suggested the following conclusions regarding the relative importance of verbal versus figural modes of mental representation in generating tentative problem formulations.

Of the three checklist items pertaining to mental images (figural), the item concerning mental images of previous patients was checked with a frequency of over .5.

Table 4.5.--Classification of Checklist Items on Two Dimensions: Subject Stability and Situation Stability

Subject Stability[b]	Situation Stability[a] 6	5	4	3	2	1	0
9							
8							
7			4	19			
6			12	6	15	24	
5					7		
4						27	2
3						5	3, 18
2							13, 17 25, 26
1					14		9, 20 28, 29
0							1, 8, 10, 11 16, 21 22, 23

[a]Number of situations in which the item was checked by at least seven of the nurses who viewed the situation.

[b]Number of subjects who checked the item in at least four situations.

NOTE: Entries in the cells are the item numbers from the checklist.

The item matrix cell data revealed that this mode of mental representation was consistently present in four of the nine nurses who performed the exercise. The other items pertaining to mental images were checked less consistently (.34 and .27 for items 9 and 20). These referred to mental images relative to the anatomic location of the cues and to textbook descriptions of patients presenting these cues. That the nurses found textbook descriptions of patients not consistently helpful substantiates the findings of Hammond and Kelly (1964).

The two items pertaining to mental lists (items 17 and 18) were checked consistently by two and three subjects respectively. However, the relative frequency of these two items was only .37 and .38. Two subjects used this mode of mental representation consistently across all situations. They indicated that, in problematic situations in actual practice, they gathered cues and compare them with established mental lists of cues to arrive at hypotheses about situations.

With respect to this small sample of nurses, the primary mode of mental representation was figural and based on mental images of past patients. It would appear from these data that, for these nurses, experience with patients has been a major determinant in assisting them to organize cues in the long-term memory. Less frequently did these nurses employ verbal modes of mental representation (i.e. mental lists). In Tanner's study (1977), she based the design of instructional materials on a cue-hypothesis linkage, which assumes that the primary mode of mental representation is verbal. These data appear to indicate that the primary mode of mental representation was figural and based on images of past patients with similar problems.

Strategies of Problem Formulations--Initial Routines. This topic was concerned with the occurrence of heuristics involved with the initial deliberations in the search for problem formulations. The items of relevance to this topic were designed to determine whether one of the nurse's first steps in the problem formulations was: (1) to consider if the cues represented a life-threatening situation (item 13); (2) to contemplate whether the cues represented an organic or psychological problem (item 22); or (3) to relate the patient's medical diagnosis to the cues presented (item 26). All three of these strategies related to highly general principles of problem formulations. Thus, this topic was also concerned with whether the nurse begins the process of generating problem formulations at a high level of generality or with the intent of developing multiple hypotheses as Gordon (1972) found in her research. The data in Tables 4.4 and 4.5 suggested the following conclusions regarding initial routine strategies.

Examination of the relative frequency scores and the table on stability indicated that these items were generally not selected by the nurses and that they were not consistently selected across situations. Two nurses consistently selected item 13 (life-threatening). One of the nurses indicated that in her experience with patients having end-stage renal disease, she found that she should always "expect the worse" when patients develop new signs or symptoms. The other nurse worked in an intensive cardiac care unit and indicated likewise. However, there were three other nurses in the sample with intensive cardiac care experience who did not consistently select this item.

Item 17 (associated medical diagnosis) was selected by two nurses consistently. These were the same two nurses who used mental lists as their primary mode of mental representation. They stated that they usually begin their problem formulation development with the patient's medical diagnosis and a mental list of the patient's signs and symptoms. They then were able to "check off" the patient's cues with their mental lists.

The third item in this category, item 22, pertained to a deliberation as to whether the patient's cues represented a psychological versus a physical problem. This item occurred with the lowest relative frequency of the three items in this category (.13) and was not consistently selected by any nurse or in any situation. It would appear, therefore, that this type of deliberation would be used less frequently by these nurses.

In summary, the use of initial routines involving highly general distinctions was not typically the first step in the process of generating tentative problem formulations. Only a few individuals followed these routines consistently across situations. There were no situations in which these initial routines were consistently used.

General Strategies of Problem Formulation. While the previous topic dealt with the initial routines that the nurse might employ as she is faced with a problematic situation, this topic is concerned with the strategies or heuristics that the nurse might employ throughout her investigation of the problematic situation. There were 11 items in this category. Four items pertained to information that is commonly available to the nurse prior to her encounter with the patient and included: (1) demographic data (item 3), (2) background data leading up to the situation (item 12), (3) nurses' notes or doctor's orders, (item 14) and (4) the patient's medication record (item 25).

Three items were based on medical information. These included the underlying pathophysiological disturbance (item 6), uncommon reasons for the cues (item 8), and the patient's medical diagnosis (item 28). Three items sought to determine if the nurse employed convergent (item 1) or divergent strategies (items 10, 16, and 27). An analysis of the data suggests the following conclusions.

Consideration of demographic data (item 3, relative frequency .40) and the written information in the patient situation (item 12, relative frequency .65) were similar and thus will be discussed together. Six nurses checked either or both of these items consistently across situations. In their discussions, most of the nurses indicated that the patient's age and developmental stages were two major factors they used in developing a list of tentative problem formulations. For example, if the patient was elderly, the nurse listed safety needs as a probable consideration. If the patient was at the prime of his life, as was the patient in Situation 1, the nurses considered how his illness would affect his role as provider for his family.

The other two items in this category of written information, items 14 and 25, were checked with relative frequencies of .46 and .29 respectively. Of these two items, item 14 was consistently checked across situations 4 and 5. In situation 4, the patient was seen waving his hands in the air while stating that nothing was wrong. In situation 5, the patient was a diabetic who was difficult to arouse from her sleep. In both of these situations, the nurses stated that, in order to arrive at tentative problem formulations, they needed more data. They looked to the nurses' notes to establish baseline information to assist in developing tentative problem formulations. Item 25 pertained to using information about the patient's medications. Two subjects used this information consistently in developing problem formulations. However, this item was not consistently used across situations as was item 14.

Of the items that pertained to the medical information about the patient, item 6 (relative frequency .71) was used consistently by six subjects and across three situations (3, 5, and 6). This item was concerned with a strategy in which the nurse used the underlying pathophysiological disturbances to generate tentative problem formulations. That this strategy was used by the majority of the nurses was consistent with the nature of the task environment; i.e., hospitalized patients who were ill. Items 28 and 8 (relative frequencies .35 and .13) were used less frequently. One subject used item 28 consistently and none used item 8. Neither item was used consistently across situations. Item 28 referred to the act of making a medical diagnosis. Although this act is not within the legal parameters of the practice of nursing, clearly there are occasions when the nurse hypothesizes either an undiagnosed medical problem or a change in the patient state that is medically derived. One nurse used this strategy consistently, but the others only if the task environment variables supported this process. Since the majority of the nurses selected item 6 (concerning pathophysiology), it would appear that the nurses processed patient state information on the basis of how the cues affected the patient's body rather than how the medical diagnosis was causing the change in the patient state.

The third grouping of items under general strategies of problem formulations was related to convergent and divergent strategies. Examination of these data revealed that the two convergent items were checked infrequently (items 1 and 16, .08 and .06). That these items were selected rarely indicated that the nurses shunned strategies that would generate one problem formulation to account for all the information. To accept this type of formulation might be intellectually appealing, since it could account so parsimoniously for all the available data. However, the formulation might be incorrect because of the possibility of premature closure.

In contrast, the use of divergent strategies of problem formulation would help to counteract any tendency toward premature closure. Of the three divergent strategies that were considered, item 27 (.63) was used consistently by four of the nurses, and item 19 was consistently used by seven of the nurses. These items were also consistently checked across situation 6 (item 27) and situations 1, 3, and 6 (item 19). Part of the reason for the selection of this item may have been due to the nature of the problem formulation task, since the nurses were asked to arrive at as many problem formulations as they could, given the data. However, since these items were checked so consistently by subjects and across situations, it would appear that the nurses sought to generate as many problems as the data would permit without causing a mental overload (since none of the structures of the sets of problem formulations exceeded 7+2).

Although item 27 was used frequently, the other divergent item (10) was checked infrequently (.17). Item 10 referred to a heuristic in which the nurse waits until all the data are gathered before arriving at any hypotheses about the situation. The infrequent use of this strategy would support the findings from other problem solving studies that subjects generate hypotheses early in the problem-solving process to structure their search for more information (Allal, 1974; Elstein, Shulman, & Sprafka, 1978; Gordon, 1972; Kraus, 1976).

Associative Processes of Problem Formulation. The items under the two previous topics were developed to investigate strategies the nurses used as they generated problem formulations. The items under this topic were designed to determine whether the act of generating problem formulations entailed associative processes; i.e., rapid cue-to-problem formulation retrieval, essentially outside the realm of conscious search. There were two items of relevance to this topic. Their purpose was to determine whether problem formulations were immediately brought to mind: (1) by some "particularly salient cue," (item 24) and/or (2) by a combination of cues (item 15). Both of these items were checked relatively frequently (.58 and .67 respectively). Both items were checked consistently by six subjects. Item 24 was checked consistently across situation 5; item 19, across situations 1 and 3.

On examination of the checklist items, those items with consistently high relative frequencies (items 12, 15, 19, 24, and 27) were those which support the notion that nurses use multiple hypotheses developed from combinations of cues, and in one situation, a single cue which might appear to be extremely important. It would appear, then, that the generation of multiple problems from combinations of cues was derived from individual and task environment variables. It would also appear that, in some task environments, one salient cue may be used to generate multiple problem formulations. However, since the relative frequencies of items 15 and 24 were nearly the same, more research would be necessary to substantiate this finding. In addition, the task environment variables in these situations may have influenced the associative processes used by the subjects.

Cue Utilization. The items under this topic were designed to measure several aspects of the nurse's information processing behavior with respect to detecting, interpreting, and using cues. These were: (1) focusing on verbal cues (item 11) and/or nonverbal cues (item 5), (2) relating verbal with nonverbal cues (items 4 and 7), (3) focusing on certain cues and paying less attention to others (item 21), and (4) relating cues sequentially as the data were presented (item 23). The analysis of the data suggests the following conclusions regarding cue utilization.

When viewing the videotapes, some nurses tended to rely more heavily on the patients' nonverbal communication than his verbal communication patterns (items 5 and 11, .5 and .06 respectively). Item 5 was a stable characteristic of three nurses, but it was only used consistently in situation 4. More often than not, however, the nurses tended to look at relationships between the verbal and nonverbal cues, as supported by the relative frequency with which item 7 was selected (.67). In addition, this item was consistently selected across situations 1 and 3. Therefore, it would appear that relying on nonverbal behavior or seeking relationships between verbal and nonverbal behavior was more characteristic of the nurses' cue utilization strategies than relying solely on the patients' verbal cues. Since these two items were consistent across only half of the situations, it was not possible to determine if cue utilization strategies were more related to the task environment or to individual characteristics of the nurses. Probably a combination of the two existed.

The item concerned with giving more weight to some bits of data rather than others (item 21) had a low relative frequency score (.13) and was not checked consistently by any subjects or across any situations. Some of the nurses indicated in their recall protocols that although some pieces of information may eventually become more important than others, they preferred to look at all cues initially before making decisions about which were more important than others. This strategy may be useful in guarding against premature closure, since a cue that may seem insignificant may grow in importance depending upon what hypotheses the nurse may be proposing.

Finally, very few nurses selected item 23 (relative frequency, .17), which was concerned with using cues sequentially as they were presented. This would indicate that the nurses were able to selectively use cues and to categorize them throughout the situations or to chunk them mentally when they occurred. This process would reduce the amount of cognitive strain that would occur if the nurses had to process each cue as it occurred.

Conclusions

Several tentative conclusions may be drawn from the analysis of the recall protocol and checklist data regarding the processes involved in the act of generating tentative problem formulations.

1. When generating problem formulations, the nurses tended to use figural modes of mental representation (i.e., developing mental images of patients they had assisted before).

2. In their search for problem formulations, the nurses did not consistently use one strategy. This would

indicate that task environment variables largely determine the initial approaches taken by nurses. This finding substantiates the work of Frederickson and Mayer (1975), who found that nurses did not use any generalizable patterns of problem solving.

3. The majority of the nurses consistently used demographic and other historical data to generate initial problem formulations. From the recall data, most nurses used the patient's age and developmental stage in developing tentative problems. This finding supports Gordon's (1972) research in which she found that nurses used historical contextual cues to generate multiple hypotheses in the early stages of problem solving.

4. Nurses consistently considered pathophysiological disturbances in developing tentative problem formulations. They less frequently based their problems formulations on the patient's medical diagnosis or the emergent nature of the patient's complaints. It would appear that the nurses tried to determine how the cues were related to bodily dysfunctions rather than directly to the medical diagnosis.

5. Nurses consistently used divergent strategies when developing problem formulations. When cues were presented, they tried to associate them with as many problem formulations as they could. Since the instructions of the

exercise encouraged the nurses to do so, the use of this strategy may be exaggerated. However, the nurses overwhelmingly avoided responding to items on the checklist that supported convergent strategies. This finding supports Gordon's (1972) study in which nurses consistently generated multiple hypotheses at the outset of problem-solving activities.

6. Nurses tended to use a combination of cues to develop problem formulations, but in some task environments, one salient cue was used. This finding supports other studies (Broderick & Ammentorp, 1979; Kelly & Hammond, 1964) which noted that experienced nurses used a variety of cues in developing hypotheses about patients.

7. Nurses used a combination of verbal and nonverbal cues or nonverbal cues rather than verbal cues in generating problem formulations. Using nonverbal cues is consistent with figural modes of mental representation, which was noted to be the primary type of mental representation employed by the nurses. Although no previous studies examined these variables per se, Kraus' work (1976) may lend credence to this. In her study, nurses, who had been told that the patient was anxious, looked for behaviors reflective of anxiety (many of which are nonverbal). This finding, however, may be caused more by task environment variables

than individual variables due to the nature of the simulations.

Having analyzed these data with respect to the cognitive processes used by the group of experienced nurses as they performed the simulation exercises, the instructional materials were developed and tested on the sample of freshmen nursing students. The analyses of the results of the experimental phase of the study are described in the next chapter.

CHAPTER 5

RESULTS OF THE EXPERIMENTAL PHASE

This chapter consists of the findings of the experimental phase of the project conducted with freshmen nursing students. It includes two major sections: (1) results of the analyses conducted to test the experimental hypotheses; and (2) results of several supplemental analyses conducted to aid in interpreting the outcomes of the hypothesis tests.

