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Cognitive strategies of female nursing students using a computer simulation individually and in dyads to identify a nursing diagnosis

Castner, Linda J., Ph.D.
The Ohio State University, 1992
COGNITIVE STRATEGIES OF FEMALE NURSING STUDENTS
USING A COMPUTER SIMULATION
INDIVIDUALLY AND IN DYADS
TO IDENTIFY A NURSING DIAGNOSIS

DISSERTATION

Presented in Partial Fulfillment of the
Requirements for the Degree of
Doctor of Philosophy
in the Graduate School of
The Ohio State University
by
Linda J. Castner, RN, MSN

The Ohio State University
1992

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College of Education
To Florence Nightingale

Her vision of nursing

transcended time.
ACKNOWLEDGMENTS

I express sincere appreciation to Marge Cambre for her support, guidance, and insight throughout the research and writing process. Her goal of excellence encouraged me to expand myself to meet the challenge. Thanks go to Michelle Walsh for her advice on qualitative methodology and on maintaining a sense of perspective/humor through the process. Keith Hall contributed expertise in computer-related research. Each of these members of my committee contributed to my growth.

A special thanks to the College of Nursing at The Ohio State University who permitted me to use their facilities and students to collect data. To the students who willingly donated their time, I offer my gratitude for their generosity.

To O. J. Sahler, MD, of Rochester, N.Y., I express a special thanks for her vision of the future regarding computer-assisted problem solving in clinical education (MED-CAPS).

Finally, I wish to recognize my family for their patience and encouragement for the last four years. Each has contributed uniquely to this degree. Thank you: Harvey, Ray, David, Susan, and Ruth.
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CHAPTER I

STATEMENT OF THE PROBLEM

Background of the Problem

"The everyday management of a large ward, let alone of a hospital—the knowing what are the laws of life and death for men, and what the laws of health for wards—(and wards are healthy or unhealthy, mainly according to the knowledge or ignorance of the nurse)—are not these matters of sufficient importance and difficulty to require learning by experiences and careful inquiry, just as much as any other art? They do not come by inspiration to the lady disappointed in love, nor to the poor workhouse drudge hard up for a livelihood." (Nightingale, 1859/1969, p. 134)

Florence Nightingale's description of nursing as an art and a science requiring organized, scientific, and formal education was a vision of the future. Today the National League for Nursing (NLN) continues this tradition with the emphasis on nursing as a human science. With the emergence of technology and advances in medical care, the new social mandate demands nurses who are compassionate, well educated, creative, capable of independent judgment and action, and morally astute and courageous (Bevis & Watson, 1989).

This demand for "thinking" nurses is reflected in the nursing education literature over the last several years. Professional journals emphasize topics such as: diagnostic reasoning strategies (Tanner, Padrick, Westfall, & Putzier,

Nursing students are generally characterized as a homogeneous group of women with predictable characteristics, including computer anxiety and less advanced cognitive skills. Whether this is reality or not, this stereotype deserves study to sort out the cognitive characteristics of nursing students, especially as they relate to the new technologies that are becoming more and more prevalent in nursing schools and hospital environments.

Frisch (1987) concludes from her study of cognitive maturity of nursing students that "nursing students are developmentally similar to other students though their level of cognitive growth may be less advanced than many nurse educators and leaders assume" (p.27). Beyer (1984) indicates that there may be several obstacles to the development of thinking skills in nursing students including failure to identify the cognitive operations that are necessary, inappropriate methods of instruction and overload (attempting to teach too much in too little time).

The application of simulations to problem solving in medical and nursing education indicates the strong interest in improving problem solving ability (Elstein, 1987; Shulman & Sprafka, 1978; Gale & Marsden, 1983). The
significance of developing skills in both individual and group problem solving is important given the characteristics of the nursing profession. The nurse must make independent and interdependent decisions. Clinical simulation is one method that can develop this competency. In a simulation the student is involved as an active participant rather than a passive observer (Boss, 1985). There needs to be more study about how the computer can be used to develop problem solving skills, especially nursing diagnostic problem solving where each simulation (client) requires an independent conclusion. Computer programs that stimulate development of the diagnostic problem solving abilities would add to the efficiency of nursing education while encouraging student cooperative learning with a potential for greater time and cost effectiveness.

Much of the research on the application of the computer in learning has focused on the use of the computer as individualized instruction (Kulik, Bangert, and Williams, 1983; Gaston, 1988). It seems important to expand this view of the computer to include its use in small group (2-4 students) instruction. Small group interaction is a stimulus to the development of problem-solving abilities (Slavin, 1983). The development of these problem-solving skills has been identified by nurse educators as a high priority for nursing research (Tanner & Lindeman, 1987). Tanner (1984b) suggests empirical testing of teaching strategies that complement problem solving instruction. Studies which identify cognitive strategies that nursing students use in individual and/or group
problem-solving situations provide an important baseline for planning and implementing nursing education.

This researcher's observations of medical students and nursing students using computer simulations indicate that students tend to complete simulations in small groups with much discussion involving significant aspects of the simulation. Research on small group application of computer-based instruction (CBI) indicates that students who work cooperatively significantly outperform those who work individually (Dalton, Hannafin & Hooper, 1989) and students working in pairs frequently discuss content with their partners (Carrier & Sales, 1987). However, Johnson and Johnson (1986) and Slavin (1983) suggest that the small group enhances learning in some cases and not in others.

Most of the studies related to the cooperative use of the computer have used students in grades 7-12. Two studies used college juniors (Okey & Majer, 1976; Carrier & Sales, 1987). The results of these studies using college students did not indicate higher scores on achievement tests for students working cooperatively than students working alone. Additionally, there was a great variation in the way that pairs interacted. More information needs to be collected related to ways that specific students use computer programs, especially in problem solving.

A first step in this process is to determine how students use a computer program. What cognitive strategies do students demonstrate in individual use of the computer program and in cooperative (dyad) use of the computer
program? Answers to these questions can guide the design of computer software and computer use. Thus, this study will attempt to describe cognitive operations of nursing students using a computer simulation approach to problem solving.

Research Questions

The questions asked for this research were:

1. What cognitive strategies do female nursing students demonstrate when completing a computer simulation in dyads and individually?

2. Do students working in dyads demonstrate the same or different cognitive strategies than students working individually on the same computer simulation?

3. Do senior students demonstrate the same or different strategies than junior students working either individually or in dyads on the same computer simulation?

4. What factors can be identified which influence cognitive strategies?

The Purpose of the Study

The purpose of the study was to describe the cognitive strategies that female nursing students use during the completion of the computer simulation in dyads and individually and to identify factors that influence this cognitive strategy. Identification of these characteristics can lead to improvements in nursing education.
The Methodology

Qualitative research methodology was used to investigate the questions. The study is descriptive in the sense that it describes and interprets "what is". It describes what cognitive strategies the students are presently using and the factors that are influencing these strategies. A detailed description of the methodology is presented in Chapter III.

Significance of the Study

Nursing diagnosis has been labeled the "weak link" in the nursing process (Aspinall, 1976; Anderson & Briggs, 1988). Anderson and Briggs found that 44% of nursing diagnoses were not supported by assessment data (1988). The accuracy of a nursing diagnosis depends in part on the skill with which one uses the diagnostic reasoning process (cognitive strategies). The cognitive strategies that students use to make a nursing diagnosis are crucial to the knowledge base of the nurse educator.

If we accept the assumption that nursing diagnosis is indeed a process of concept attainment, then it becomes important to understand the student's use of this process. Do students apply an organized approach in the assessment of a client? Can we identify what they do and what they omit? What strategies do students use when working individually or in groups (dyads)? To improve education in this subjective area of learning we must begin to understand what the student is perceiving as important and applying in the nursing diagnosis process. Previous studies tend to concentrate on the
end product of a decision -- the right or wrong diagnosis (Aspinall, 1979; Fredette, 1988). Some studies stress the significance of cue recognition (Theile, Baldwin, Hyde, Sloan, & Stradquist, 1986; Broderick and Ammentorp, 1979). Studying the process of nursing diagnosis from a student strategy perspective can highlight some of the problem areas.

Computer technology has been described as an asset to nursing education in so far as it can be a means to enhance classroom and/or clinical teaching. Jacobsen, Jacobsen, & Tulman (1991) comment that the versatility, speed, and portability of the personal computer make it a great partner in the classroom for teaching statistics in nursing education. Lowdermilk & Fishel (1991) used computer simulations to evaluate clinical decision-making skills of baccalaureate nursing students. It is important to continue to evaluate the integration of the computer in teaching strategies. In this study the computer serves as a simulated client to reinforce the application of nursing diagnosis.

Assumptions of the Study

The following assumptions were made at the outset of this study:

Students learn using computer programs. Computer-based instruction is effective in improving achievement.

Qualitative research methodology is appropriate to describe the strategies that students use to complete a diagnostic case simulation.

Computers can be used for strengthening cognitive skills -- not just for
drill and practice.

Nursing client studies are viewed as problems.

Humans operate as information processing systems (IPS). Various cognitive strategies can be identified in the process.

Nursing diagnosis is concept attainment.

Limitations of the Study

The following limitations apply to this study:

The study focuses only on completion of nursing diagnosis at a computer work station. It does not include other means of developing diagnostic skills.

The study does not consider the total nursing process but only the clinical diagnostic phase of the nursing process.

The study includes only dyads and individuals who are completing the diagnostic case simulation and does not include small groups of more than two.

The study uses a specific population -- female baccalaureate nursing students at The Ohio State University.

Definition of Terms

The following definitions were used in this study:

Attainment of Concepts -- "The behavior involved in using the discriminable attributes of objects and events as a basis of
anticipating their significant identity" (Bruner, Goodnow, and Austin, 1962, p. 21).

Attributes (cues) -- "Any discernible feature of an event that is susceptible of some discriminable variation from event to event" (Bruner, Goodnow, and Austin, 1962, p. 26). A characteristic or quality of a person or thing.

Behavior trace -- A handwritten record of all choices students make during the computer case simulation (NURS-CAPS).

Clinical reasoning -- That cognitive activity which enables one to collect pertinent information about the client, to interpret and organize the information, and to apply a diagnostic label. It involves decision making, inference, conceptualization, and judgment (Gordon, 1982).

Cognition -- The act or process of knowing in the broadest sense. An intellectual process by which knowledge is gained about perception or ideas.

Cognitive Strategies -- "The skills by means of which learners regulate their own internal processes of attending, learning, remembering, and thinking" (Gagne, 1985, p. 55). Processes used in finding and solving problems (Bruner, 1971).

See Diagnostic Reasoning Process

Competitive learning -- A situation where students are assigned to a
group and instructed to compete to see who is best (Johnson & Johnson, 1986).

Cooperative learning -- A situation where students work on learning activities in small groups and receive recognition/rewards based on the group's performance (Johnson & Johnson, 1986).

Decision-making -- A process which involves a number of steps by which information is assimilated, integrated, weighed, and valued to arrive at the solution or a course of action from among a number of possible alternatives (Gordon, 1982; Janis & Mann, 1977).

Diagnosis -- The careful, critical study of something in order to determine its nature.

Diagnosis (Medical) -- Clinical medicine is concerned with the diagnosis and treatment of disease based on knowledge from biomedical sciences. These sciences seek to describe, explain, predict, and control events associated with pathophysiology or psychopathology (Gordon, 1982).

Diagnosis (Nursing) -- A clinical judgment about an individual, family, or community response to actual or potential health problems/life processes which provides the basis for definitive therapy toward achievement of outcomes for which the nurse is accountable. (Caroll-Johnson, 1990)
Diagnostic Concept-attainment Model -- Diagnosis can be thought of as concept attainment -- attainment of a concept of the state of the client (Gordon, 1980; Elstein, Shulman, & Sprafka, 1978).

Conceptualization of a health condition is communicated by using a concise word-label that replaces long, narrative descriptions (Gordon, 1979).

Diagnostic Reasoning Process -- "Complex observation-critical, thinking-data gathering process [sic] used to identify and classify phenomena that are encountered in presenting clinical situations" (Carnevali, 1984, p. 26).

The Diagnostic reasoning process is made up of a series of elements/pattern of steps.

Disjunctive Concepts -- "Concepts which have defining attributes such that one or another of these attributes can be used in identifying or categorizing them" (Bruner, Goodnow, and Austin, 1962, p. 156).

Inference -- A conclusion or judgment drawn from data (Kelly, 1964).

Any tentative conclusion based on, or extending beyond, the cues presented (Westfall, Tanner, Putzier, & Padrick, 1986).

Individual learning -- A situation where students complete the assignment alone and their performance is compared with a preset criteria of excellence (Johnson & Johnson, 1986).
Information processing system -- Human organization for problem solving. System consisting of a memory containing symbol structures, processor, effectors, and receptors. It consists of complex processes to arrive at a solution to a problem.

Judgment -- Act or process of the mind in comparing its ideas to find their agreement or disagreement and to ascertain truth. The process of examining the relationship between one proposition and another. Syn: discernment, discrimination, decision. Judgment may include: perception, concept formation, thinking, memory, discrimination, decision-making and creative imagination (Beiri, Adkins, Briar, Leamon, Miller, and Tripodi, 1966).

Metacognition -- The knowledge one has about his/her own thought processes. There are two components of metacognition: an awareness of what is needed to perform a task and the ability to use the appropriate strategies.

Nursing -- The diagnosis and treatment of human responses to actual or potential health problems (American Nurses Association, 1980). Operational definition: Nursing is a problem solving process consisting of an orderly series of steps designed and interrelated to assist clients to achieve and maintain optimal functional activity (Goodwin & Edwards, 1975).

Nursing Process -- An organized, systematic method of examining the
client’s health status, identifying the client’s needs, and determining appropriate solutions to meet these needs. Uses the steps of assessing, diagnosing, planning, implementing, and evaluating (Pinnell & de Meneses, 1986, p. 31). May also be referred to as clinical decision-making or clinical problem solving (Goodwin & Edwards, 1975).

Problem solving -- Process by which one learner discovers a combination of previously learned rules and plans their application to achieve a solution for a novel problem situation. Yields new learning (Gagne, 1985).

A person is confronted with a problem when he/she wants something and does not know immediately what series of actions he/she can perform to get it (Newell & Simon, 1972).

Reliability (interpretive) -- Common labels are consistently applied to the units (Garvin, Kennedy, & Cissna, 1988).

Reliability (unitizing) -- Consistency in the identification of what is to be categorized across time and/or judges (Garvin, Kennedy, & Cissna, 1988).

Verbal or "thinking aloud" protocol -- Subjects are asked to say aloud everything that crosses their minds while they are performing the task, no matter how trivial the thought may be" (Hayes, 1982, p. 67).
CHAPTER II
REVIEW OF THE LITERATURE

Introduction

The "thinking processes" of humans have long fascinated scholars. As a result there is a multitude of writing reflecting research and speculation about what goes on inside another person's head. For the current study certain aspects of this research literature were deemed useful to an understanding of cognitive strategies in nursing diagnosis. A core of literature describing problem solving, general cognitive strategies, and concept attainment became a basis for medical problem solving which in turn provided a framework for diagnostic reasoning in nursing. This relationship is depicted in Figure 1.