Tests of Experimental Hypotheses

Inter-scorer reliability

Each posttest was scored twice using a blind analysis, once by the investigator and once by another master's prepared nurse. Initially five posttests were selected at random and scored by each person individually. Scores were compared and adjustments made when there were discrepancies among the scores. Subsequently, all posttests were graded and reviewed by each person independently. Agreement on each posttest was consequently a unanimous decision.

Results of Hypothesis Tests

The experimental hypotheses were tested in the following manner. First, a multivariate analysis of covariance was conducted on the dependent variables by entering each in a stepdown procedure to be discussed below.

When it was found that there was a significant F ratio in the multivariate stepdown procedure, a univariate analysis of covariance was conducted on each dependent variable in order to identify the dependent variable(s) on which a significant treatment effect occurred. Third, for each variable having a significant univariate F ratio, the Sheffe *post hoc* confidence interval procedure was used to test for significant differences between each pair of experimental conditions. Both the multivariate and univariate analyses of covariance and the Scheffe test were conducted using the SPSS program (Hull & Nie, 1981).

The observed means and standard deviations on the three dependent variables and on the covariate for each condition are displayed in Table 5.1.

TABLE 5.1.-- Means and Standard Deviations on the Dependent Variables and Covariate, by Experimental Condition

	Experimental Condition		
Variable	Treatment I	Treatment II	Control
CUE	35.85 (9.25)	31.57 (8.69)	29.93 (11.28)
PF	15.08 (6.55)	13.29 (4.43)	9.57 (4.67)
CUE-PF	32.54 (23.22)	27.50 (13.73)	16.07 (7.76)
NUR 150	86.00 (5.20)	84.71 (5.98)	86.00 (5.77)

Examination of the means in Table 5.1 revealed that on each of the dependent variables the Treatment I (i.e., outcome feedback only) means were consistently higher than the Treatment II (i.e., outcome plus process feedback) means. In turn, Treatment II means were consistently higher than the control means. Examination of the standard deviations indicated a high degree of variability in Treatments I and II on the variable CUE-PF and in the control condition on the variable CUE.

The multivariate analysis of covariance included one fixed independent variable (experimental condition) having three levels, with 13 subjects nested in one level and 14 in each of the other two levels, one covariate (final grade in NUR 150, the nursing course immediately preceding the course in which the subjects were enrolled at the time of the experimental phase), and three dependent variables (CUE, PF, and CUE-PF). The ordering of the dependent variables for the conditional stepdown F tests was based on the following deliberations. First, since performance on CUE (i.e., the detection and utilization of cues) is prerequisite to the generation of problem formulation titles (PF), the variable CUE was ordered first and the variable PF second. Thus, for CUE the stepdown F test was the same as a univariate F test, while for PF the stepdown F provided a test of treatment effect on the generation of problem formulation titles with between-group difference on CUE partialled out. Second, since the classification of cues with respect to problem formulations (CUE-PF) is a function of both cues obtained and problem formulation titles generated, CUE-PF was ordered third. Thus, the stepdown F ratio for CUE-PF provided a test of treatment effect on this variable with between-group differences on both CUE and PF partialled out.

The results of the multivariate analysis of covariance are presented in Table 5.2. As is evident from the table,

TABLE 5.2. Multivariate Analysis of Covariance on CUE, PF, and CUE-PF

Stepdown F tests	df	F	p
on CUE	2, 37	1.40316	.259
on PF	2, 36	5.28306	.010
on CUE-PF	2, 35	1.04517	.362

the stepdown F tests yielded the following results: (1) no significant treatment effect on the variable CUE; (2) a significant treatment effect ($p = .01$) on the variable PF conditioned on the variable CUE; and (3) no significant treatment effect on the variable CUE-PF, conditioned on the variables CUE and PF.

In order to determine whether the nonsignificant stepdown F ratio for CUE-PF occurred either because of nonsignificant differences between group means or because of the fact that significant differences existed but had been partialled out in the calculation of the conditional stepdown F ratios, univariate F ratios were calculated for the three dependent variables. The univariate analysis of covariance model was the same as the multivariate model; i.e., one fixed independent variable (experimental condition with subjects nested within three levels) and one covariate (final grade in NUR 150). The results of the analysis of covariance on each dependent variable are presented in Table 5.3. As shown in the table, there was a significant treatment effect on the variables PF and CUE-PF (p = .006 and p = .012, respectively), but no significant treatment effect on the variable CUE.

TABLE 5.3.-- Univariate Analyses of Covariance on CUE, PF, and CUE-PF

Dependent Variable	Sources of Variation	df	MS	F	p
CUE	Group	2	128.06	1.40316	.259
	Subjects: Group	37	91.27		
	Total	39			
PF	Group	2	122.67	5.83686	.006
	Subjects: Group	37	21.02		
	Total	39			
CUE-PF	Group	2	1086.48	5.04379	.012
	Subjects: Group	37	215.41		
	Total	39			

The results of the stepdown and univariate F tests indicated the following conclusions regarding each dependent variable.

1. The differences among adjusted group means on the variable CUE were nonsignificant, as tested by the univariate F ratio.

2. The differences among adjusted group means on the variable PF were significant, as tested by a univariate F ratio or by a stepdown F ratio with PF conditioned on CUE. Therefore, a significant treatment effect on PF was found not only when this variable was tested singly (by a univariate F ratio), but also when between-group variance on CUE was partialled out (by a stepdown F ratio).

3. The differences among adjusted group means on the variable CUE-PF were significant, as tested by the univariate F ratio. However, when CUE-PF was conditioned on CUE and PF (via a stepdown F ratio), differences among groups were not significant. Since significant between-group differences were found on PF but not on CUE, the nonsignificant stepdown F for CUE-PF could be attributed to the partialling out of between-group differences on PF.

The average within-group correlations between the covariate and the dependent variables were .1630 for CUE, .4233 for PF, and .2352 for CUE-PF. Of the three coefficients, only the PF-NUR150 coefficient was found to be significantly different from zero ($p<.003$). Consequently, it could be concluded that the covariate was somewhat effective in increasing the precision of the F tests, particularly for PF. For the variable CUE-PF, a significant univariate F ratio was found in spite of the nonsignificance of the correlation between the covariate and the dependent variable.

Having found a significant univariate treatment effect on the variables PF and CUE-PF, the Scheffé *post hoc* confidence interval procedure was used to test for significant differences on these variables between each pair of experimental conditions. The results of the Scheffé *post hoc* procedure indicated a significant difference in the group means between Treatment I and the control group ($p = .05$). In addition, there was no significant difference between the two treatment groups.

The results on the preceding analysis will now be discussed with respect to each of the experimental hypotheses.

Hypothesis 1:

> The average performance of freshmen nursing students who have undergone instruction in cue detection and problem formulation (Treatment I and Treatment II) will be superior to that of students who have not received instruction, as measured by three dependent variables: (1) CUE score, (2) PF score, and (3) CUE-PF score.

The results of the analysis supported this hypothesis with respect to the variables PF and CUE-PF, but not with respect to the variable CUE.

On the variable CUE there was no significant difference between the treatment group means and the control group mean, although both treatment group means were higher than the control group mean. By expressing the means on CUE as a percentage of the maximum possible score on this variable (75), it is found that the average performance under all three conditions was less than 50% (47.8% for Treatment I, 42.1% for Treatment II, 39.9% for the control group).

On the variable PF the treatment group means for Treatment I differed significantly from the control group mean. Since the treatment and control subjects did not differ on the variable CUE, the significant differences on PF cannot be attributed to a failure on the part of the control subjects to acquire sufficient cues to generate problem formulations. Therefore, based on the analysis of covariance results, it can be concluded that the effect of the instructional strategy was to improve the subject's skill in making use of the cues obtained.

On the variable CUE-PF the treatment I group mean was significantly different from the control group mean. Thus, the instructional strategy was also effective in improving subjects' performance on the task of classifying cues with respect to the problem formulation categories of major importance for the situation. However, the results of the stepdown F test on CUE-PF indicate that between-group differences on this variable can be attributed to the between-group differences that occurred on PF. Therefore, it may be concluded that although the instructional strategy significantly improved the subjects' performance on CUE-PF, this effect was a function of improvement in the thoroughness and appropriateness of the problem formulations they generated.

Hypothesis 2:

> The average performance of freshmen nursing students who have undergone instruction in cue detection and problem formulation involving outcome and process feedback (Treatment II) will be superior to that of students who have received instruction in cue detection and problem formulation involving outcome feedback only (Treatment I), as measured by the three dependent variables (1) CUE score, (2) PF score, and (3) CUE-PF score.

There were no significant differences between the two treatment groups on any of the variables. Thus, the second experimental hypothesis was not supported. Moreover, the direction of observed differences indicated a trend in the opposite direction than that hypothesized: namely, the means for the "outcome feedback only" condition (Treatment I) were consistently higher than the means of the "outcome plus process feedback" (Treatment II) condition. Consequently, it appeared that Treatment I was superior to Treatment II. Further interpretation of the results of the hypothesis tests will be undertaken in the second section of this chapter.

Relationships Among Dependent Variables

As described in Chapter 3 (pp. 98-106), each dependent variable scoring key was designed to measure a distinct component of the subject's performance on the basic posttest task. It was assumed that the measures would show moderate positive intercorrelations, but that no correlation would be so high as to indicate that performance on one variable could be fully predicted by performance on any other(s). In particular, it was suggested that the ability to classify cues with respect to problem formulations would not be a simple linear function of performance on the two single-dimension variables (CUE and PF). The keys were constructed so that even though two subjects had identical CUE and PF scores, they could differ in performance on CUE-PF. The results of the stepdown F tests indicated that, at least so far as between-group differences were concerned, performance on CUE-PF could be predicted by performance on PF. In order to determine if this were also true at the within-group level, a within-group multiple linear regression of CUE-PF on PF and on CUE was carried out. Results of these regression analyses are shown in Table 5.4 for each of the three groups.

Although all dependent variables displayed positive correlation coefficients with each other, the strength of the correlations was not constant among the three

TABLE 5.4.--Relationships Among Dependent Variables
Within-Group Correlations Among Dependent Variables

	CUE	PF	CUE-PF
CUE	1.0000*		
	1.0000		
	1.0000		
PF	.1777	1.0000	
	.4899	1.0000	
	.0566	1.0000	
CUE-PF	.6172	.3615	1.0000
	.5504	.7288	1.0000
	.2918	.5536	1.0000

Multiple Regression of CUE-PF on CUE and PF (within-group)

Dep. Var	Multiple r	r^2	r^2 Change	Simple r
CUE	.61723	.38098	.38098	.61723
	.76179	.58032	.04920	.55043
	.61199	.37453	.06809	.29185
PF	.66820	.44650	.06552	.36159
	.72878	.53112	.53112	.72878
	.55357	.30644	.30103	.54798

*Scores are represented by Treatment I (top line), Treatment II (middle line) and Control (bottom line).

experimental conditions. In Treatment I there was a weak positive correlation coefficient between CUE and PF but a strong correlation between CUE-PF and CUE. Stepwise regression coefficients confirmed this relationship, with CUE accounting for 38% of the variance in CUE-PF and PF accounting for an additional 6.5%. It would appear that, for this group, within-group performance on CUE-PF was a linear function of performance on CUE primarily and PF secondarily. These results indicated that the subjects in Treatment I may have obtained cues from the situation and deliberated first as to the association of the cues with problem formulations and then developed problem formulation titles.

For Treatment II and the control group, the linear relationship between PF and CUE on CUE-PF differed from that of Treatment I. The estimates of variance accounted for by step-wise addition of PF and CUE to the equation indicated that PF alone accounted for 53% and 30% of the variance (in Treatment II and the control group, respectively), while the addition of CUE accounted for only an additional 5% and 7% respectively. Since the multiple r for these two groups was high (.55 to .76), it would appear that within-group performance on CUE-PF for these two groups was a linear function of performance on PF and CUE. For these groups, therefore, a subject obtained the cues presented in the situation and generated a set of problem formulation titles. Classification of cues to problem formulations did not appear to pose any further difficulty.

Supplemental Analyses

Additional Posttest Tasks

As detailed in Chapter 3, two additional tasks were administered at the posttest session in order to determine whether failure in the processes of cue detection, encoding and retrieval may have inhibited performance on the basic posttest task as measured by the three dependent variables. The CUE score was a weighted sum of points obtained for each cue a subject listed under at least one problem formulation title. Since there was no significant difference in the group means on this dependent variable, apparently failure in cue acquisition was not responsible for low performance on the PF variable in Treatment II and the control group. The additional posttest tasks were administered in order to aid in interpreting the experimental outcomes in the event that there were significant between-group differences on CUE. Since there were no differences on CUE, the data from the additional posttest tasks corroborates the conclusions reached in the first section of this chapter.

The subject's performance on the Recognition of Cues task was summarized in terms of the number of each type of item he checked: (1) number of cues (out of 17); (2) number of consistent distractors (out of 7); (3) number of contradictory distractors (out of 5); (4) and number of inconsistent distractors (out of 5). In some instances a subject failed to check a cue on the recognition sheet even though he had listed it under one of his problem formulations in carrying out the basic posttest task. Since the primary purpose of this analysis was to determine the number of cues the subject had obtained from the situation and could have potentially used in generating problem formulations, an additional variable was also calculated: number of cues obtained (i.e., number of cues checked on the recognition task plus the number of cues used on the basic posttest task but not checked on the recognition sheet). Group results on each of these measures are presented in Table 5.5.

Of the cues that were listed on the Recognition of Cues sheet or by the subjects in the basic posttest task, all subjects listed at least half. The majority of the subjects in all three groups listed the following cues: coughing, complaining of chills, moving frequently in bed, thirsty, temperature of 103°, facial expression of discomfort,

TABLE 5.5.--Results of the Recognition of Cues Task by Experimental Condition

Variable	Treatment I	Treatment II	Control
No. cues checked	11.54 (7-14)*	11.50 (8-15)	11.57 (8-15)
No. cues detected	12.15 (8-14)	12.00 (8-15)	13.93 (8-15)
No. distractors			
consistent	.38 (0-2)	.29 (0-2)	.14 (0-2)
contradictory	1.00 (0-5)	2.21 (0-3)	.57 (0-3)
inconsistent	1.54 (0-4)	.79 (0-2)	.71 (0-3)

*Ranges for each item are listed in parentheses.

states her operation hurts, dry lips, warm skin, receiving IV fluids, is not permitted anything by mouth, and states her IV hurts. These were all cues that were weighted with a 3 or a 4 on the CUE scoring key (indicating that they were selected by the majority of the experienced nurses). All of the four remaining cues that were not listed by the majority of the subjects were weighted with a 2, indicating that they were checked by less than half of the experienced nurses. Clearly, the detection, encoding and retrieval of cues carrying the most weight presented no obstacle to carrying out the basic posttest task, and therefore did not contribute to the between-group differences on PF.