Figure 1. Pyramidal relationship of cognitive literature.
The computer was used as a medium in this study to present a diagnostic simulation to students requiring them to use cognitive strategies individually or in dyads to determine a nursing diagnosis. A review of the individual and cooperative learning literature revealed characteristics of these methods that might be important to nursing education.

Clark (1984) comments that research on thought processes examines how instructional presentations influence what students think, believe, and feel and how those thoughts in turn influence achievement. Thus, the purpose of this section is to review the research on general problem solving, medical problem solving, diagnostic reasoning in nursing, and cooperative learning as a base for this study of cognitive strategies.

Problem solving

One of the assumptions of this study is that the human functions as an information processing system (IPS). Methods of studying problem solving fall into two general approaches: process tracing and modeling input-output relations (Elstein, Shulman, & Sprafka, 1978; Woods, 1984; Radwin, 1990). The aim of process tracing is to observe the process of thinking in as natural an environment as possible. In input-output modeling investigators have compared human performance in decision making with mathematical models. Examples of these include Bayes' theorem and the Brunswikian lens model (Elstein, et al., 1978; Woods, 1984). While both of these methods show promise for the study of diagnostic behavior in nurses, process tracing was
used in this study to explain strategies producing the diagnostic decision rather than merely predicting the decision. Therefore, some discussion of IPS is necessary as a baseline.

Newell and Simon (1972) in *Human Problem Solving* state that the human operates as an information processing system (IPS). The IPS is a system consisting of a memory containing symbol structures, a processor, effectors, and receptors. This relationship is shown in Figure 2.

![Diagram of Information Processing System (IPS)](image)

**Figure 2.** Information processing system (IPS).

Memory is the component of IPS capable of storing and retaining symbol structures. A symbol structure designates an object. An information process is a process that has symbol structure for its inputs or outputs. The processor is the component of IPS that consists of a set of elementary information processes, a short-term memory, and an interpreter to provide the integration. This process occurs within an environment called the task environment (an environment coupled with a goal, problem, or task -- the one for which the motivation of the subject is assumed).
A theory of thinking (problem-solving) must encompass both an analysis of the environment and the human processes involved (Newell & Simon, 1972). It should be noted at this point that this description bears a strong resemblance to the description of factors important in the diagnostic reasoning process presented by Carnevali (1984) to be discussed later.

It is important to differentiate between the external task environment, the internal task environment (the problem space) and the researcher's description of the environment. The stimulus from the task environment must be "describable so that it can and will be encoded in highly simplified form by any subject exposed to it" (Newell & Simon, 1972, p. 58). This becomes transformed into the internal problem space of the human. This is the space where the problem solving activities take place. Newell & Simon (1972) state that a person is confronted with a problem when the person wants something and does not know immediately what series of actions to perform to get it. An analysis of the task environment is important to reveal its demands. The structure of the task environment sets constraints on the problem solver. The problem solver works to simplify the problem space within the task environment. Problem solving takes place by search in a problem space.

Newell & Simon (1972) comment that the problem space and the problem formulation already impose an overall organization on the problem solving process as sketched in Figure 3. Activities within the problem solving process may shift from one to another but there will be a rational organization
of processes within itself. Repeated loops may occur around the circuit.

Subgoals may be pursued and new goals developed.

Figure 3. General organization of problem solving. From Human Problem Solving by A. Newell and H. A. Simon, 1972, p. 89. Copyright by Prentice-Hall, Inc. Reprinted with permission.
Characteristics of long-term memory (LTM) and short-term memory (STM) are important in the IPS. There is no limit on the symbols that can be stored by LTM. Therefore, the IPS has a potentially infinite vocabulary of symbols. In comparison IPS has a short-term memory of very small capacity (about 5 - 7 symbols). Details of the memory activities is unknown but it is assumed that inputs and outputs must reside in STM at execution time.

Thus, human problem solving is characterized as a complex information processing system.

"Human problem solving is to be understood by describing the task environment in which it takes place; the space the problem solver uses to represent the environment, the task, and the knowledge about it that he gradually accumulates; and the program the problem solver assembles for approaching the task" (Newell & Simon, 1972, p. 868).

A basic awareness/understanding of this complex information processing system was essential to the progression of this study and the analysis of the data. Again the similarity to the nursing diagnostic reasoning process is apparent. Descriptions of the importance of the task environment (from the student and researcher perspective), the search of the problem space, and the problem solving strategies define nursing diagnostic reasoning in educational theory.
Cognitive Strategies

Gagne (1985) describes cognitive strategies as "the skills by means of which learners regulate their own internal processes of attending, learning, remembering, and thinking" (p.55). Bruner (1971) also refers to these skills as cognitive strategies and relates them to processes used in solving problems. Other authors refer to these strategies as "executive control processes" (Greeno and Bjork, 1973) or "self-management behaviors" (Skinner, 1968).

There are varieties of cognitive strategies that students may use. These include: (1) attending to and selectively perceiving particular parts of a lesson media, (2) encoding incoming material for long-term processing, (3) retrieving information, (4) problem solving. There are differences in strategies used by experts and novices. Experts take fewer steps to arrive at the solution and may use additional strategies that the novice has not yet acquired (Gagne, 1985).

Cognitive strategies can be learned by students through verbal instruction or by discovery by the students, themselves. Verbal instruction frequently takes the form of simple rules. It must be remembered that students may not actually use a strategy that was taught (Gagne, 1985).

Radwin (1990) discusses diagnostic strategies in nursing. She comments that the diagnostic reasoning process is complex and can strain cognitive abilities to produce errors. The use of strategies reduces this strain. "A diagnostic strategy represents a set of decisions made during information processing" (Radwin, 1990, p. 72). An example of a strategy decision is how
much information to collect. Ways to use information during hypothesis testing would be another strategy.

Specific cognitive strategies as applied to diagnostic reasoning in nursing are discussed later. The need to develop a strategy to approach the complex task of determining a nursing diagnosis is evident. In this study, ways that students used cognitive strategies were explored and described. The emphasis was on the strategies that students used not the strategies they had been taught. Factors influencing diagnostic strategies were examined to determine student perceptions of the importance of classroom learning and experiential learning.

Concept Attainment

Conceptualizing nursing diagnosis as concept attainment promotes a particular type of cognitive strategy. It is helpful to consider the process of concept attainment in some depth. Medical diagnostic literature and nursing diagnostic literature frequently refer to Bruner in presentations of concept attainment.

Bruner, Goodnow, & Austin (1962) in *A Study of Thinking* discussed the significance of categorizing. Categorizing serves various functions including reducing the complexity of the environment, becoming a means by which the objects of the world around us are identified, reducing the necessity of constant learning, and providing direction for activity. "Categorizing an event as a member of a class and giving it identity involves an act of inference" (Bruner, et.
Bruner, et al. (1962) defines the "attainment of concepts" as "the behavior involved in using the discriminable attributes of objects and events as a basis of anticipating their significant identity" (p.21).

Part of the process of concept attainment involves recognizing attributes. Attributes are defined as "any discriminable feature of an event that is susceptible of some discriminable variation from event to event" (Bruner, et. al, 1962, p. 26). An attribute may vary. Any attribute represents a dimension along which one may specify values. There are defining and criterial attributes. Defining attributes are an external statement of the defining properties of a class while criterial attributes are used by a particular individual to identify a class. The distinction between defining attributes and criterial attributes permits us to think of categorizing as a process of achievement (Bruner, et. al, 1962). We discover the defining attributes of the environment so that they serve with their proper values as the criteria for making judgments about identity (Bruner, et. al, 1962). The learning process enables one to isolate and use the defining attributes; thus, making them one's own criterial attributes.