Examination of the cues that had been listed by the subject on the basic posttest task, but not checked on the Recognition of Cues task, revealed that 17 subjects failed to check cues on the additional posttest task while including them in the basic posttest task. Of these, eight subjects failed to check the cue, "states operation hurts," while listing it as a cue in the basic task. Deletion of this cue may have been due to the manner in which it was presented in the videotape. In the situation, the patient stated, "Everytime I cough, my operation hurts." Perhaps the subjects did not pick up on this cue due to the presentation of two cues simultaneously. Five of the detected but unrecognized cues were the patient's complaint of her IV hurting. Three subjects listed two cues but failed to list them on the additional posttest task. All of the other subjects deleted only one cue. Thus, with the exception of the cue related to the pain from the operation, there was very little forgetting of cues between the two tasks.

Examination of the distractors checked on the recognition task indicated that there were very few errors. Subjects were least likely to check consistent distractors. Of all of the distractors, those that were consistent with the other cues or more closely related to the valid cues should have been the ones to be checked rather than the contradictory or inconsistent distractors. However, there were several subjects who selected more than one contradictory or inconsistent distractor (one subject in Treatment I selected five contradictory distractors). In fact, examination of the means for all three conditions revealed that the control condition consistently had lower means on distractors than the two treatment groups.

In the second additional posttest task, the subject was provided with a list of the cues presented in the situation and asked to make any additions he wished to his original response sheets. The purpose of this task was to determine if performance on the basic posttest task would have been higher if the process of generating problem formulations had not been dependent on the subject's detection, encoding and retrieval of cues. For each subject a new set of PF, CUE and CUE-PF scores was calculated on the basis of his initial reponses plus his additions to his reponse sheets. As discussed in Chapter 3, additions to response sheets could occur for two reasons: (1) because the list of cues provided the subject with data which he had failed to obtain while participating in the simulation, and (2) because the list provided the subject with a second exposure to cues he had originally obtained, but failed to use in generating problem formulations. Since the present analysis was concerned only with the first factor listed above, the following criteria were used in determining which additions a subject made would be included in the calculation of his new dependent variable scores. First, problem formulation titles were counted as additions providing that at least one of the cues listed under this title had not been previously obtained. Second, cues were counted as additions only if not previously listed.

The results of the additions task are presented in Table 5.6. There was considerable change in the group means with regard to variables CUE and CUE-PF. On these variables the increments in the group mean were fairly constant across experimental conditions, with Treatment I having the largest increase in CUE and PF scores and Treatment II having a slightly higher increase in CUE-PF score. A multivariate analysis of covariance was performed on these adjusted scores. The results of this analysis revealed that the difference in group means was statistically significant for both the PF and CUE-PF scores. In fact, the level of significance increased ($p = .010$ for PF and .003 for PPF) and $p = .362$ for CUE-PF and .028 for PCUE-PF). A Scheffé _post hoc_ confidence interval was performed on these data, which revealed that the difference in means was again

TABLE 5.6.-- Means and Standard Deviations on the Posttest Additions to Dependent Variables, by Experimental Condition

Variable	Experimental Condition: Treatment I	Treatment II	Control
CUE*	35.85	31.57	29.93
PCUE**	50.23	45.50	41.93
(sd)	(9.29)	(11.63)	(12.34)
PF	15.08	13.29	9.57
PPF	15.92	13.71	9.57
(sd)	(6.33)	(3.81)	(4.67)
CUE-PF	32.54	27.50	16.07
PCUE-PF	41.15	35.35	23.42
(sd)	(27.60)	(17.94)	(10.77)

*CUE, PF, and CUE-PF means for the basic posttest task.
**PCUE, PPF, and PCUE-PF means for the additions to the posttest task.

Mean increment for subjects whose scores changed	Treatment I	Treatment II	Control
CUE	14.5	13.64	12.92
(n)	(12)	(14)	(12)
PF	6	3.67	0
(n)	(1)	(3)	0
CUE-PF	11.0	11.2	9.9
(n)	(11)	(10)	(10)

significant for Treatment I and the control group for both PF and CUE-PF scores. These findings substantiated the basic posttest data results, but they also indicated that when the experimental conditions were given additional information, the treatment groups were able to increase their scores to a greater extent than the control condition. In addition, the superiority of Treatment I was sustained throughout the additional posttest tasks. That there was no statistically significant increase in the CUE score across the three conditions corroborated the conclusion drawn from the hypothesis tests reported earlier: namely, treatment-control differences in the generation of problem formulations cannot be attributed to differences in cue acquisition.

TABLE 5.7.--Multivariate Analysis of Covariance on PCUE,PPF, and PCUE-PF

Stepdown F tests	df	F	p
on PCUE	2, 37	2.09702	.137
on PPF	2, 36	8.51622	.003
on PCUE-PF	2, 35	1.40250	.028

Treatment-Control Differences in Problem Formulations

Several supplemental analyses were undertaken in order to determine more precisely the nature of the significant treatment-control differences that were found on the variable PF. The first analysis was concerned with the structural properties of the "problem spaces" generated by subjects under each experimental condition. As discussed in Chapter 4, four features were found to be characteristic of the sets of problem formulations generated by the experienced nurses: (1) hierarchical organization; (2) competing formulations, (3) multiple subspaces, and (4) functional relationships. In addition, it was found that the size of the nurse's set of formulations could be measured in terms of how many problem formulations and subspaces it contained. Analysis of the student data relating to these six variables yielded the results presented in Table 5.8.

TABLE 5.8.--Analysis of the Structure of the Students' Sets of Problem Formulations, by Experimental Condition

Variable	Treatment I	Treatment II	Control
Structural Features*			
Hierarchical Organization	5	4	1
Competing Formulations	1	1	2
Multiple Subspaces	10	14	11
Functional Relationships	0	0	1
Problem Space Size**			
Number of problem formulations	4.15 (2-8)	3.89 (2-8)	2.43 (0-4)
Number of subspaces	3.62 (1-6)	3.43 (2-5)	2.28 (0-3)

*Number of students whose set of problem formulations exhibited each feature.
**Average number of each variable (ranges in parentheses).

In order to determine whether the observed treatment-control differences on the measures of problem space size were statistically significant, a multivariate analysis of covariance was conducted (with the final grade in NUR 150 as the covariate). The results of the analysis, reported in Table 5.9, indicated the following: (1) a significant main effect for treatment (p <.003) on the number of problem formulations; and (2) a significant main effect for treatment on the subspaces (p<.001). The results of the stepdown F tests revealed that a large percentage of the variance in problem formulations was accounted for in the number of subspaces (as indicated by the F ratio of .668 for the stepdown test of subspaces on problem formulations).

TABLE 5.9.--Multivariate Analysis of Covariance on Number of Problem Formulations and Subspaces

F tests	df	F	p
Subspaces	2, 37	8.978	.001
Problem Formulations	2, 37	8.433	.001
Stepdown F tests			
on number of subspaces	2, 36	8.978	.001
on number of pro-lem formulations	2, 37	.407	.668

In order to test for significant differences on these variables between each pair of experimental conditions, a

Scheffe post hoc procedure was executed. This procedure yielded the following results: (1) the Treatment I and Treatment II means were significantly higher than the control means on both number of problem formulations and number of subspaces ($p < .05$), and (2) the difference between the treatment groups was not significant on either variable.

Comparison of the Treatment Conditions

Although there were no significant differences in the means for each of the treatment conditions on the dependent variables, it was noted that on every variable examined in the hypothesis tests, the direction of the difference between the groups was in favor of Treatment I. In the supplemental analysis, the two treatment group means on problem formulations and subspaces were significantly higher than the control group. Since the major analysis of problem formulations was related to a score derived from the data obtained from the experienced nurses, it would appear that the subjects in Treatment I possessed higher means because they identified problem formulations carrying greater weight than those of Treatment II group. When the data were subsequently analyzed for number (without regard to weight), both treatment groups had higher means than the control group. Thus, there was evidence to suggest that both treatment methodologies increased the size and depth of the subjects' problem spaces, but, if one type of instructional strategy was to be preferred, it would be the "outcome feedback only" procedure rather than the "outcome plus process feedback" procedure.

PF Scores on Five Situations. PF scoring keys were prepared for each of the five simulations used in the instructional phase of the experiment. Table 5.10 presents the treatment group means and standard deviations on PF for each of the films.

TABLE 5.10.--Means and Standard Deviations of Treatment Group PF Scores on the Five Situations

Situation	Treatment I	Treatment II
1[a]	11.15 (3.11)	14.57 (4.13)
2	10.69 (6.33)	11.36 (5.23)
3	13.85 (3.13)	15.14 (5.38)
4[b]	13.92 (3.86)	9.79 (4.12)
5	10.54 (2.07)	8.79 (4.49)

[a]The treatment group means on Situation 1 are significantly different at $p < .05$, $F = 5.785$, with 1 and 24 df.

[b]The treatment group means on Situation 4 are significantly different at $p < .05$, $F = 6.905$, with 1 and 24 df.

The results were inconclusive, regarding any trend in superiority of Treatment I over Treatment II. It is possible that over time a trend of one type of feedback superiority might have been evident.

Questionnaire Results. A second supplemental analysis was based on the responses to the questionnaire, administered at the end of the posttest session. The questionnaire was designed to determine the students' opinions of the instructional sessions and the materials. A subject's response to each item on section 1 of the questionnaire was scored on a five-point scale: -2 = strongly disagree; -1 = disagree; 0 = no opinion; +1 = agree; and +2 = strongly agree. The group means and standard deviations for each item are listed in Table 5.11.

In addition, each subject's score on three summary variables was calculated. These variables were as follows:

1). EVSITUATION: the subject's evaluation of the five situations (i.e., the mean of his responses to items 3-7 and 12, with the sign reversed for 4).

2). EVFEEDBACK: the subject's evaluation of the feedback materials (i.e., the mean of his responses to items 8, 9, 10, and 13, with the sign reversed for 10).

3). EVGENERAL: the subject's evaluation of the overall effectiveness of the instructional materials and procedures (i.e., the mean of his responses to items 11, 17, and 19).

The group means and standard deviations on these variables are reported in Table 5.12. In order to test the significance of the differences in the group means, a one-way fixed effects analysis of variance was performed on each variable. The results of these analyses are found in Table 5.13. A review of the data from these tables suggested the following conclusions with regard to the students' opinions of the simulations.

First, both groups evaluated the videotapes, feedback materials, and the instructional procedures as a whole in a positive manner. Although the Treatment II means for evaluation of the simulations and the feedback materials were slightly higher than the Treatment I means, there was no significant difference in the between-group means. Therefore, it may be concluded that the overall evaluation of the simulations was positive among the students, without regard to treatment.

Second, a review of Table 5.11 suggested that, among individual items on the questionnaire, there was little variation in between-group means. There were, however, a few exceptions. With regard to the feedback materials, the means to the individual items (10 and 14) were weighted

TABLE 5.11.--Means and Standard Deviations of Treatment Group Responses to Questionnaire Items (Section 1).*

Item	Treatment I	Treatment II
1. The instructions were generally clear and easy to follow.	1.000 (.7071)	.9231 (.8623)
2. The instructional sessions were too long.	-.6923 (1.0316)	-.5385 (.9674)
3. The actors who played the role of patients were convincing.	1.2308 (.8321)	1.3846 (.6504)
4. The dialogue in the videotapes was sometimes difficult to follow.	-.3077 (1.1821)	-.4615 (1.0500)
5. The videotapes provided a realistic simulation of patient situations.	1.2308 (.5991)	1.3846 (.8697)
6. The nurses in the situations did a good job of interacting with the patients.	-.1538 (1.3445)	.9231 (.8623)
7. I enjoyed watching the films.	1.0769 (.7596)	1.2308 (.4385)
8. The written materials in the patient situations were easy to understand.	.8462 (.9871)	1.3846 (.5064)
9. The feedback materials were well organized and easy to follow.	1.2308 (.5991)	1.2308 (.4385)
10. The feedback materials were somewhat overly redundant.	-.4615 (.9674)	-.0769 (1.0377)
11. The opportunity to compare my problem formulations to those of experienced nurses helped me to improve my skill in generating tentative problem formulations.	1.3077 (.6304)	1.2308 (.9268)
12. The patient situations were too complicated for me to follow.	-1.0769 (.6405)	-.5385 (1.1266)
13. I found the feedback materials interesting.	1.4615 (.5189)	1.4615 (.5189)

*As measured on a five-point scale: +2=strongly agree; +1=agree; 0=no opinion; -1=disagree; -2=strongly disagree

TABLE 5.11 continued

Item	Treatment I	Treatment II
14. Treatment I: The third viewing of the videotape helped me to consolidate my understanding of the situation. Treatment II: The third viewing of the videotape, which portrays the nurse thinking aloud during her interaction with the patient, provided me with an understanding of the process by which the experienced nurses generated tentative problem formulations.	.7692 (.8321)	1.3077 (.8549)
15. Treatment I: The third viewing of the videotape was not worthwhile. Treatment II: The "think aloud" segments during the third viewing of the videotape tended to disrupt my own thinking process.	-.7692 (.8321)	-1.000 (.7071)
16. The Self-Evaluation Checklists helped me to evaluate my performance as compared to that of experienced nurses.	1.4615 (.6602)	1.0769 (.7596)
17. My ability to generate tentative problem formulations has improved as a result of using this instructional package.	1.0000 (.7071)	1.0385 (.4935)
18. For some of the situations, I did not have enough nursing knowledge to be able to generate appropriate problem formulations.	.8462 (.8987)	.7692 (1.0919)
19. If a library of situations like these, with accompanying feedback materials, was available to nursing students, I would make use of it.	1.3846 (.5604)	1.5385 (.5189)
20. It would be more interesting to use the videotapes and feedback materials in a group setting than in an individual self-instructional format.	.7692 (1.1658)	.3846 (1.2609)

TABLE 5.12.--Means and Standard Deviations of Treatment Group Scores on Evaluation Items from Questionnaire

Score*	Treatment I	Treatment II
EVSITUATION	.7938 (.4563)	.9885 (.3483)
EVFEEDBACK	1.000 (.4449)	1.0385 (.3798)
EVGENERAL	1.2823 (.4872)	1.2823 (.5602)

*Range of scale is from +2 (highly positive) to -2 (highly negative).

TABLE 5.13.--Analyses of Variance on the Questionnaire Scores: EVSITUATION, EVFEEDBACK, and EVGENERAL

Score	Sources of Variation	df	MS	F	p
EVSITUATION	Between groups	1	.2462	1.051	.2335
	Within groups	24	.1648		
EVFEEDBACK	Between groups	1	.0096	.056	.8146
	Within groups	24	.1711		
EVGENERAL	Between groups	1	.0000	.000	1.000
	Within groups	24	.2756		

more favorably in the direction of Treatment II. On one item (5) there was a difference in the direction of the group means indicating that, on the average, the Treatment I subjects did not approve of the nurses' interactions with the patients. During the sessions, several students expressed informally that they disagreed with the nurses' approach to the patients, stating that the nurses did not appear to be empathetic to the patients' problems. Evidently, some students were uncomfortable with the notion that the nurse would not act more quickly on the patient's behalf. [In contrast, the experienced nurses almost uniformly ignored the interactive aspects of the videotapes and focused solely on the patient problems. In one situation, however. in which the patient's symptoms were pointing to a low blood sugar, the experienced nurses indicated that the nurse in the situation should have appeared more concerned than she did. In general, it would appear that the experienced nurses had no difficulty separating the nurse's interaction with the patient and the presentation of the patient's problem.]

Finally, both treatment groups' indicated that the students believed that they did not have enough nursing knowledge to be able to generate appropriate problem formulations (item 18), although the mean response to an improvement in their ability to generate problems (17) was also positive. In addition, both group means indicated a strong positive response to item (19), indicating that the students believed they could learn from the simulations.

In summary, analysis of the questionnaire data indicated that there was no significant difference in the opinions of the two treatment groups relative to the instructional procedures, feedback materials, or simulations. Both group means indicated a positive response to these three parts of the instructional strategy.

The next chapter consists of a summary of the project, a discussion of the findings with respect to findings from previous research on problem solving in nursing, implications of the project, and suggestions for future research.

CHAPTER 6

CONCLUSIONS, DISCUSSION, AND IMPLICATIONS

This chapter consists of three sections: (1) summaries and conclusions of the study, (2) discussion of the results, and (3) implications for future research and instructional development.

Summary of the Study

The aim of this study was to determine if selected problem-solving skills of freshmen nursing students could be enhanced by an instructional strategy that combined simulated patient encounters with two types of feedback obtained from experienced nurses. The selected problem-solving skills were: (1) the detection, encoding, and retrieval of cues and (2) the generation of tentative problem formulations. The study consisted of three phases: (1) development of the videotaped simulated patient situations; (2) collection of problem-solving data from a sample of experienced nurses who participated in the simulation exercises; and (3) development and testing of an instructional package designed from the data obtained by analyzing the experienced nurses' problem-solving processes and outcomes.

In the experimental phase, the sample of freshmen nursing students was randomly divided into three groups:

(1) Treatment I, which performed the simulation exercises and received outcome feedback (i.e., feedback based on the problem-solving outcomes) developed from the sample of experienced nurses; (2) Treatment II, which performed the simulation exercises but received both process and outcome feedback (i.e., feedback based on the processes by which the nurses arrived at their problem-solving outcomes in addition to the problem-solving outcomes themselves); and (3) a control group, which received no instruction but participated in a posttest exercise. It was hypotheseized that the selected problem-solving skills of the treatment groups would be significantly improved by the instructional strategy. It was further hypothesized that the skills of the Treatment II group, which received outcome and process feedback, would be enhanced more than the Treatment I group, which received outcome feedback only. The selected problem-solving skills were measured by a set of three dependent variables: (1) CUE score, which measured the subject's ability to detect cues; (2) PF score, which measured the ability to formulate problems, and (3) CUE-PF score, which measured the ability to associate cues with specific problem formulations.

The results of the posttest were analyzed using a multivariate analysis of covariance, with the covariate as the final grade in the nursing course immediately preceding the course in which the students were enrolled at the time of the study. The results of the developmental and experimental phases of the study are described in the following sections.

Problem Formulation Outcomes and Processes by the Experienced Nurses and Implications for Future Research

Conclusions drawn from the analysis of the nurse data were tentative due to the small size of the sample and limited problems. Nevertheless, since this analysis examined the nurse's initial problem formulations in greater detail than had been done in previous studies, it may provide some valuable indications as to directions future research in nursing problem solving could take.

Analysis of the nurse data revealed that what results from the nurse's information-processing activity is not a unidimensional list of problem formualtions, but one that contains features described in previous research on the structure of the problem space in medical problem solving (Allal, 1974). These features include hierarchical organization, competing formulations, multiple subspaces, and functional relationships. Of these features, multiple subspaces were found to be present almost uniformly across task environments and individual subjects. This finding is consistent with one of the primary goals of nursing; i.e., to assist people who, for reasons of illness, are unable to or have difficulty with meeting their own basic needs. Since all people have multiple basic needs, the nurses usually structured their sets of problem formulations by determining which of the basic needs were being disturbed by illness. Consequently. the multiple subspace forms the predominant structure of the problem space. Which and how many of the other three features are present, on the other hand, are more likely to be a function of the task environment (properties of the situation) and individual variables (characteristics of the nurses).

With respect to the processes involved in generating a set of tentative problem formulations, the findings of this study suggest that: (1) the major mode of mental representation is figural; (2) nurses consistently prefer divergent strategies to convergent strategies; (3) nurses consistently use associative linkages of cues in their search for hypotheses; 4) in some task environments, nurses use one salient cue to develop multiple hypotheses; (5) nurses use patient demographic and other historical contextual variables as well as the pathophysiological basis for cues; and (4) nurses use both nonverbal and verbal cues. In addition, it was found that, in their development of sets of tentative problem formulations, nurses do not employ consistent strategies across situations. It is possible that specific strategies do play an important role in the generation of problem formulations, but that reliance on introspective and retrospective data may not be the means for identifying them.

Instructing Nursing Students in the Generation of Tentative Problem Formulations

Conclusions

The results of the experimental phase support two major conclusions:

1. An instructional strategy, which consists of: (a) problem-solving exercises using videotapes and written materials to simulate nurse-patient situations and (b)feedback based on data obtained from a sample of experienced nurses, is an effective method of improving freshmen nursing students' skills in generating sets of tentative problem formulations.

2. The instructional strategy is just as effective, if not more so, for freshmen nursing students when it provides outcome feedback only, rather than outcome and process feedback.

The analysis of student posttest performance in terms of three dependent variables (CUE, PF, and CUE-PF scores) suggests the following conclusions regarding the nature of the instructional effect:

1. The major effect of the instruction is in the improvement of the students' ability to generate problem formulations.

2. Additionally. the instruction significantly improves the students' ability to make use of cues, once obtained, in order to generate a set of problem formulations.

Discussion of Results

On the Dependent Variable CUE. There were no significant differences in means among all three conditions, but all three conditions achieved scores of less than 50% of the total possible score. Even when subjects were given the list of cues deemed to be relevant by the experienced nurses (in the additional posttest task), all groups increased their mean scores, but the highest mean score achieved (Treatment I) approached 67% of the total possible. Thus, it appeared that all three groups, while being able to detect some cues, were still developing this skill. This finding is consistent with previous research findings indicating that novices and experts alike are able to detect and categorize cues (Broderick & Ammentorp, 1979; Newell & Simon, 1972; Nichols, 1968; Verhonick, Nichols, Glor, &

McCarthy, 1968). However, cue detection has been found to increase with experience and education (Verhonick, Nichols, Glor, & McCarthy, 1968). Since the subjects were freshmen students, their relatively low score on this variable was not incongruent with past findings. In fact, several subjects commented (in the questionnaires) on their inadequacies relative to this skill. One student wrote: "As a[n] LPN I am ashamed to say I misdiagnosed many things and did not see some problems as well as not being too observant [of cues]."

Relative to cue acquisition, there was one particular worrisome finding. This was evidenced by the results of the "Recognition of Cues" task. Subjects in both treatment groups selected more inappropriate cues than did the control subjects. One could speculate that the experimental subjects had become too careless in their observational skills. However, if this were true, the CUE and CUE-PF scores would probably have been lower. All subjects recorded very few inaccurate cues on the problem formulations sheets in the basic posttest task. Perhaps the students were still in the process of learning how to detect and encode cues.

<u>On the Dependent Variable PF</u>. The within-group mean for Treatment I was significantly higher than that for the

control group. Therefore, it was concluded that the effect of the instructional strategy was to improve the subject's skill in formulating problems. This finding differed from a previously cited study (Tanner, 1977), who found no significant difference in treatment and control means after teaching a nursing unit based on cue linkages rather than traditional signs and symptoms of specific conditions. There were several notable differences between Tanner's approach and the approach used in the present study. First, Tanner based her approach on assumptions about cue linkages without testing them on expert nurses. Therefore, her assumptions may not have been validated if tested. Second, Tanner found that, in testing the research hypothesis, subjects who failed to generate the correct problem in their initial sets of problem formulations were unsuccessful. In the present study, the cues were designed to generate multiple hypotheses that would structure the nurse's search for solution. Subjects were told that there were no right or wrong hypotheses but that the cues should be used to develop multiple hypotheses. The results of this study indicated that experimental subjects (particularly in Treatment I) were able to generate more appropriate hypotheses than control subjects. Theoretically, therefore, the experimental subjects would have increased in their abilities to structure more extensive problem spaces at least on a horizontal dimension (as evidenced by the data on the structure of the problem spaces) than the control subjects.

On the Dependent Variable CUE-PF. Univariate analysis of covariance demonstrated a significant difference in the between-group means. The Scheffe post hoc confidence interval revealed that the differences in group means were significant at the .05 level for Treatment I and the control group. This finding supports the results obtained from Broderick and Ammentorp's (1979) study, in which novices and experts alike categorized cues to diagnoses in similar fashion. These investigators found, however. that experts were more likely to use pertinent cues and create more appropriate cue linkages than the novices, who tended to sample indiscriminately. In this study, subjects were penalized for inappropriate linkage of cues to problem formulations (by the CUE-PF score). Since there were no significant differences on CUE scores, but significant univariate differences on CUE-PF scores, it would appear that at least for Treatment I, cue linkages were more appropriate and that the instructional strategy made a difference in the way in which the subjects listed cues under problem formulations.

Of the Supplemental Analyses on PF. On the basis of these analyses, it was concluded that the treatment-control difference on the variable PF could be attributed in part to the fact that the subjects in the treatment conditions generated a larger number of problem formulations and subspaces than the control subjects. The larger number of problem formulations and subspaces generated by the subjects in the treatment conditions indicated that one effect of the instructional strategy was to increase the scope (or horizontal dimension) of the subjects' problem spaces.

It is also of interest here to consider the data on subspaces with respect to the parameter of memory organization that has been proposed by Mandler (1967). The range of subspaces generated under both treatment conditions coincided closely with Mandler's proposition than human information-processors organize and store items in terms of 5 ± 2 categories. Under the control condition, however, the number of subspaces never exceeded the lower limit of the range.

An examination of the data on structural features indicated that all three groups used multiple subspaces as the predominant structural feature of the set of problem formulations. In addition, the treatment groups used hierarchical organizations more than the control group.

That fewer control subjects generated hierarchically organized sets of problem formulations may be due in part to the fact that they generated fewer problem formulations, and therefore had less need to use hierarchical organization as a means of increasing working memory storage capacity.

As discussed in Chapter 4, the structure of the set of problem formulations was conceptualized as having four features. The results of this study inicated that the predominant feature of the set of problem formulations of the students was the multiple subspace. This finding was similar to the data obtained from the experienced nurses (p. 128), whose problem spaces consisted of multiple subspaces 89% of the time. In fact, the data obtained from the experienced nurses indicated that the multiple subspace characterized the set of problem formulations most consistently across task environments and subjects. Additionally. the structural feature least used by both students and experienced nurses in these simulations was functional relationships. In these respects, therefore. the students' sets of problem formulations was most like that of the experienced nurses.

The primary differences between the students' sets of problem formulations and those of the experienced nurses appeared to be related to the infrequency of use of hierarchical organization and competing formulations. For Situation 6 (the posttest simulation) both of these features were used by the majority of the experienced nurses (56% and 67%, respectively) but by only a few students. This finding may represent the notion that the novice differs from the expert in the complexity with which each views the set of cues being presented in the task environment. The experienced nurse perhaps possesses a more complex and intricate linkage of cues to hypotheses present in the long-term-memory than does the student. Consequently, when the experienced nurse views a situation, she is able to hypothesize that certain patient problems may be present in a hierarchical or competing fashion. The student, who is learning the set of cues, is unable to draw upon these linkages; consequently, more problems appear to be independently present, rather than subsumed under larger categories, in competition with others, or related to others.

In comparing the data obtained from the number of problem formulations and subspaces of the students and the experienced nurses (p. 133), there were several similarities. The average number of problem formulations for the experienced nurses was 4.44, which is slightly larger than that of Treatment I group. The average number of subspaces for the nurses was less than that of the two treatment groups (2.67). Although these data are highly tentative, it appears that the nurses were able to structure their sets of problem formulations more parsimoniously than the students. This corroborates the finding that the nurses were more apt to use hierarchical organization than did the students (thus reducing the number of subspaces at the superordinate level).

To summarize, the results of the supplemental analyses corroborate the conclusions drawn from the hypothesis tests on the variable PF, namely, that the subjects in the treatment conditions generated more thorough sets of problem formulations.

Differences in Treatment Conditions. In examining the reasons for rejection of the second experimental hypothesis, it was necessary to consider the possibility that "outcome plus process feedback" was superior to "outcome feedback only." but that its effectiveness was not detected due to some failure in the experimental procedure. As discussed in Chapter 3 and described by Campbell and Stanley (1963), there were two potential sources of internal invalidity. The first was concerned with failure of random assignment to yield equivalent groups or selection biases. However, there was little basis for hypothesizing this factor as an explanation of the ineffectiveness of process feedback. The groups had similar scores on the covariate (Treatment I mean on NUR 150, 86; Treatment II, 84.7). In addition, both groups had similar clinical experience in nursing prior to the experiment (Table 6.1).