Identity in a category is frequently inferred not from a single attribute but by the observance of several attributes taken together. How attributes (or cues) are combined is significant. Bruner et al. (1962) identifies three modes of combining attributes:

1. Conjunctive - "joint presence of the appropriate values of several attributes" (p. 41).
2. Disjunctive - "lack of apparent relation between attributes which may be substitute for one another" (p.41).
3. Relational - "specifiable relationship between defining attributes" (p.43).

One can recognize the strategies of diagnostic reasoning used by the nurse to make a nursing diagnosis in Bruner's discussions. Defining attributes bears a strong resemblance to the "Defining Characteristics" of the North American Nursing Diagnosis Association (NANDA) diagnostic labels (see Appendix A). Distinctions between diagnoses may involve conjunctive, disjunctive, or relational modes of combining attributes which may make diagnosis complex for the beginning student.

There are various conditions that affect concept attainment behavior. These include the definition of the task, the nature of instances encountered, the nature of validation, the consequences of specific categorizations, and the nature of imposed restrictions (Bruner, et al, 1962). Newell and Simon (1972) also stressed the importance of the structure of the task environment and the problem formulation to the overall organization of the problem solving process. The identification of nursing diagnosis in nursing as concept identification provides structure to the problem space.

Selection strategies involve the order in which to make one's inquiries. A planned strategy increases the opportunity to obtain information appropriate to the objectives of one's inquiry, increases or decreases the cognitive strain in assimilating information, and controls the degree of risk.
Bruner et al. (1962) labels four discernible strategies including:

1. Simultaneous scanning - "the person uses each instance encountered for deducing which hypotheses are tenable and which have been eliminated" (p. 83).

2. Successive scanning - "the person tests a single hypothesis at a time" (p. 85).

3. Conservative focusing - "the person finds a positive instance to use as a focus and alters one attribute value to determine if that yields a positive or negative instance" (p. 87).

4. Focus Gambling - "the person uses a positive instance as a focus and changes more than one attribute value at a time" (p. 89).

Reception strategies involve freedom of the problem solver in formulating or altering hypotheses based on the common attributes. Problem solvers must learn to modify their initial hypotheses upon encountering different cases (or contingencies). There are four general contingencies that the person can encounter positive confirming, positive informing, negative confirming, and negative informing (Bruner, et. al, 1962). Problem solvers tend to use a holist strategy or a part-scanning strategy. In the holist strategy the initial hypothesis is based on the "whole instance initially encountered, followed by an adherence to the rules of focusing" (Consider what is common to your hypothesis and any positive informing instances. Ignore everything else.). In the part-scanning strategy the problem solver begins with a hypothesis about part of the initial encounter. If this hypothesis is not confirmed, the person seeks to change it by referring back to all instances previously met and making modifications (Bruner et al. 1962).
Bruner et al. (1962) comments that the focusing strategy appropriate to an initial whole hypothesis is less demanding both on inference and memory than the scanning strategy required to make good an initial part hypothesis. More people tend to start with a whole hypothesis (Bruner, et. al, 1962).

Disjunctive concepts are concepts which "have defining attributes such that one or another of these attributes can be used in identifying or categorizing them" (Bruner et al. 1962, p. 156). An instance containing any one or any combination of these defining attributes is necessary and sufficient for producing the class-defining effect. What is problematic is that in any given category two of its members may have no defining attributes in common. One must rely upon information derived from negative instances. Interestingly, humans demonstrate an inability or reluctance to use information illustrated by a negative case.

In an overview Bruner et al. (1962) commented about techniques for the study of cognitive processes. He stated that the researcher must work with units larger than a single response. One must work with sequential patterning of the behavior being studied. It becomes important to externalize these component steps in order to get at them.

The objective of this study was to attempt to externalize the component steps of diagnostic reasoning in nursing using a verbal protocol and to study them in some depth. Many of the strategies Bruner describes in concept attainment were evident in a study of the transcripts of student strategies (note analysis/discussion sections).
Matthews and Gaul (1979) completed two studies to determine variables which relate to nurses' cognitive ability to process information during the nursing diagnostic process. "The ability of the nurse clinician to use appropriate information-processing strategies in concept attainment or categorization is basic to the nursing diagnostic task" (p.18). In identifying the cognitive processes used in nursing diagnosis, Matthews and Gaul (1979) label nursing diagnosis as a disjunctive concept. Subjects were senior undergraduate students and graduate nursing students. It was found that the subjects' ability to deal with abstract concepts as measured by the Concept Mastery Test was considerably below the national average. Graduate students performed better than undergraduate students. In the discussion section the authors suggest that the informational value of the cue to the individual rather than the number of cues used may be significant. Variability in nursing experience may account for differences in students.

It is important when scrutinizing the above study to consider the experiences undergraduate and graduate students might have had with selection strategies and reception strategies applied to disjunctive concepts. The strong influence of information derived from negative instances coupled with the reluctance of humans to use information from negative cases creates a dilemma for the researcher/educator in studying/teaching diagnostic reasoning. At what point in the educative process or experiential process do students learn strategies for dealing with disjunctive concepts?
Medical Problem solving

Medical problem solving is a branch of the human problem solving process which concentrates on diagnostic reasoning, treatment selection, and patient management (Elstein et al. 1982; Gale & Marsden, 1983) in medicine per se. The focus of research is largely on the process of diagnostic reasoning. Inclusion of a discussion of medical problem solving in this study is useful since it is seen as the predecessor to nursing diagnostic reasoning.

Gale and Marsden (1983) refer to the "Diagnostic Thinking Process" and relates this to theories of Bruner and Gagne. They comment:

' The problem of diagnosis is especially difficult because there seem to be no "rules" and no boundaries, no defined beginning and no pre-established end to aim for. It begins with whatever the patient presents, it ends when the clinician judges that he has enough information and understanding on the basis of which suitable action can be taken. The problems of diagnosis are not neat and tidy problems. Each one is different. Each one requires judgment.

(Gale & Marsden, 1983, p. 3)

Gale and Marsden's stages of the diagnostic thinking process include Stage I (Initiation), Stage II (Progress) and Stage III (Resolution) as shown in Figure 4. The authors caution that the differentiation of stages is merely a device for description and understanding. In reality an individual may be at all three stages simultaneously in the different threads of the thinking process. Boundaries between stages may be blurred, and a cognitive strategy may be identified as belonging to more than one stage.
### Stages, Thinking Processes, and Psychological Factors

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<tr>
<th>Stage</th>
<th>Thinking Processes</th>
<th>Psychological Factors</th>
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<tbody>
<tr>
<td>I: Initiation</td>
<td>1. Prediagnostic interpretation</td>
<td>Instantaneous, active response</td>
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<td></td>
<td>2. Diagnostic interpretation</td>
<td>Structure of memory</td>
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<td></td>
<td>3. Judgment of need for further enquiry</td>
<td>Structuring elicited information</td>
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<td></td>
<td>4. Reinterpretation: no new information</td>
<td>Extrapolation</td>
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<td></td>
<td>5. Reinterpretation: with new information</td>
<td>Forceful feature</td>
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<td></td>
<td>6. Enquiry responsive to elicited information</td>
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<td>7. Enquiry determined by clinician’s interpretations</td>
<td>Cognitive vs. traditional approaches to history taking</td>
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<td>8. Routine enquiry</td>
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<td>II: Progress</td>
<td>9. Failure to make specific enquiry</td>
<td>Retrieval problems</td>
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<td></td>
<td>10. Failure to make general enquiry</td>
<td>Difficulty in “thinking on one’s feet”</td>
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<td></td>
<td>11. Enquiry responsive to elicited information</td>
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<td></td>
<td>12. Active confirmation of an interpretation</td>
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<td>13. Active elimination of an interpretation</td>
<td>Psychological probability</td>
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<td>14. Postponement of judgment</td>
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<tr>
<td>III: Resolution</td>
<td>15. Failure to make correct interpretation</td>
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<td>16. Designation of irrelevance</td>
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<td></td>
<td>17. Set affect</td>
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<td></td>
<td>18. Use of non-standard information</td>
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Figure 4. Summary of the diagnostic thinking process; stages, thinking processes, and psychological factors. From: Medical Diagnosis: from Student to Clinician by J. Gale & P. Marsden, 1983, p. 148. Copyright by Oxford University Press. Reprinted with permission.