A second potential source of internal invalidity was extra-session or intra-session history. As described by Campbell and Stanley (1963), "history" pertains to events which occur concurrently with the administration of treatment. The second section of the questionnaire was designed to ascertain if extra-session historical events could have confounded the experimental outcome. In this section, the subject was asked to indicate for each situation: (a) whether he discussed it with other students; (b) whether he discussed it with faculty members; and (c) whether he looked up reference materials relevant to the situation. The numbers of subjects who responded positively to any of these requests are listed in Table 6.1. As indicated, there was no evidence of serious between-group differences with respect to this variable. Moreover, these data may reflect in part the level of interest the subjects had in the instructional materials. The data indicated that over half of the subjects in Treatment I discussed the situations with other students, while over half of the

TABLE 6.1.--Responses to Parts Two and Four of the Questionnaire

Variable	Treatment I	Treatment II
Pursuit of interest in instructional materials outside of sessions		
Number of subjects who:		
(a) discussed with other students	8	6
(b) discussed with faculty	0	2
(c) looked up references	5	8
Clinical experience prior to participation in experiment (40-hour weeks)		
Number of subjects who had:		
(a) 0-12 weeks of experience	8	9
(b) 13-52 weeks of experience	1	1
(c) over 53 weeks of experience	4	4

subjects in Treatment II looked up references pertaining to the situations.

Although there appeared to be no confounding difference in extra-session historical events, the possibility existed that there might be between-group differences due to intra-session historical events, since the majority of the subjects participated in the experimental phase in group sessions. This weakness in the experimental design was recognized at the outset, but could not be avoided because of the impracticality of attempting to administer five instructional sessions individually to 27 students. This source of internal invalidity was thought to be minimized by the use of individual instructional packages. In addition, no events occurred during the sessions to suggest that there were systematic between-group differences in intra-session history. Nevertheless, this possibility cannot be completely ruled out.

Since neither extra-session nor intra-session historical events appeared to be sources of internal invalidity, two alternative explanations were considered for the outcome of the experiment. One was that the process feedback was in fact ineffective (as evidenced by rejection of the second experimental hypothesis). The other was that the process feedback was effective, but that the posttest task failed to demonstrate the effectiveness (as hinted in the statistically significant results obtained by analysis of the means of problem formulations and subspaces of both treatment groups compared with the control group, reported in Table 5.9).

Assuming that failures in the experimental method did not occur (the first explanation), the results indicated that providing the subject with process feedback, in addition to outcome feedback, did not have a positive effect on the development of his problem formulation skills. This assumption was based on two hypotheses. First, it would appear that the Treatment I subjects had no difficulty in inferring the nurses' reasoning processes in order to generate the formulations listed on the outcome feedback sheets. This hypothesis was substantiated by the results of the analysis of the variance in group means on PF scores from each of the instructional situations. Thus, it appeared that the Treatment I subjects were able to provide themselves with self-generated process feedback, and thereby received, in essence, the same "treatment" as the Treatment II group. However. a second hypothesis was needed in order to account for the evidence that there was superiority of the outcome feedback alone. Perhaps the Treatment II condition may have provided the subject with too much feedback. Since the third viewing of the videotape with the process feedback included was longer than the videotape itself, the subjects may have become bored with the feedback. However, there is no objective evidence to support this from the responses on the questionnaire. In fact, one statement made by a Treatment II subject in the third section of the questionnaire would seem to negate this hypothesis. This subject wrote: "I learned that every minute in the patient's room is important--the experienced nurse was formulating problems while I was still saying 'hello.'" This statement could only have been made from someone who had listened to the thought processes of the nurse as she interacted with the patient.

An alternative solution to the rejection of the experimental hypothesis was that the Treatment II condition did in fact increase the subjects' ability to formulate problems, but that the posttest results failed to demonstrate this. The supplemental analyses did indicate a significant increase in the problem spaces constructed by both experimental conditions. Repetition of the experiment on a subsequent group might yield different results.

A third interpretation to be considered was that process feedback could potentially be effective but was not in this experiment due to inadequacies in the data that were obtained from the experienced nurses. In this study, introspection was the technique used to obtain data on cognitive processes. As reported in Chapter 4, the strategies for generating problem formulations employed by the majority of the nurses (and thus included in the "think aloud" segments of the videotapes) were small in number, a factor which may have helped to account for the Treatment I subjects' apparent ability to generate their own process feedback. Of particular note was the finding from the nurse data that the primary mode of mental representation was figural (as opposed to verbal). The majority of the experienced nurses stated that, when they were presented with a problematic situation, they conjured up (among others) mental pictures of patients they had assisted before. This information was incorporated into the process feedback. However, this particular mode of mental representation may not be reflective of the entire porpulation. In fact, Allal (1974) found that physicians primarily used a verbal mode of mental representation (i.e., mental lists). Therefore, the heuristics emphasized in the process feedback may not have been the most representative or most appropriate for the subjects in that treatment group. This may have in part accounted for the failure of that group to have higher scores on the dependent variables.

Limitations

In Chapter 3 the potential threats to external validity were discussed. Of major importance to this project were the notions of the *interactive effects* of selection biases and the experimental variable and *reactive arrangements*. In order to determine whether the study violated the former effect, the subjects were compared with selected demographic characteristics of the universe of associate-degree students (i.e., those enrolled in associate degree programs throughout the U.S.). The subjects' characteristics approached those of the universe of students in all aspects except race. Since the program was housed within a predominantly black institution, the majority of the students in the sample were black. However, the student passage rate for the licensing examination (taken at the completion of the associate degree program) was comparable to the national passage rate (approximately 85%). Since the success of students in nursing education is partially determined by success on the national licensing examination, it would appear that the sample of students approximated the universe of associate-degree students. Nevertheless, it cannot be stated conclusively that the results can be generalized to that universe. Replications of the study might help to determine whether these results can be generalized.

With regard to reactive arrangements, the subjects were aware of the nature of the study but were informed that the emphasis was on simulation exercises, rather than on problem-solving. However, it cannot be discounted that the so-called Hawthorne effect did not influence the results of the experiment and thus the generalization to the universe of freshmen associate-degree nursing students.

Implications for Future Research

Research into Problem-Solving Processes and Outcomes

This study demonstrated one method of collecting data about problem-solving methods in nursing. The method was similar to that used in other types of research that have employed and tested the information-processing theory of problem solving. Applying this theory for further research, one goal might be to determine the way in which the task environment affects the initial problem space developed by experienced nurses. To answer this question, it would be necessary to carefully construct simulations that are highly similar but hold some cues constant while varying others. A second complementary goal of research might be to investigate individual variables to determine which, if any, affect the nurse's problem-solving outcomes. This could be accomplished by the use of simulated cases similar to the ones developed for this study. The emphasis of the research would be to compare problem formulation outcomes with such individual variables as amount and type of clinical experience, area of specialization, cognitive style variables, and personality traits.

Since the findings of the present study did not shed much light on how nurses associate cues and retrieve them from the long-term memory, a second goal of future research might be to attempt to devise tasks which require the subject to externalize the steps in his thinking. This approach was used by Gordon (1972) and based on the research by Bruner. Goodnow, and Austin (1956). Further replications of this type of research with emphasis on gaining information about the nurses' memory structures and cue linkages may help to clarify the cognitive approaches used in problem solving.

The outcomes of these lines of research could have important implications for nursing education. If the generation of problem formulations is found to be primarily a process of figural mental representation from past experiences with patients, then videotaped and other types of simulations that encourage the development of mental pictures should be employed more often in the course of the students' learning. It would also mean that nursing faculty should assist students to remember their clinical experiences by the types of patients they have assisted so that they can draw on their past experiences in future situations.

Research in Teaching Problem-Solving Skills

Given the effectiveness of the simulation-exercises-plus-feedback model as a means of improving the ability of nursing students to generate problem formulations, one possibility for future research would be to apply the model to extended nurse-patient encounters; i.e., not just one brief scenarios. In this manner, the student would have to test initial problem formulations by collecting more data, revising the problem formulations in light of new data, and ultimately making decisions about the prepotency of the patient's needs and ruling out other problems. To extend these simulations it might be necessary to add other written materials or to combine computer-assisted-instruction with videotaped simulations. It might then be possible to teach and evaluate the student's ability to carry out the entire problem-solving process from assessment through implementation and evaluation.

A second type of future research that might be attempted pertains to the feedback component of the model. It would be of interest to determine the degree to which feedback contributes to the effectiveness of the model by comparing students' performance under two experimental conditions: (1) simulation exercises with feedback; and (2) simulation exercises without feedback. A second question of interest is whether there may be an interaction between the type of feedback provided and the level of knowledge of the student. Since many of the students stated in the questionnaires that they sought additional information after the situations, it might be interesting to conduct the study on second-year students rather than freshmen students. It is possible that process feedback might be more effective when students have had more opportunities to formulate a larger repertoire of cues and linkages in their memory organizations. More experienced students might then benefit from comparing their mental processes with those of experienced nurses. This possibility was evident in the pilot testing in which the small sample of second-year students were asked informally which type of feedback they found more interesting. Almost uniformly they preferred the process feedback. Unless it can be demonstrated that process feedback makes a difference in the problem-solving abilities of nursing students, however, this type of feedback should not be included in future instructional programs. The reason for this is the expense in time that the development of such feedback requires (i.e., individual sessions with the sample of experienced nurses), while outcome feedback can be gathered relatively quickly (in group sessions with experienced nurses).

A third line of research might be to determine if other types of simulations would have the same effect on teaching problem-solving. For example, color slides of patient situations could be developed instead of videotapes.

Another type of simulation could be computer-based with decision trees. In the latter type, feedback could be provided by the computer program. However, the use of slides and computers would reduce the fidelity of the simulation. Since the experienced nurses relied heavily on the patients' nonverbal behaviors to generate initial sets of problem formulations, many of these types of cues would be more poorly represented in color slides and computer programs. Nevertheless, comparative studies could be conducted to determine which types of simulations improve students' abilities to detect cues and generate problems.

Since there was firm evidence that the instructional strategy increased the students' size of the problem space, a fourth line of research might be developed which would be designed to enhance the development of the structural features of the problem space. This would include assisting the students to develop other features of the problem space, such as hierarchical organization, functional relationships, and competing formulations.

Instructional Applications

In conclusion, the instructional materials already developed may be used in a number of ways in the nursing curriculum.

1. Self-instruction. Each of the simulation exercises were packaged in self-contained units. The set could be made available on an individual basis. The students' responses to the questionnaire indicated that if a library of such units were available, the majority of the students would make use of it.

2. Group instruction. A number of the students indicated that they would be more interested in participating in the exercises in a group. Such a setting would encourage the students to compare their outcomes and may be effective in assisting students to learn from one another.

3. Evaluation. Simulation exercises have been used for evaluative purposes (McLaughlin, Carr, & Delucchi, 1981; Williamson, 1965). The simulations developed for this project could be used, along with other written materials, in developing a clinical examination of problem-solving abilities.

REFERENCE NOTE

Rice, R. Unpublished research investigating the academic progress of associate degree nursing students at Norfolk State University, classes graduating from 1978 through 1981.

APPENDIX A

CASE OUTLINES FOR THE SIX SITUATIONS

CASE OUTLINE FOR SITUATION 1

"A 55-Year-Old Insurance Salesman"

A. Written information

1. Introduction to patient situation

B. Nonverbal cues

1. Well dressed
2. Carries brief case and suitcase
3. Appears anxious--moving around quickly
4. Inquisitive--examining room
5. Smokes cigar
6. Slits throat when referring to hole in neck
7. Turns back to nurse

C. Verbal dialogue

Nurse asks patient if he has been hospitalized previously. He says that he has had some tests on his neck and begins to look for the results. States that he has been in good health previously. When asked about the present surgery, he states that he will have a lump removed that he cannot feel and that a hole will be put in his neck. He then excuses himself to make a phone call.

CASE OUTLINE FOR SITUATION 2

"A 65-Year Old Retired Librarian"

A. Written information

1. Patient situation
2. Nurses' notes
3. Patient medication administration record

B. Nonverbal cues

1. Hair well kept
2. Many personal articles on bedside
3. Much reading material
4. Patient appears neat, well-groomed
5. Patient speaks clearly, very articulate
6. Answers questions patiently
7. Determined, precise
8. Religious

C. Verbal dialogue

The nurse, holding the patient's pills, approaches the patient. The patient carefully examines the pills and refuses to take them, stating that she does not take them at home. The nurse attempts to convince her that the pills are the same--only that there are two of them at half dose. The patient apologizes but refuses to take them.

CASE OUTLINE FOR SITUATION 3

"A 50-Year-Old High School Teacher"

A. Written Information

1. Patient situation
2. Patient's medication administration record

B. Nonverbal cues

1. Clutching at chest
2. Looks anxious
3. Burping
4. Emerging from bathroom
5. Well dressed
6. Breathing rapidly
7. Lowers self slowly into chair

C. Verbal dialogue

The patient tells the nurse that she was attempting to have a bowel movement when she began to have pain in her chest. The nurse asks the patient to describe the pain. The patient states that the pain started in her back and has gone into her left arm. She says that it may be her arthritis or something that she ate because she does have a hernia. Since she is burping, she figures that it is something that she ate. However, her chest feels quite heavy.

CASE OUTLINE FOR SITUATION 4

"A 70-Year-Old Retired Mechanical Engineer"

A. Written information

1. Patient situation
2. Patient's medication administration record
3. Nurses' notes

B. Nonverbal cues

1. Wearing own pajamas
2. Gesturing in air
3. Has eyes open most of the time
4. Picking at clothing
5. Scratching at chest
6. Restless, moving back and forth in bed

C. Verbal dialogue

Nurse calls to patient whom she sees gesturing with his hands in the air as if he is grabbing at something or milking a cow. The patient answers the nurse appropriately. When she asks if something is wrong, he says that everything is fine. He also states that he is not having any pain.

CASE OUTLINE FOR SITUATION 5

"A 67-Year-Old Retired School Teacher"

A. Written information

1. Patient situation

2. Nurses' notes

B. Nonverbal cues

1. Sleeping

2. Must be called several times to arouse

3. Yawning

4. Wearing own clothes

5. Drifts to sleep evertime she answers a question

6. Points to head as hurting

C. Verbal dialogue

Nurse tries to arouse patient. The patient answers slowly but appropriately to questions. She states that she has a headache. She states that she is not nauseated. She claims that she is a bit cool.

CASE OUTLINE FOR THE POSTTEST

"A 32-Year-Old Homemaker"

A. Written information

1. Patient Situation

2. Nurses' notes

3. Doctor's orders

B. Nonverbal cues

1. Patient arouses slowly

2. Patient looks tired

3. Licking lips as if they are dry

4. Moving about in bed slowly

5. Shivering

6. Coughing

C. Verbal dialogue

The nurse takes the patient's vital signs, checks her dressing, IV site, and catheter drainage system. She asks the patient how she feels. The patient says that she does not feel too good, that everytime she coughs, her incision hurts. The patient complains of being cold and requests another blanket. The patient also states that her lips are dry and wants something to wet her lips. When the nurse tells her that her temperature is elevated, the patient asks what could be causing that. The nurse leaves to check the doctor's orders. The patient asks if she will return. The nurse states that she will be right back.

APPENDIX B

THE RESPONSE SHEETS

Film ______

Problem formulation title: ______________________________

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CUE LIST

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Film___________

SUMMARIZING ASSESSMENT

APPENDIX C

THE PROCESS CHECKLIST

PROCESS CHECKLIST

Subject ______________

Situation ____________

Directions: Check as many times as apply. Do not check items that you consider to be praise-worthy, or which describe your approach to patients in general. Check only those items which characterize your thinking while viewing this particular videotape.

______ 1. As I viewed the videotape, I tried to develop one tentative problem formulation that would account for all the data presented.

______ 2. As I observed the patient and listened to his/her verbal cues, I thought of patients whom I have assisted before.

______ 3. I used the patient's age and other demographic data to "lock in" to a particular mode of thinking about what the patient's tentative problems might be.

______ 4. As a bit of data was presented, I tried to think of how it might be related to other bits of data.

______ 5. In developing tentative problem formulations, I relied more heavily on the patient's nonverbal communication than on his verbal communication patterns.

______ 6. I thought of the underlying pathophysiological disturbances that might be responsible for the patient's verbal and nonverbal cues.

______ 7. I tried to look at interrelationships between verbal and nonverbal cues to develop tentative problem formulations.

______ 8. In attempting to arrive at tentative problem formulations, I tried to think of "way-out" problems; i.e., reasons for the patient's behavior(s) that are not likely or common.

______ 9. In attempting to arrive at tentative problem formulations, it helped me to try to visualize (i.e., to form some sort of mental image of) the anatomical location of the problem.

______10. I tended to wait until I had seen the tape before making tentative problem formulations.

______11. In attempting to develop tentative problem formulations, I paid attention primarily to what the patient was saying.

______12. I used the written information in the patient situation to develop some tentative problem formulations.

______13. One of the first things I tried to do was to think of the most life-threatening problems and rule them out as the data base developed.

______14. The nurses' notes (or doctor's orders) in this situation helped me to determine some tentative problem formulations.

______15. It was the combination of the patient's verbal and nonverbal behaviors that led me to think of tentative problem formulations.

______16. Once I thought of a tentative problem formulation, I had difficulty developing any others.

______17. In developing a list of tentative problem formu-tions, I tried to think of problems I have developed in the past on patients having similar medical diagnoses.

______18. In attempting to arrive at tentative problem formulations, one or more sorts of "mental images" came to mind.

______19. As soon as a tentative problem formulation came to mind, I made an effort to think of other problems that might need to be considered.

______20. As I observed the patient and listened to his/her verbal cues, I thought of textbook descriptions of patients with the same medical diagnoses.

______21. In attempting to arrive at tentative problem formulations, I focused on a couple of bits of data that appeared to be most essential and paid less attention to the other bits of data.

______22. One of the first things I tried to do was to differentiate problems as either psychogenic or organic.

______23. I tended to use the data as it was presented sequentially in the tape to develop a list of tentative problem formulations.

______24. One particular bit of data immediately brought to mind one or more tentative problem formulations.

______25. I used the information recorded on the patient's medication record to develop a list of tentative problem formulations.

______26. One of the first things I tried to do was to relate the patient's behavior to associated medical diagnoses.

______27. Given the written information and the patient behaviors as seen in the tape, I tried to think of as many tentative problem formulations as possible.

______28. As I viewed the tape. I tried to think of a medical diagnosis that would account for the patient's behaviors and then determine the tentative problem formulations.

______29. As the videotaped simulation progressed, the cues elicited sort of a "mental list" of possible problem formulations.

APPENDIX D

GUIDELINES FOR COMPLETION OF THE RESPONSE SHEETS

OVERVIEW OF THE TASK

Thank you for assisting me in the development of instructional materials to be used in a research project designed to enhance problem-solving skills among nursing studets.

You will be shown six videotapes that depict common inpatient situations. Accompanying each tape is a brief written description, termed the patient situation, in which is depicted demographic information, medical history, and events leading up to the videotaped simulation. Some situations also contain physician's order sheets, patients' medication administration records, and nurses' notes.

Imagine yourself to be the nurse in each situation. Read the patient situaiton first. Then, approach the situation as you would in the hospital. You may choose to examine all written materials first (these you would have on hand in the hospital), or you may choose to view the videotape first.

I will be asking you to perform two types of activities after viewing the film. First, I want to know your assessment of the situation. Second, I want you to share with me the mental processes you used to arrive at your assessment. In order to collect these data. I will ask you to complete the following:

(1) tentative problem formulation sheet;
(2) summarizing assessment sheet;
(3) process checklist.

In addition, I will ask you to reconstruct your thinking while you viewed this videotape. I will tape record your responses.

Once again, thank you so much for your cooperation.

GUIDELINES FOR COMPLETING THE
TENTATIVE PROBLEM FORMULATION SHEETS

In reading these guidelines, refer to the sample sheets following this page. All of these sheets apply to the same patient.

1. At the top of each sheet, list the title of each tentative problem you have formulated. Use terminology with which you are most faimliar. Underneath, in the space provided, list the cues (i.e., all relevant bits of data) to support this tentative problem formulatio.

2. In listing the cues, try to record, as closely as possible, the words used by the patient, or, in the case of nonverbal cues, your actual observation. Include any cues you think are relevant from the written materials.

3. List both positive cues (i.e., cues that tend to confirm your formulation) and negative cues (i.e., cues that tend to disconfirm your formulation). If you consider a cue to be negative, indicate this by writing "(neg.)" in front of the cue. See the following example.

4. A cue may be listed under more than one problem formulation. A cue that is listed as positive for one problem may be listed as negative for some other problem formulation.

5. Use a separate sheet for each problem formulation.

6. Write legibly and avoid abbreviations.

The following pages present tentative problem formulation sheets for a hypothetical patient, a 25-year-old nursing students, who has just been admitted complaining of weakness, dizziness, and vomiting for five days. The following data represent what might be obtained from the interview in this hypothetical situation. For convenience purposes, data are divided into information received from the patient (subjective data) and information observed by the nurse (objective data).

<u>Subjective data</u>

states she is nauseated

states she has lost weight in past two months

states urine is dark

no epigastric distress with meals

states she doesn't feel like eating

states no other related abdominal pain

states she gets dizzy when she gets up

has not fallen before being hospitalized

no visual or hearing problems

no arthritis or joint pain

states she is doing poorly in school

has always wanted to be a nurse

has missed one menstrual period

states she is sexually active

describes loving relationship with parents

"I don't think everyone has to be married to have a child."

<u>Objective data</u>

retching into emesis basin

looks thin

lethargic-appearing

appears dehydrated--eyes look sunken, speech sounds sticky when she talks

normal muscle strength against resistance

looks worried

Film *Sample*

Problem formulation title: *Interference in need for fluid & electrolyte balance*

CUE LIST

states she is nauseated

retching into emesis basin

states she has lost weight in past 2 months

states she doesn't feel like eating

looks thin, lethargic - appearing

appears dehydrated - eyes look sunken, speech sounds "sticky" when she talks, states urine is dark

(neg) no epigastric distress ̄c meals or ̄p meals)

(neg) states no other related abdominal pain

Film *Example*

Problem formulation title: *Difficulty in meeting need for safety*

CUE LIST

states she gets dizzy when she gets up

looks pale

(neg) has not fallen before being hospitalized

(neg) normal muscle strength against resistance

(neg) no visual or hearing loss

(neg) no arthritis or joint pain

Film *Example*

Problem formulation title: *Potential Alteration in self-Concept / self-esteem*

CUE LIST

states she is doing poorly in school

has always wanted to be a nurse

describes loving relationships with parents & boyfriend

looks worried

has missed one menstrual period & states she might be pregnant

has missed one menstrual period

(ny) describes loving relationships ē parents.

might be confused as to goals – "I want to be a nurse." "I don't think everyone has to be married to have a child."

Film *Example*

SUMMARIZING ASSESSMENT

This is a 25 year old nursing student who is primarily in need of nursing to assist her back to a state of fluid & electrolyte balance & positive nitrogen balance. Secondarily, she needs assistance in sorting out her immediate and long-term goals as well as her feelings concerning her sexual relationship c̄ her boyfriend & her desire to be a nurse.

Her primary needs are relative to the fact that she is nauseated & shows the signs of dehydration (thin, mouth is dry, eyes look sunken, states that urine is dark) & electrolyte imbalance (weakness, lethargic-appearing). She will probably need IV fluid replacement & monitoring of electrolytes. Medication could be given for nausea so she can eat. Since she may be pregnant, we would certainly want to know that before giving her any medication.

Her statement that she is dizzy might be related to the lack of food & electrolyte imbalance. Of course, it might also be caused by something more serious (such as cancer, anemia, etc.). It might also be related to pregnancy or to a psychogenic problem

Film Examples

SUMMARIZING ASSESSMENT (continued)

because of her stated poor performance in school. At any rate, she will need to be ambulated c̄ assistance; side rails up while in bed.

Lastly, she is indicating a potential disturbance in self-concept/self-esteem (not doing well in school, thwarting of goal to be a nurse, possibility of pregnancy). She will need to identify her problems & work on solutions to them. Nursing can assist by listening to her & encouraging her to ventilate.

APPENDIX E

EXCERPTS FROM THE INSTRUCTIONAL AND RESPONSE BOOKLETS FOR SITUATION 1

INTRODUCTION

<u>What is a tentative problem formulation?</u>

In practice, the nurse usually interacts with her patient sporadically over a period of time. During those times that she is with the patient, she is continually using her senses to gather in data about the patient. Data may be gathered from the patient's verbal or nonverbal behavior, from his medical record, from other members of the health team, and from his family, among others. The data are used to make inferences about which of the patient's basic needs are being disturbed or altered by the presence of illness and can benefit from nursing assistance. The nursing diagnosis is a statement that incorporates the disturbance or alteration in the patient's basic needs and provides direction for the nurse in planning her nursing assistance. The diagnosis, then, becomes the tool by which the nurse plans and implements her care. It should be remembered, however, that when the nurse finds that there are patient problems beyond the scope of her nursing practice, she makes referrals to other members of the health team. Nevertheless, in her own practice the nursing diagnosis is the term used to describe the classification of patient problems in which the nurse can assist the patient.

Many times in the process of data gathering, the information that the nurse obtains is incomplete. That is, the nurse has a brief encounter with her patient, and some of the cues from the patient indicate a potential problem that the nurse needs to explore further. Still the nurse develops tentative diagnoses or problem formulations to guide her search for more data.

This instructional package focuses on this aspect of nursing; namely, the development of initial tentative problem formulations made during a brief encounter with a patient. The materials have been designed to provide you with the opportunity to practice developing tentative problem formulations for patients with a variety of problems. For each patient, an instructional sequence consisting of three basic components will be followed. The three components are:

1. You will read the written information about the patient and view a videotape recording the nurse's encounter with the patient;

2. Having viewed the videotape, you will record the tentative problem formulations you have developed and write a summarizing assessment;

3. You will be provided with feedback materials which describe the tentative problem formulations and summarizing assessments developed by a group of experienced nurses who have viewed each videotape.

COMPONENTS OF A TENTATIVE PROBLEM FORMULATION

Each of your initial problem formulations should include two components:

1. a problem formulation title;
2. a list of cues.

A problem formulation title is a label describing an interference or an alteration in the patient's basic needs that can be inferred from the videotape and written materials. Another name for the problem formulation is the nursing diagnosis.

A cue list should include all elements of data that are relevant to the problem formulation under which they are listed. The list may include items from the written materials, verbal information from the patient, and nonverbal behaviors which you observe.

WRITING A SUMMARIZING ASSESSMENT

After you have written your tentative problem formulations for the patient, you will be asked to write a brief paragraph giving your summarizing assessment of these formulations. Your assessment will discuss the set of initial problem formulations you have generated. It should indicate:

--how well substantiated you consider each of your problem formulations to be, based on the data obtained;

--which of the tentative problems is(are) the most important in your own mind.

A reminder. . .

As you view the videotapes and attempt to generate tentative problem formulations, keep in mind that these are only tentative and that the situations are designed to be vague with no one right or wrong answer. In actual practice you would need to gather more information to confirm or disconfirm these tentative problem formulations.

INSTRUCTIONAL MATERIALS

The Patient Situations

Each patient situation describes in varying detail some information about the patient. The information is appropriate to what the nurse in the situation would know about the patient prior to her encounter with the patient. In addition to the typed patient situation page, some situations also contain medication records, nurses' notes, and/or doctor's orders that would be present under normal nursing practice situations.

The Videotapes

The videotapes are designed to simulate your encounter with the patient. Each of these tapes shows a "nurse's eye view" of the patient encounter. In some tapes, the nurse is not seen at all, but her voice is heard. While viewing the tape, you should attempt to put yourself in the role of the nurse.

The Response Booklet

The Response Booklet is divided into six sections. There is one section for each of the videotapes you will view. Each section contains the following materials: (1) a set of response sheets on which you will record the problem formulations you have generated; (2) a sheet on which you will write your summarizing assessment; and (3) a self-evaluation checklist to be filled out at the end of the instructional session.

The Feedback Materials

The feedback materials summarize the tentative problem formulations and assessments generated by a group of nine experienced nurses who viewed the videotapes. The purpose of these materials is to provide you with a means of comparing your own performance on each case to that of the experienced nurses.

THE INSTRUCTIONAL SEQUENCE

For each of the videotapes, the same instructional sequence will be followed. The steps in the sequence are summarized below. This summary is intended to provide you with an overview of the instructional sequence. Complete instructions for each step will be repeated throughout the booklet.

STEP 1: You will read the PATIENT SITUATION and other written materials for the patient in the videotape.

The materials contain information that the nurse would have on hand prior to her interaction with the patient.

STEP 2: You will view the videotape twice.

As you view the videotape, you should generate a set of tentative problem formulations.

STEP 3: You will record the problem formulations and write a brief summarizing assessment.

Use one sheet for each problem formulated. Use the summarizing assessment sheet to record your assessment.

STEP 4: You will be provided with feedback materials describing the performance of the group of experienced nurses.

a. You will be provided with "Feedback Sheet 1."

This sheet presents the major problem formulations generated by the group of nurses; i.e., those formulations developed by the majority of all nurses who viewed the videotape.

b. You will view the videotape a third time.

This viewing will provide you with the opportunity to repeat your encounter with the patient. As you view the tape, attempt to reconstruct in your mind the reasoning processes which led the nurses to develop the problem formulations listed on Feedback Sheet 1.

c. You will be provided with "Feedback Sheet 2."

This sheet has two sections.