Eistein, Shulman, and Sprafka (1978) present a four-stage model of medical enquiry that includes cue acquisition, hypothesis generation, cue interpretation, and hypothesis evaluation. Their model is based on studies of process-tracing directed at development of an information-processing model using both experienced physicians and medical students. The emphasis on process reflects a view of diagnosis as concept attainment or concept recognition. Interesting findings included: early generation of tentative hypotheses is a major strategy used by clinicians to bound the regions of the problem space; possible solutions are retrieved from long-term memory via associative processes that link cues to content stored in memory; accuracy of
cue interpretation is found to be related to accuracy of diagnostic outcome; cue interpretation is found to be independent of thoroughness of cue acquisition; and a conscious effort to employ useful experimental (trial and error) strategy does appear to help adapt one's thinking to the demands of medical problems.

Diagnostic Reasoning in Nursing

Problem solving in medicine has served as an predecessor to problem solving in nursing. Problem solving in medicine (medical diagnosis) emphasizes the identification of disease processes while problem solving in nursing (nursing diagnosis) emphasizes human responses to actual/potential health problems. This distinction guides the assessment process in nursing and influences the judgment and implementation phases of the nursing process. Stripped of content, diagnostic reasoning can be viewed as a universal process. For the purposes of this study, it is useful to understand diagnostic reasoning in nursing both as a general thinking process (as previously discussed) and as a nursing-oriented reasoning process. Models of the diagnostic reasoning process in nursing have been suggested by Gordon (1982) and Carnevali (1984).

Gordon (1982) presents diagnosis as a process involving reasoning and judgment. Diagnosis involves four activities:

1. Collecting information
2. Interpreting the information
3. Clustering the information
4. Naming the cluster

This process is not composed of four activities that are sequenced steps; rather the diagnostic process is a cycle of perceptual and cognitive activities.

Within the four activities in the cycle are various contingent activities. In the collection of information, three basic factors are considered. One is the situational context in which information is collected -- both physical and interpersonal characteristics are important. The second factor is the nature of the information available. Third is the cognitive and perceptual capabilities of the diagnostician. All three factors operate simultaneously when information is being collected. Interpreting information includes developing strategies, hypotheses and decisions about the collection and use of information.

Clustering information involves hypothesis testing. This focused cue search is different from earlier cue clustering for prediction of possibilities. When sufficient supporting data exists, problems identified are stated as nursing diagnoses.

Carnevali (1984) comments that skillful use of the diagnostic reasoning process in identifying health-related problems is the foundation of professional health care. The diagnostic reasoning process itself is made up of a series of elements or pattern of steps. In actual practice, the blurring of steps or the modification of the sequence makes the process much less linear and simplistic than diagrams suggest (see Figure 5). Thus, a description of the process involves an explanation of elements and a potential pattern of use rather than
rigid steps. Carnevali (1984) identifies several factors outside the actual clinician-patient encounter that affect the diagnostic reasoning occurring in the encounter. These include the nature and background of the diagnostician (experience, personal variability, memory), the nature of the setting (physical structure and equipment, role expectations, type of clientele) and the nature of the diagnostic task (infer and classify the status of the client).

The nature of the elements of the diagnostic reasoning process must be understood before they are viewed as a sequence. Pre-encounter client data (age, sex, pathology, chart data) reduces cognitive strain by setting early limits on the data space before the actual one-to-one encounter with the client. The

Figure 5. Elements of the diagnostic reasoning process. From Diagnostic Reasoning in Nursing by D. L. Carnevali, 1984, p. 28. Copyright by J. B. Lippincott Co. Reprinted by permission.
entry into the data field involves the direct encounter with the client and the collection of data (cues). Single cues lead to cue clustering which in turn lead to hypothesis activation (early tentative labels). Early hypothesis activation limits the size of the search field and brings it into manageable dimensions while providing direction for subsequent data-searching. A danger of early hypothesis activation is ignoring contrary data. Short- and long-term memory are critical elements of hypothesis activation. Individual differences in use of diagnostic reasoning will be influenced by the way in which knowledge and experience are stored in long-term memory for diagnostic purposes. Carnevali (1984) comments "Refinement of the problem classification consists of searching the data field for cues associated with the features of the problems being considered and matching them with the problem profiles for congruence or goodness of fit" (p.48). Diagnostic possibilities are rejected or refined. The final stage is to select the diagnostic label as precisely as possible.

Research of the last 10-12 years has focused on the study of cognitive strategies in an attempt to add to our knowledge and understanding of this phenomenon. It is useful to review several of these studies as they relate to the present study.

Matthew and Gaul (1979) completed studies to measure diagnostic abilities of undergraduate nursing students and graduate nursing students. Instruments included the Concept Mastery Test and the Watson-Glaser Critical Thinking Appraisal. A case study and the Concept Mastery Test were
administered to subjects (N = 42; undergrads = 18) in a study of concept attainment. A case study and the Watson-Glaser Critical Thinking Appraisal were administered to subjects (N = 48; undergrads = 22) in a study of critical thinking. Matthew and Gaul (1979) found that while graduate students performed better than undergraduate students, general subjects' ability to deal with abstract concepts was considerably below the national average; graduate and undergraduate students' ability to think critically was consistent with the mean score of a national sample; and among undergraduate subjects a strong relationship existed between cue perception in nursing diagnosis and the scores on the Concept Mastery Test.

Data obtained from the studies (Matthew & Gaul, 1979) were analyzed for cue grouping. None of the subjects in either study used all of the information (cues) available for a diagnosis. Therefore, it was concluded that the value of each cue, rather than the number of available cues, enabled each subject to determine the nursing diagnosis. As will be noted in the analysis and discussion section, the significance of cues and cue clustering activities at various phases of the diagnostic reasoning process appears significant in determining the nursing diagnosis in the current study.

Cianfrani (1984) studied clinical reasoning with 120 students in four graduate nursing programs and 60 members of the ACCN (American Critical Care Nurses). He investigated whether amounts and relevance of data influence identifying health problems. Ciafrani's (1984) findings indicate that
when data increased, more health problems were hypothesized and more time was taken to identify the health problems; accuracy decreased with low relevant data; and with increased amounts of data and low relevant data, more errors were made (the correct health problem was less likely to be hypothesized). For the purposes of the present study, it is important to note that subjects were registered nurses with an average of 7.5 years of experience (not students).

Radwin's (1989) findings tend to disagree with Cianfrani's (1984). In her study, Radwin found that there was no significant difference between subjects making accurate or inaccurate diagnoses in the amount of information gathered in the acute pain cases she studied. Subjects in the Radwin study were 20 RN's each with a Master's degree and a minimum of 1 year of experience with patients in pain. Subjects were given case studies and asked to diagnose client's pain conditions. There was no limit to the amount of information the subject could request.

Radwin comments that a strategy includes both the amount of information collected and the type of information collected. Subjects most frequently collected items about verbal report of pain and location of pain. Strategy also includes how information is used in hypothesis testing (multiple- or single-hypothesis testing). In the study more of the subjects with accurate diagnoses used multiple-hypothesis testing the majority of the time while subjects with inaccurate diagnoses used single-hypothesis testing the majority of the time.
Perhaps some of the differences noted in the two studies relate to the
differences in the subjects used... expert or novice status. According to Benner
(1984) there are five levels of competency in clinical nursing practice:

1. Novice -- no experience of the situations where they are expected
to perform.
2. Advanced Beginner -- demonstrate marginally acceptable
performance.
3. Competent -- conscious, deliberate planning helps achieve
efficiency and organization.
4. Proficient -- perceives situations as wholes rather than aspects.
   Performance is guided by maxims.
5. Expert -- enormous amount of experience, intuitive grasp of each
   situation, zero in on accurate region of problem without wasteful,
   unfruitful solutions.

Benner’s data came from descriptive research involving interviews with 21 pairs
of nurses (preceptors and newly graduated nurses) describing the same
clinical incident and interviews and/or participant observations with 51
experienced nurse clinicians, 11 newly graduated nurses, and 5 senior nursing
students discussing characteristics of nurse performance.

Significant for the present study, Benner (1984, p.24) comments "Novices
and advanced beginners can take in little of the situation: it is too new, too
strange, and besides, they have to concentrate on remembering the rules they
have been taught [sic]." Students (as novices) have little understanding of the
contextual meaning of textbook information. Experience is needed before
students can apply guidelines to clients.

Westfall, Tanner, Putzier, and Padrick (1986) conducted an exploratory
study examining nursing inferences within the framework of information
processing theory. They used verbal responses to a client simulation by 28
nursing students (15 juniors, 13 seniors) and 15 practicing nurses as data. It was found that all subjects activated diagnostic hypotheses. There were no differences in the number of hypotheses activated between more experienced and less experienced subjects. Practicing nurses activated more complex inferences than students. Hypothesis activation occurred in the first half of the simulations.

The Westfall et al. (1986) study used a verbal protocol method of data collection which the authors suggest created some problems. It is possible that the protocol method and scoring procedures used to define content of inferences may not have been sensitive enough to reflect differences in groups. This indicates that caution must be used in interpretation of data from verbal protocol.

Tanner (1984) presents a comparison of factors influencing the diagnostic process of the novice and the expert and a comparison of diagnostic strategies between the novice and the expert (see Appendices B & C). These ideas presented were drawn from the rapidly expanding body of research designed for investigating the diagnostic processes used by physicians, medical students, psychologists, nurses, and nursing students including a study by Westfall, Tanner, Putzier, and Padrick (1986).

By considering the work of both Benner (1984) and Tanner (1986), one can develop an interesting picture of the novice and the expert nurse (nursing student). This comparison was helpful when considering the cognitive strategies of the students in the present study.
It is apparent from the literature already presented that the nature of the diagnostician is an influencing factor in diagnostic reasoning in nursing. It is useful to consider cognitive development/maturity as a characteristic of the diagnostician and an influencing factor. The classic work of Perry (1970) was based on observations and extensive interviews with undergraduate students (mostly male). His theory of young adult cognitive development traces stages of growth as noted in Figure 6.

<table>
<thead>
<tr>
<th>Stage of Thinking</th>
<th>Description</th>
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| Dualism           | (The student:)
| 1.                | Sees the world in polar terms. Right answers for everything exist. Authority provides "right" answers. |
| 2.                | Perceives diversity of opinion and uncertainty. Accounts for them as confusion and poor quality of Authorities. |
| Multiplism        | 3. Accepts diversity and uncertainty but still temporary. Authority hasn't found The Answer yet. |
| 4.                | a) perceives legitimate uncertainty. Interprets it as "anyone has a right to his own opinion". |
|                   | b) discovers qualitative contextual relativistic reasoning as a special case of "what they want" to hear. |
| Relativism        | 5. Perceives all knowledge and values as contextual and relativistic. Subordinates dualistic right-wrong to status of special cases. |
| 6.                | Apprehends necessity of orienting himself in a relativistic world through some form of personal Commitment. |
| 7.                | Makes initial Commitment in some area. |

Figure 6. Positions of cognitive development: Summary of Perry positions. From Forms of Intellectual and Ethical Development in the College Years: A Scheme by W.G. Perry, 1970, N.Y.: Holt, Rinehart, & Winston, Inc.
Frisch (1987) considered cognitive maturity of nursing students. She evaluated two separate groups of junior nursing students (N=42) using Allen’s (1983) paper and pencil test designed to measure development according to Perry’s positions. She found that a majority of students in both groups were operating at Perry position 3. Frisch (1987) comments that nursing students are developmentally similar to other students, though their level of cognitive growth may be less advanced than educators expect.

Belenky, Clinchy, Goldberger, and Tarule (1986) have presented research related to women’s intellectual development based on qualitative research using 135 women from both within and outside of universities. Building on Perry’s scheme they explored women’s perspectives on knowing and have presented five categories of women’s knowing (see Figure 7). These categories are perceived as not necessarily fixed, exhaustive, or universal.

Specific research in nursing related to the role of intuitive reasoning includes studies by Pyles and Stern (1983) and Young (1987). It is important to note that these two studies were conducted using experienced nurses, not students. Pyles and Stern (1983) conducted in-depth interviews with 28 critical care nurses to determine assessment and decision-making processes. From analysis of these interviews, they developed a theory of Nursing Gestalt to explain cognitive process used by experienced critical care nurses. Nursing Gestalt was defined as a matrix operation whereby nurses link together basic knowledge, past experiences, identifying cues, and sensory clues including
<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silence</td>
<td>women experience themselves as mindless and voiceless and subject to whims of external society.</td>
</tr>
<tr>
<td>Received knowledge</td>
<td>women conceive themselves as capable of receiving knowledge from external authorities.</td>
</tr>
<tr>
<td>Subjective knowledge</td>
<td>truth and knowledge are conceived as personal, private, and subjectively known or intuited.</td>
</tr>
<tr>
<td>Procedural knowledge</td>
<td>women are invested in learning and applying objective procedures for obtaining and communicating knowledge.</td>
</tr>
<tr>
<td>Constructed knowledge</td>
<td>women view all knowledge as contextual, experience themselves as creators of knowledge, and value both objective and subjective strategies of knowing.</td>
</tr>
</tbody>
</table>

Figure 7. Categories of women's perspectives on knowing. Summary from *Women's Ways of Knowing* by M.F. Belenky (et. al.), 1986, N.Y.: Basic Books, Inc.

what nurses call “gut feelings”. They also found that critical care neophytes learn to make assessments, diagnoses, and sound judgments about care from a more experienced nurse who supports and teaches the neophyte.

Young (1987) completed a grounded theory study using 41 female registered nurses in seven different agencies and clinical areas. Nurses were asked to describe their past intuitive experiences. Seventy-five descriptive incidents were collected and analyzed. Interesting results were found:

Judgment activities in nursing which have been considered to be deliberate thought processes, occur in the context of an interactive clinical nursing
situation. This study demonstrates that the interactional quality of this diagnostic process embraces the intuitive as well as the deliberative. Intuition is grounded in both knowledge and experience and is involved in making nursing judgments. (p. 60)

Young (1987) emphasizes the importance of experience on the development and use of intuitive knowledge. These findings suggest that emphasis on the personal dimension must take place in nursing education and staff development programs. "The work experience provides opportunities for nurses to experience multiple and repeating cue patterns and to increase their confidence about cues and decisions. Programs need to provide time for professional nurses to review and analyze the process of making judgments" (p. 61).