The first section presents additional problem formulations generated by some of the nurse who viewed the videotape. It represents the range of diversity of problems formulated.

The second section describes the nurses' summarizing assessments.

STEP 5: You will fill out a self-evaluation checklist designed to aid you in comparing your performance to that of experienced nurses.

GUIDELINES FOR COMPLETION OF THE PROBLEM FORMULATION RESPONSE SHEETS

In reading these guidelines, you should refer to the hypothetical situation on the next few pages.

1. At the top of each response sheet, list the title of one problem formulation you have developed. Underneath, in the space provided, list the cues (i.e., all relevant bits of data--verbal, nonverbal, or from the written materials) for this formulation.

2. In listing the cues, try to record, as closely as possible, words used by the patient, or in the case of nonverbal cues, your actual observation.

3. List both "positive" cues (i.e., cues that tend to confirm a problem formulation) and "negative" cues (i.e., cues that tend to disconfirm a problem formulation). If you consider a cue to be "negative" for a problem, indicate this by writing "(neg.)" in front of the cue (see example on following pages).

4. A cue may be listed under more than one problem formulation. A cue that is listed as "positive" for one problem may be listed as "negative' for some other problem.

5. Use a separate sheet for each problem formulation.

6. Write legibly and avoid abbreviations.

7. If you want to take notes while viewing a videotape, you may do so. Use a sheet in the RESPONSE BOOKLET for note-taking and write "NOTES" at the top.

GUIDELINES FOR COMPLETION OF THE SUMMARIZING ASSESSMENT SHEETS

After writing your tentative problem formulations, write a brief summarizing assessment of these formulations. Indicate:

1). the most important problem(s) you have formulated. Include the data that led you to make this decision.

2). how well substantiated you consider your problem formulations to be, based on the data.

SITUATION 1

INSTRUCTIONS

Patient Situation

STEP 1: Read the patient situation and other written materials (when applicable) for this videotape. Do not write in this booklet. You may make notes in the Response Booklet at the appropriate patient situation.

WHEN YOU ARE FINISHED, TURN TO STEP 2 (AFTER PATIENT SITUATION) AND LOOK FORWARD.

SITUATION 1

Mr. Johnson is a 55-year-old insurance salesman who has just been admitted to the hospital for a bilateral neck dissection and laryngectomy for cancer of the larynx. The nurse is about to do a nursing history.

STEP 2: The videotape will now be presented twice.

While viewing this tape, you should generate a set of tentative problem formulations that you would want to investigate more fully if you were the nurse in the situation. If you wish to take notes, please do so on the cover sheet in the Response Booklet entitled, "Responses for Situation #."

PRESENTATION OF THE VIDEOTAPE

After you have seen the videotape twice, turn to the next page.

STEP 3: Turn to the section of the RESPONSE BOOKLET for this videotaped situation.

Record the problem formulation(s) you have generated.

Fill out one response sheet for each problem formulated.
You may refer back to the GUIDELINES for completion of these sheets (see pp. 6 and 7).

RECORD PROBLEM FORMULATIONS

After you have recorded your problem formulations, write a brief paragraph giving your summarizing assessment of the case. Your assessment should indicate:

--the most important problem(s) you have formulated. Include the data that led you to make this decision.

--how well substantiated you consider your problem formulations to be, based on the data.

WRITE YOUR SUMMARIZING ASSESSMENT

When you have finished, look forward.

STEP 4: You will now be provided with feedback on the performance of the group of nurses who viewed the videotape.

TURN TO THE NEXT PAGE AND READ FEEDBACK SHEET 1.

A. While reading Feedback Sheet 1, check your response sheets to see if they include the major problem formulation(s), listed on Feedback Sheet 1, which were generated by the majority of the nurses.

DO NOT ADD ANY CUES OR PROBLEM FORMULATIONS TO YOUR OWN LISTS.

When you are finished, look forward.

FEEDBACK SHEET 1 SITUATION 1

MAJOR PROBLEM FORMULATIONS

After completing this same exercise, almost all of the nurses who viewed this videotape identified three major tentative problem formulations. These are:

ANXIETY DUE TO IMPENDING SURGERY
GRIEVING
KNOWLEDGE DEFICIT

ANXIETY DUE TO IMPENDING SURGERY

Almost all nurses indicated that Mr. Johnson was showing behaviors reflecting anxiety, most likely due to his impending surgery. These nurses indicated that anxiety was a problem even prior to seeing the videotape, since most patients have some degree of anxiety prior to any surgery, but particularly prior to major surgery for cancer. The following table presents the cues listed as relevant for this problem. Cues marked with "!!" were listed as relevant by the majority of nurses who viewed the videotape.

Problem	Cues
ANXIETY DUE TO IMPENDING SURGERY	!!moving about a lot !!repeatedly running hands through hair !!turns away and says he has to call his daughter !!is pre-operative patient has difficulty answering questions reason for admission (cancer) smoking never has had operation before (neg.) wants to show results of tests has been in good health no significant other has come with him rubbing throat doesn't know what will be done to him (neg.) has been hospitalized before

	wants to know time of surgery
	initially gives short answers
	face appears worried, tense
	avoiding nurse, turns away

GRIEVING

The majority of the nurses indicated that some of Mr. Johnson's behaviors indicated grieving. The following table presents the cues listed as relevant to this tentative problem formulation. Cues marked with "!!" were listed as relevant by the majority of nurses who viewed the videotape.

Problem	Cues
GRIEVING	!!states, "I have a lump in my throat."
	!!doesn't know the name of the operation
	!!recently diagnosed as having cancer
	!!angry-looking, tense
	does not use the word cancer
	states he "can't feel the lump, but the doctor says it's there."
	doesn't mention that he will be unable to talk after surgery
	also looks depressed, voice cracks, throwing things

KNOWLEDGE DEFICIT

The third tentative problem formulation developed by the majority of the nurses who viewed the videotape was that of a knowledge deficit. The following table presents the cues listed as relevant to this problem formulation. Cues marked with "!!" were listed as relevant by the majority of nurses who viewed the videotape.

Problem	Cues
KNOWLEDGE DEFICIT	!!recently diagnosed as having cancer !!is a preoperative patient never has had surgery been in good health hospitalized only for tests doesn't say the word cancer can't feel the lump doesn't know the name of the operation smoking says he'll have a hole in his throat doesn't state that he knows he won't be able to talk

Step 4

B. You will now view the videotape a third time. This viewing will provide you with the opportunity to repeat your encounter with the patient. As you view the tape, attempt to reconstruct in your mind the reasoning processes which led the nurses to develop the problem formulations listed on Feedback Sheet 1.

VIEW THE VIDEOTAPE

After viewing the videotape, TURN TO THE NEXT PAGE AND READ FEEDBACK SHEET 2.

DO NOT ADD ANY CUES OR PROBLEM FORMULATIONS TO YOUR OWN LISTS AFTER READING FEEDBACK SHEET 2.

While reading Feedback Sheet 2, check your response sheets to see if they include any additional problem formulations generated by the group of experienced nurses.

Compare you summarizing assessment to the nurses' summarizing assessment on Feedback Sheet 2.

WHEN YOU ARE FINISHED READING FEEDBACK SHEET 2 AND THE SUMMARIZING ASSESSMENT, TURN TO STEP 5.

FEEDBACK SHEET 2 SITUATION 1

ADDITIONAL PROBLEM FORMULATIONS

In addition to the formulations of problems concerning anxiety, denial, and knowledge deficit, over half of the nurses indicated three other tentative problem formulations that they believed were reflected in Mr. Johnson's behaviors. These are:

ALTERATION IN BODY IMAGE
POTENTIAL ALTERATION IN ABILITY TO COMMUNICATE
POTENTIAL ALTERATION IN ROLE DUE TO LOSS
OF NORMAL COMMUNICATIVE PATTERNS

In this listing, cues identified by the majority of the nurses who viewed the videotape are marked with an "!!".

ALTERATION IN BODY IMAGE

states lump will be removed from neck and a hole will remain
voice changed as he talked about making a hole in neck
patient is 55, at prime of life
patient is insurance salesman, wearing suit

POTENTIAL ALTERATION IN ABILITY TO COMMUNICATE

!!diagnosis and surgery will result in this
knows lump will be removed and a hole will remain

POTENTIAL ALTERATION IN ROLE DUE TO LOSS OF NORMAL COMMUNICATIVE PATTERNS

diagnosis and surgery
bringing work to hospital (briefcase)
uses voice in job
age--55
insurance salesman

Finally, several nurses identified two additional tentative problems prior to viewing the videotape. These problems were generated as a result of the nurses' knowledge of signs and symptoms associated with cancer of the larynx. They were:

INTERFERENCE IN THE NEED FOR OXYGEN
INTERFERENCE IN THE NEED FOR NUTRITION

After viewing the videotape, however. the nurses indicated that Mr. Johnson did not have these problems based on the following negative data.

(neg.) weight appears normal
(neg.) no hoarseness evident
(neg.) no problem with speech, no cough

SUMMARY OF THE NURSES' ASSESSMENTS

Prior to viewing the videotape, all nurses discussed their concerns for Mr. Johnson's emotional well-being. They based their concerns on their knowledge of the diagnosis of cancer of the larynx and the potentially disfiguring aspects of the surgery to remove the cancer. After viewing the videotape, every nurse generated tentative problems related to Mr. Johnson's psychological needs. The majority of nurses identified anxiety as the major problem formulation. Some nurses believed the same behaviors reflected denial and/or grieving over the upcoming loss of body image and the ability to communicate. In addition, the majority of nurses stated that many of Mr. Johnson's behaviors were reflective of a knowledge deficit about his diagnosis and the impending surgery.

Finally, several nurses indicated that the nurse should consider Mr. Johnson's physiological needs for oxygen and nutrition. These nurses also stated that the data did not indicate physiological needs as the primary focus of nursing concern in this case.

STEP 5: Now turn to the Self-Evaluation Checklist at the end of the Response Booklet section for this situation.

SELF-EVALUATION CHECKLIST

INSTRUCTIONS: The checklist is designed to aid you in evaluating your own problem formulation performance as compared to that of the experienced nurses. The checklist presents the title of all problem formulations generated by the nurses in the order of priority. Part A includes the problems identified by the majority of the nurses. Part B includes the remainder of the problems identified by the nurses. Place a check next to each item in the checklist which corresponds to one of your own responses. In order to check an item, there does not have to be an exact wording in the checklist. A general equivalence in meaning is sufficient.

FILL OUT THE CHECKLIST.

KEY FOR INTERPRETATION OF SELF-EVALUATION CHECKLIST

If you have checked . . .	You may consider the degree of agreement between your performance and that of the experienced nurses is . .
All items marked "!!," and some (or all) of the other items	HIGH
All items marked "!!," and none of the other items OR Some items marked "!!," and some of the other items	MODERATE
None of the items marked "!!," and some (or none) of the other items	LOW

Note: If your own set of problem formulations included items that do not appear in the checklist, you cannot evaluate them by means of the checklist, but this does not necessarily mean that they are inappropriate.

SELF-EVALUATION CHECKLIST

Situation 1

Before filling out the checklist, review the directions on the previous page.

Part A: Major problem formulations

______ 1. Anxiety due to impending surgery!!

______ 2. Grieving!!

______ 3. Knowledge deficit!!

Part B: Addition problem formulations

______ 1. Alteration in body image

______ 2. Potential alteration in ability to communicate

______ 3. Potential alteration in role due to loss of normal communicative patterns

______ 4. Interference in the need for oxygen

______ 5. Interference in the need for nutrition

Key for interpretation of Self-Evaluation Checklist is on the previous page.

According to the key, how does your performance compare with that of the experienced nurses?

______ HIGH ______ MODERATE ______ LOW

APPENDIX F

SUMMARY OF STUDENT RESPONSES TO SITUATION 1

SUMMARY OF STUDENT RESPONSES TO SITUATION 1

After reviewing all of the responses for Situation 1 (Mr. Johnson, who was going to have radical neck surgery), the following can be summarized:

1. With regard to the major problem formulations generated by the experienced nurses:

   a. The majority of students listed ANXIETY, which was also identified by the experienced nurses.

   b. In addition, many students listed KNOWLEDGE DEFICIT, which was also a major problem formulation.

   c. One student picked up on the signs of the GRIEVING process (denial and depression). This student appropriately labeled the cues that reflected DENIAL (smoking, changing the subject, etc.).

2. Regarding the other problem formulations identified by the experienced nurses, several students listed BODY IMAGE CHANGE, LOSS OF ABILITY TO COMMUNICATE, ROLE CHANGE, POTENTIAL AIRWAY PROBLEM, and POTENTIAL NUTRITIONAL PROBLEM. Good work!

3. These were seen as areas of concern:

   a. Several students listed safety as a concern, but listed cues that reflected anxiety (i.e., worried, doesn't remember the name of the operation).

   b. One student listed a potential problem concerning lack of circulation to the area due to the lump in the neck. There were no cues to substantiate this.

   c. Several students made inferences from the cues instead of listing them as they saw, heard, or read them. For example, one student listed as a cue under BODY IMAGE CHANGE, "may be embarrassed about new way of talking." Another student listed under ANXIETY, "appears upset."

   d. Other students listed cues that were not appropriate to the problem. For example, one student listed this cue under POTENTIAL AIRWAY DISTURBANCE, "perspiring interferes with ventilation."

4. Finally, several students listed "NEED FOR SUPPORT" as a problem formulation. Although this need formed the basis for the major problem formulations of the experienced nurses, it was not listed as such. Good work, students!

APPENDIX G

ADDITIONAL POSTTEST TASKS

Participant________________

RECOGNITION OF CUES

Directions: Using the pencil provided, place a check in front of each cue you remember seeing or hearing in the videotape. When you are finished, raise your hand so that the facilitator can collect this sheet.

______ 1. coughing
______ 2. complaining of chills
______ 3. moving frequently in bed
______ 4. skin is cool
______ 5. thirsty, asks for water
______ 6. IV site is edematous
______ 7. temperature of 103
______ 8. facial expression shows discomfort
______ 9. states that she feels weak
______ 10. states she was not coughing before surgery
______ 11. blood pressure is low
______ 12. states her IV hurts
______ 13. face is pale
______ 14. facial expression shows fear
______ 15. coughing up sputum
______ 16. abdominal dressing is dry and intact
______ 17. breathing rapidly
______ 18. lying quietly
______ 19. complaining of back pain
______ 20. states operation hurts
______ 21. warm skin
______ 22. dry lips
______ 23. appears dyspneic
______ 24. complaining of sore throat
______ 25. foley catheter patent
______ 26. scratching back on bed as if itching
______ 27. normal breathing pattern
______ 28. is not permitted anything by mouth
______ 29. clenching fingers in a fist
______ 30. rash on arms
______ 31. receiving IV fluids
______ 32. wide awake
______ 33. splints incision when coughing
______ 34. complaining of feeling dizzy

When you are finished, raise your hand.