It is not the purpose of this study to evaluate the cognitive development of the students included in this study. It is useful, however, to recognize that cognitive development/category of knowing probably has an impact on the diagnostic strategy applied by female nursing students. Since nursing diagnosis is conceived as a complex process, the current cognitive development level of the student may well influence the process. Some differences between juniors and seniors may be accounted for by both experiential and maturity factors.
Cooperative Learning

Cooperative learning can enrich learning by expanding the perspectives of individuals. Dalton, Hannafin, and Hooper (1989) comment that alternative explanations, perspectives or input from peers during cooperative group activities would support encoding and cognitive strategies. A review of Carnevali's (1984) elements of the diagnostic reasoning process indicates the importance of the development of cognitive strategies and encoding.

Research has been completed considering group size in the classroom. Slavin (1980) reviews 28 research findings on cooperative learning, which refer to the situation where students work on learning activities in small groups and receive recognition/rewards based on the group's performance. The outcomes of the cooperative learning techniques fall mainly into two categories: academic achievement and group cohesiveness. Some of the studies showed more positive effects on academic achievement than others. A possible explanation can be related to the population composition. Slavin (1980) comments that interaction between ethnicity and treatment favors gains by minority students. In group cohesiveness, studies indicated that there is a strong and consistent effect on relationships between races. The same positive effect is also noted on mutual concern.

In the literature one finds other words referring to student learning that merit definition. Johnson and Johnson (1986) refer to cooperative, competitive and individual learning. Competitive learning refers to a situation where
students are assigned to a group and instructed to compete to see who was best. Individual learning refers to the situation where students complete the assignment alone and their performance compared with a preset criteria of excellence.

In the present study, students were asked to complete a nursing diagnosis simulation in dyads (5 junior dyads and 5 senior dyads) to study diagnostic strategy. The following research studies serve as a background for the discussion of this aspect of the study. Content of studies in this section include problem solving and group interaction, college students, and current concerns. Content of studies in this section include problem solving and group interaction: elementary and secondary, problem solving and group interaction: college students, and current concerns.

Problem Solving and Group Interaction: Elementary and Secondary

Swing and Peterson (1982) examined student ability and student behaviors during small-group interaction. They assessed achievement, retention, and attitude toward mathematics of fifth grade students. Each day after a regular class the students worked on assignments in mixed ability groups of four students. The treatment group of students were trained in small-group interaction. A group consisted of one high, one low, and two medium ability students randomly assigned. Groups were randomly assigned to treatment. "Results suggested that task-related interaction in the small group enhanced the achievement and retention of high and low ability students but did not facilitate the achievement of medium ability students" (p. 259). Trained low ability students outperformed control low ability students. " Thus,
small-group learning may be particularly effective for lower ability students because it offers enhanced learning support” (p. 272). This study did not discuss any implications that might have occurred related to the type of interaction that was occurring in the untrained groups. How were these groups functioning? Were some more effective than the trained group? It would have been valuable to expand the comparison to students working individually. For the current study, the findings are valuable to illustrate the benefits of group interaction to enhance learning support for particular students.

Trowbridge (1984) reports on a study of group size. Seventh and eighth grade students of the same ability level were placed in groups of from one to four students. Individual interactivity and achievement were assessed. On achievement post-testing of individual competence, no differences were found among individuals and members of groups. What was found was that students working in groups seemed more likely to interpret program questions as the authors had intended — discussion would converge on the correct interpretation. Individuals were more likely to misinterpret program questions and pursue incorrect paths through the material. This study makes use of both quantitative and qualitative methods to study student interactivity. Since classrooms are not all homogeneous, it would be useful to have a similar study where students are grouped heterogenously.

Cox and Berger (1985) studied sixty-six (66) seventh and eighth grade students solving problems using a microcomputer in groups of one to five.
Students were from a middle-class suburban school district and they volunteered to be part of the study. Analysis of student characteristics was done in an attempt to describe the population. Students were randomly assigned to groups -- the ability distribution was consistent throughout the varied sized groups. Results indicated that the number of problems successfully solved significantly differed based on group size with students in groups scoring best. More specifically, teams of two, three, and four solved more problems than groups of one and five. While the generalizability of this study is low related to the subject selection process, the study is valuable to consider because it addresses the area of problem solving using the computer. It demonstrates the effective use of the computer in group problem solving with positive results.

Johnson and Johnson (1985, 1986) completed a study with eighth grade students related to computer-assisted cooperative, competitive, and individualistic learning assessing student achievement, student interaction, and attitudes. Subjects were from a midwestern, suburban, middle class school district and were randomly assigned to the three conditions. Results indicated that "computer-assisted cooperative instruction promoted greater quantity and quality of daily achievement, more successful problem solving, more task-related student-student interaction, and increased the perceived status of female students" (p. 382). The authors warn readers that the generalizability of the study is limited. This was one of the first studies to compare the effectiveness of three methods and is frequently quoted and discussed.
In "A Process-Outcome Analysis of Learning in Group and Individual Settings" Webb (1980) presents a model of behavior and achievement in the group setting derived from previous research which compared mathematics learning of eleventh grade students in groups of four to learning individually. Ability level was determined and students were assigned to mixed-ability or uniform-ability groups. The model relates interaction events and test performance of individual learners proceeding through the group process. These include categories of student interaction: makes error, witnesses another's error, asks question, calculates correctly, and does not participate. An analysis of the interactions occurring in each of these categories led to the following findings:

1. Neither the group nor the individual setting is best for all persons. The benefits of a particular setting depend upon the experiences of the learner within that setting.

2. Medium-ability students may learn most when working with others of similar ability. High-ability and low-ability students may do best when working with each other.

3. Effects unique to the group setting: Interaction. "Learning was maximized in groups that developed norms encouraging explaining". (p. 81)
Webb (1980) notes that the link between personality and participation has not been considered in this research. Introverted and extroverted persons need to be studied. Webb does achieve the purposes of the paper and provides much food for thought. The purposes were stated as: "(1) to show that intensive analysis of a learner’s experiences within a setting will promote better understanding of the impact of that setting on learning, (2) to show that by examining learners’ experiences, the group versus individual setting question may be reinterpreted as a question of active participation in the learning setting" (p. 69). Further research needs to be completed on group interaction and individual behavior in various instructional settings related to learning. Webb’s (1980) study provides some guidelines for the conduct of that research.

Mevarech, Stern, and Levita (1987) conducted a study in Israel addressing whether learning with a computer in small-group settings would produce higher levels of achievement, attitudes, and prosocial orientation than learning with a computer in an individualized setting. Subjects were 115 junior high school students in a language arts class. One-third of the students completed the computer program individually and the rest completed the program in pairs. An achievement test (beginning and end of study), a social behavior scale (SBS by Kagan, Zahn, Widaman, Schwarzwolf, & Turell, 1985), and an attitude scale related to CAI and cooperative learning were administered. Results on achievement indicated that differences between the groups was marginally significant [sic]; thus supporting the premise that there
is no evidence that learning alone or together in CAI produces different levels of achievement. The SBS indicated that students who worked in pairs at the computer became more altruistic toward their teammates than other class members. This was supported by a stronger attitude toward cooperativeness [sic] by the individuals in pairs. There were no significant differences in any variable between boys and girls. The authors summarize findings by saying, "This study shows that CAI in small-group settings can improve prosocial orientation without producing a negative impact on achievement and attitudes" (p.167). It is valuable to compare this study to those completed in the United States. The results are similar. One must beware of the generalizability of the results based on the population characteristics and environmental differences. The abstract of the article is misleading in the results section indicating that students who learned in pairs tended to score higher on the achievement test. In the analysis section one finds that this is marginally significant at p<.09 [sic].