Participant___________________

ADDITIONS TO PROBLEM FORMULATION SHEETS

Situation 6

The attached sheet lists the cues from the situation which the nurses used to generate tentative problem formulations.

You are to use this sheet to do the following:

1. In reading the attached list, you may notice some cues which you did not record, but which you now consider relevant to one or more of your own problem formulations. IF THIS IS THE CASE. using the pencil provided, add these cues in the space under the relevant problem formulation.

2. Having read the attached sheet, you may have thought of some additional tentative problem formulations. IF THIS IS THE CASE, using the pencil provided, record the title of each additional formulation on a response sheet. Underneath, in the space provided, list the number(s) of all cues of particular relevance from the attached sheet.

Note: Please use the pencil that has been provided to record any of the above information on the problem formulation sheets.

When you are finished, raise your hand.

LIST OF CUES WHICH THE NURSES USED TO GENERATE TENTATIVE PROBLEM FORMULATIONS

1. Patient is a smoker
2. Coughing
3. Temperature of 103
4. States she was not coughing before surgery
5. Breathing pattern normal
6. Chills
7. Preoperative complete blood count (CBC) within normal limits
8. Blood pressure is OK
9. Pulse is OK
10. Preoperative chest x-ray within normal limits
11. Moving a lot in bed
12. Warm skin
13. Abdominal surgery
14. States "operation hurts"
15. States "IV hurts"
16. Facial expression of discomfort
17. Potassium in IV
18. Abdominal dressing dry and intact
19. Complaining of thirst
20. Receiving IV fluids
21. Skin appears flushed
22. Received one unit of blood in recovery room
23. Mouth appears dry
24. Asking for water
25. Not coughing properly

APPENDIX H

THE QUESTIONNAIRE

Participant __ ___

QUESTIONNAIRE

Part I

Please read carefully each of the statements below. For each statement, indicate your opinion by circling one of the five response options:

SA = strongly agree
A = agree
NO = no opinion
D = disagree
SD = strongly disagree

Statements

1.	The instructions were generally clear and easy to follow	SA	A	NO	D	SD
2.	The instructional sessions were too long	SA	A	NO	D	SD
3.	The actors who played the role of the patients were convincing . . .	SA	A	NO	D	SD
4.	The dialogue in the videotapes was sometimes difficult to follow . .	SA	A	NO	D	SD
5.	The videotapes provided a realistic simulation of patient situations	SA	A	NO	D	SD
6.	The nurses in the situations did a good job of interacting with the patients	SA	A	NO	D	SD
7.	I enjoyed watching the films. . . .	SA	A	NO	D	SD
8.	The written materials in the patient situations were easy to understand .	SA	A	NO	D	SD
9.	The feedback materials were well well organized and easy to follow . .	SA	A	NO	D	SD
10.	The feedback materials were sometimes overly redundant.	SA	A	NO	D	SD

SA = strongly agree
A = agree
NO = no opinion
D = disagree
SD = strongly disagree

11.	The opportunity to compare my problem formulations to those of experienced nurses helped me to improve my skill in generating tentative problem formulations. . .	SA	A	NO	D	SD
12.	The patient situations were too complicated for me to follow . . .	SA	A	NO	D	SD
13.	I found the feedback materials interesting	SA	A	NO	D	SD
14.	The third viewing of the videotape helped me to consolidate my understanding of the situation.	SA	A	NO	D	SD
15.	The third viewing of the videotape was not worthwhile.	SA	A	NO	D	SD
16.	The Self-Evaluation Checklists helped me to evaluate my performance as compared to that of the experienced nurses.	SA	A	NO	D	SD
17.	My ability to generate tentative problem formulations has improved as a result of using this instructional package.	SA	A	NO	D	SD
18.	For some of the situations, I did not have enough nursing knowledge to be able to generate appropriate problem formulations	SA	A	NO	D	SD
19.	If a library of situations like these, with accompanying feedback materials, was available to nursing students, I would make use of it.	SA	A	NO	D	SD
20.	It would be more interesting to use the videotapes and feedback materials in a group setting than in an individual self-instructional format.	SA	A	NO	D	SD

Part II

After participating in one of the previous sessions, you may have pursued your interest in one or more of the situations outside of the instructional sessions. For example, you may have discussed the situations with other students or a faculty member, or you may have looked up materials pertaining to the situations in a nursing reference book. Please indicate below the ways (if any) in which you pursued your interest in the situations outside of the instructional sessions. Check all items that are applicable.

___ Situation 1 (a 55 year old insurance salesman who is admitted for laryngectomy and bilateral neck dissection)
- ___a. I discussed the situation with other student(s).
- ___b. I discussed the situation with faculty member(s).
- ___c. I looked up relevant reference materials.
- ___d. Other (specify)___________________________

___Situation 2 (a 65 year old retired librarian who is admitted after a fainting episode and who refuses to take her medications)
- ___a. I discussed the situation with other student(s).
- ___b. I discussed the situation with faculty member(s).
- ___c. I looked up relevant reference materials.
- ___d. Other (specify)___________________________

___Situation 3 (a 50 year old school teacher who is being discharged and complains of discomfort)
- ___a. I discussed the situation with other student(s).
- ___b. I discussed the situation with faculty member(s).
- ___c. I looked up relevant reference materials.
- ___d. Other (specify)___________________________

___Situation 4 (a 70 year old man who is recovering from a transurethral resection of his prostate and who has bizarre behavior at night)
- ___a. I discussed the situation with other student(s).
- ___b. I discussed the situation with faculty member(s).
- ___c. I looked up relevant reference materials.
- ___d. Other (specify)___________________________

___Situation 5 (a 67 year old retired school teacher who is a diabetic and has difficulty waking up at night)
- ___a. I discussed the situation with other student(s).
- ___b. I discussed the situation with faculty member(s).
- ___c. I looked up relevant reference materials.
- ___d. Other (specify)___________________________

Part III

Please indicate below any comments regarding this instructional package, or any suggestions for the use of these materials with other nursing students.

Part IV

We are interested in knowing how much contact with patients you have had prior to participating in this experiment. Please list below any type of experience you have had that has involved patient contact. For each type of experience, please indicate the extent of the experience (e.g., how many hours per week for how many years).

Type of Experience	Extent of Experience

APPENDIX I

POSTTEST SCORING KEYS

PF SCORE: INSTRUCTIONS

1. This score is based on the titles of the subject's problem formulations.

2. Each PF is scored as follows:

   a. If the subject's title is equivalent to one of the titles on the scoring sheet:

      (1). under the column, "Points," circle the number of points for the title;

      (2). if the subject fails to list any cues for a title, do not score the title;

      (3). if, on reading the subject's summarizing assessment, he mentions a title that was not listed on a response sheet, this title may be scored, providing the the subject mentions at least one cue that led him to consider it.

   b. If the subject's title is not equivalent to one of the titles in the scoring sheet:

      write in the title and circle one point (the subject must have at least one cue for that title).

3. Sum the number of points circled and put this core in the upper right hand corner of the key.

Subject ________________

PF score________________

PF SCORING KEY

Titles	Points
Interference in need for O_2-CO_2 exchange due to pulmonary congestion	6
Alteration in comfort	6
Disturbance in allergic/immune response due to transfusion reaction	6
Interference in need for safety and security due to break in skin integrity	4
Interference in fluid and electrolyte balance	4
Anxiety due to surgery. separation from loved ones, and/or alteration in life style	4
Potential interference in need for oxygen due to hemorrhage	2
Potential knowledge deficit	1
Additional PF	1
	1
	1
Total =	________

(Maximum points = 36)

CUE AND CUE-PF SCORING KEY: INSTRUCTIONS

A. CUE score

1. The CUE score is based on the cues the subject recorded, without regard to the PF under which he listed them.

2. The entries for this score are made under the column labeled "CUE."

3. For each cue the subject recorded, circle the number of points on the scoring sheet corresponding to the cue.

4. If the subject records a cue that is clearly incorrect, write "inc" next to the cue and change the sign from + to –.

5. Sum the number of points circled in the CUE column and record the total in the upper right hand corner of the key.

B. CUE-PF score

1. The CUE-PF score is based on the cues the subject records under the PF titles included in each category across the top of the scoring grid.

2. The entries for this score are made in the cells of the cue (rows) x problem formulation (columns) scoring grid.

3. The PF titles are spelled out on the next page.

4. For each PF title the subject recorded:

9 a. determine if this title is included in one of the scoring categories;

b. if so, circle the number of points (in each appropriate formulation x cue cell) for each cue the subject recorded under this title;

c. if there is an (*) next to a cue, this indicates that the subject must have marked the cue as ("neg.") for that PF. If the subject didi not do so, change the sign of the cue from + to -, and circle the points.

5. After completion of step 4, sum the points circled across column in each row and enter this sum in the column "Total."

6. Sum the points recorded in the "Total" column and record the subject's score in the upper right hand corner of the key (marked CUE-PF score).

KEY TO PROBLEM FORMULATION TITLES
IN CUE AND CUE-PF SCORING KEY

CUE-PF	PROBLEM FORMULATION TITLE
LUNG	Interference in need for O_2 -CO_2 exchange due to pulmonary congestion
COMF	Alteration in comfort
INF	Interference in need for safety and security due to break in skin integrity
ALL	Disturbance in allergic/immune response due to transfusion reaction
H_2O	Interference in fluid and electrolyte balance
HEMO	Potential interference in need for oxygen due to hemorrhage
PSY	Anxiety due to surgery, separation from family, and/or alteration in life style
KNOW	Potential knowledge deficit

Subject __________ CUE score ______ CUE-PF score ______

CUE and CUE-PF Scoring Keys

Cue list	CUE PT	CUE-PF LUNG	COMF	INF	ALL	H2O	HEMO	PSY	KNOW	TOT
History of Smoking	4	+4	-4	-4	-4	-4	-4	-4	+4	
Coughing	4	+4	+4	-4	+4	+4	-4	-4	-4	
Temp of 103	4	+4	+4	+4	+4	+4	-4	-4	-4	
Complaining of chills	4	+4	+4	+4	+4	+4	+4	-4	-4	
Abdominal surgery	4	+4	+4	+4	-4	+4	+4	+4	+4	
Rec'd blood transfusion	4	-4	-4	-4	+4	+4	+4	-4	-4	
Thirsty	4	-4	+4	+4	+4	+4	+4	-4	+4	
Restless	4	+4	+4	+4	+4	-4	+4	+4	-4	
Warm skin	4	+4	-4	+4	+4	+4	+4*	-4	-4	
BP and P OK	3	+3*	+3*	+3*	+3*	+3*	+3*	+3*	-3	
Chest x-ray OK	3	+3*	-3	-3	-3	-3	-3	-3	-3	
Receiving IV fluids	3	-3	+3	-3	-3	+3*	-3	-3	-3	
States "operation hurts"	3	+3	+3	+3	-3	-3	-3	+3	+3	
States "IV hurts"	3	-3	+3	+3	-3	-3	-3	+3	+3	
Facial expression of pain	3	-3	+3	-3	-3	-3	-3	+3	+3	
Never had surgery before	3	-3	-3	-3	-3	-3	-3	+3	+3	
NPO	3	-3	+3	-3	-3	+3	-3	-3	-3	
Dry lips	3	-3	+3	+3	+3	+3	+3	+3	-3	
States not coughing before	2	+2*	-2	-2	+2	-2	-2	-2	-2	
Normal breathing pattern	2	+2*	-2	+2*	+2*	-2	+2*	+2*	-2	
CBC within normal limits	2	+2*	-2	+2*	-2	-2	-2	-2	-2	
Abdominal dressing OK	2	-2	-2	+2*	-2	-2	+2*	-2	-2	
KCl in IV	2	-2	+2	-2	-2	-2	-2	-2	-2	
Has children	2	-2	-2	-2	-2	-2	-2	+2	-2	

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Abstract

ANALYSIS OF THE EFFECTIVENESS OF AN INSTRUCTIONAL STRATEGY TO TEACH SELECTED PROBLEM-SOLVING SKILLS TO NURSING STUDENTS

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The College of William and Mary in Virginia. September 1984

Co-Chairmen: Roger Ries and John Thelin

The purpose of this research was to determine if selected problem-solving skills of freshmen nursing students in an associate-degree nursing program could be enhanced by an instructional strategy that combined simulated patient encounters with two types of feedback obtained from experienced nurses. The selected problem-solving skills were: (1) the detection. encoding, and retrieval of cues and (2) the generation of tentative problem formulations. The study consisted of three phases. In the first phase. six videotaped simulations representing nurse-patient encounters were developed. In the second phase. these simulations were shown to a group of experienced nurses, who, after viewing the simulated situations, were asked to write tentative problem formulations with relevant cues and summarizing assessments of the situations. Data of the nurses' information processing activities while performing the simulation exercises were additionally collected and analyzed according to a protocol developed by Allal (1974). The results of this analysis were used to develop an instructional package that was tested, with the simulations, on a sample of freshmen nursing students during the third or experimental phase of the study.

For the experimental design, the sample was randomly assigned to three groups: two treatment groups and a posttest-only control group. The following were hypothesized: (1) that the selected problem solving skills of the treatment groups would be significantly improved by the instructional strategy, and (2) that the skills would be more greatly enhanced in the treatment group which received outcome and process feedback from the experienced nurses than in the treatment group which received outcome feedback only.

The results of the analysis of covariance supported the first hypothesis but not the second hypothesis. It was found that the mean of the group receiving outcome feedback was significantly higher than the control group, but that there was no difference in the means of the control group and the treatment group which received both outcome and process feedback.

Analysis of the data from the experienced nurses revealed the following tentative conclusions relative to the processes of developing problem formulations: (1) nurses develop these formulations very early in their encounters with patients; (2) the major mode of mental representation of sets of cues is figural; (3) nurses use divergent rather than convergent strategies; (4) nurses use associative linkages of multiple verbal and nonverbal cues most frequently, but occasionally only one salient cue; and (5) nurses find demographic and historical cues helpful and tend to rely on their knowledge of pathophysiology in establishing the meaning of cues.

Limitations of the study were related primarily to the samples used. The number of experienced nurses was small; hence, the results obtained from that group were tentative. The sample of students was drawn from an existing nursing program; consequently, the results might not be generalizable. Implications for future research centered on the following: (1) other applications and modifications of the components of the instructional strategy; (2) variation of the types of simulation; (3) further research into problem-solving processes and outcomes of experienced nurses.

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