Webb, Ender, and Lewis (1986) completed a study to investigate the planning and debugging strategies and group processes that predict learning of computer programming in small groups. Thirty students (age 11-14) volunteered to participate in the project (self-selected sample). Microcomputer programming in BASIC was the topic of instruction. Six aptitude and cognitive style measures were administered at the beginning of the workshop (math computation and reasoning, verbal inference, nonverbal reasoning ability, cognitive factor reference, spacial ability, analytic processing, and field
independence). A posttest consisted of a 26-item achievement test. Students were randomly assigned to work in pairs. Verbal interactions between pairs were tape-recorded. The transcripts were used to code planning, debugging, and group interaction variables. Results indicate that a positive relationship exists between group interaction and programming achievement. Multiple regression analysis was used to determine the influence of a student's planning and debugging behavior on their partner's learning. It was concluded that working with another student on planning and debugging a computer program indirectly influences a student's learning by influencing his/her behavior. The researchers comment that since students tend to learn from each other and imitate each other's behavior, teachers can take advantage of the tendency of students to serve as resources for each other. With a self-selected sample one must limit generalizability; however, this study provides useful insight about the processes occurring in a group.

Problem Solving and Group Interaction: College Students

Okey and Majer (1976) completed a study using 60 college juniors completing lessons using a computer in undergraduate elementary teaching methods. Four classes were used. Classes were assigned randomly to one of three treatment groups (one at computer, two at computer, or three or four at computer). Lesson content was a module on Bloom's mastery learning strategy. Students completed an achievement test on content and an attitude measure related to content. The attitude measure had a reliability of 0.58.
Results indicated that there were no significant differences among the three groups in either cognitive achievement or attitude toward the content of the CAI materials. The study also measured study time and revealed significant differences. Pairs of students used the most time to study, students working alone used significantly less time than pairs, and groups of three or four students used significantly less time than either individuals or pairs. Relative efficiency of the three study groups was calculated by dividing the weighted mean achievement score for each group by the mean study time. Efficiency increased for pairs and increased again for study groups of three or four. The researchers concluded "It would appear from the data in this study that learning can take place equally effectively and more efficiently with multiple users" (p. 84). While this study supports group use at the computer, it does not support increases in achievement or changes in attitudes. Generalizations are limited based on the kind of subject matter and specific conditions under which the research was conducted. The select populations of junior education students, the short duration of the experiment (one module consisting of two, three-hour sessions at the computer) and the lack of testing for long term retention may influence results. The attitude measure may be influenced by a low reliability (.8 is commonly used as acceptable reliability - Nunnally, 1967).

Carrier and Sales (1987) state the purpose of their study was "to explore the relative effects on achievement of pairing students to learn new concepts
through a computer-delivered lesson versus having them work individually." (p. 11). They studied 36 college juniors enrolled in a social studies teaching methods course. There were identical immediate posttests and retention tests (delayed one week). Performance data from the lesson were stored on disks. Audiotapes were used to record verbal interaction of pairs. Results indicated that pairing students to work through this lesson did not lead to higher scores on achievement tests than having them work alone. Analysis of the audiotapes indicated great variation in the way that pairs interacted. One fourth of the verbal interactions between the members of pairs did not relate to the task.

The treatment groups differed in types of feedback selected. Students working in pairs chose elaborative feedback more frequently than those working alone. The researchers concluded that (1) performance may not be facilitated by students working together but it does not decrease, (2) students did appear to take advantage of the arrangement to discuss content with their partners, (3) students appeared to motivate one another to seek feedback on practice items.

In the study the researchers did not consider the characteristics or ability levels of students assigned to the treatments (pairs). Perhaps there are some significant interactions occurring. Were the students comfortable with the computer during learning? Were students sufficiently motivated to complete the program? Was there a testing effect with the same posttest and retention test?

In comparison with other studies on cooperative learning, this study seemed less structured in terms of rewards and specified student outcomes. Perhaps
there is a need to consider the structure of the cooperative learning experience more carefully.

**Current Issues**

Slavin (1991a) synthesized the findings of 70 studies of cooperative learning in elementary and secondary schools that have compared cooperative learning to traditionally taught control groups studying the same content over at least four weeks. Slavin (1991a) summarized the effects of cooperative learning as follows: (a) group goals and individual accountability are important for enhancing student achievement; (b) when group goals and individual accountability are used, achievement effects of cooperative learning are consistently positive; (c) achievement effects have been found to be about the same degree at all grade levels (2-12), in all major subjects, and in urban, rural, and suburban schools; (d) effects are equally positive for high, average, and low achievers; and (e) positive effects of cooperative learning have been found on self-esteem, intergroup relations, acceptance of handicapped students, attitudes toward school, and ability to work cooperatively (p. 71).

Allan (1991) reviewed the ability-grouping research and questioned findings related to the high-ability and gifted students. This has lead to dialogue between Allan (1991) and Slavin (1991b). One of the questions being addressed (concerning grouping and the gifted/high-ability) is whether the gifted/high-ability are needed in the regular classroom to act as role models for other students and whether this "use" of the gifted/high-ability is more important
than their own educational needs. Allan (1991) believes that research supports these conclusions: (a) gifted and high-ability children show positive academic effects from some forms of homogeneous grouping and (b) the strongest positive academic effects of groupings for gifted students result from either acceleration or classes that are specially designed for the gifted and use specially trained teachers (p. 64). These differing opinions can raise some interesting ethical questions (and research) about cooperative learning groupings.

Summary

Newell and Simon (1972) indicate that problem solving operates as an information processing system. Concept attainment is a specific type of problem solving involving the recognition of attributes to establish an identity in a category. Nursing diagnosis can be viewed as concept attainment. Within this framework it is important to determine what cognitive strategies students actually use when determining a nursing diagnosis. A comparison of the processes/cognitive strategies involved in problem solving/concept attainment as summarized from the literature reviewed is presented in Table 1. It should be noted that each author presents a process and these processes are similar.

With a foundation in cognitive strategies, the researcher can examine strategies of individual students and students in dyads for patterns or lack of patterns of thought. Determining the strategies students apply is important.
Research indicates that cooperative learning leads to enhanced problem solving but does not indicate strategies that students use during cooperative learning.

The cooperative learning studies support the positive effects of student cooperation on problem solving including improved successful problem solving, increased task-related interaction, and increased exploration of questions. Even though studies using college students were achievement-oriented studies (instead of problem solving studies), findings indicate improved efficiency of groups in task-related activities and a wide variation in group interaction.

Research in diagnostic reasoning including cognitive strategies influences nurse educators by identifying the baseline strategies of students. Clark (1984) comments "The distinctive characteristics of cognitive research is the idea that instruction influences achievement through student thought processes. Instruction influences thinking" (p. 2).
Table 1. Comparison of problem solving processes.

<table>
<thead>
<tr>
<th>Problem Identification</th>
<th>Newell &amp; Simon (IPS)</th>
<th>Gale (Medical)</th>
<th>Elstein (Medical)</th>
<th>Carnavelli (Nursing)</th>
<th>Gordon (Nursing)</th>
<th>Gagné</th>
<th>Bruner</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Problem Statement</td>
<td>I. Initiation</td>
<td>Cue Acquisition</td>
<td>Pre-encounter Data</td>
<td>Collecting</td>
<td>Attending to and</td>
<td>Recognizing</td>
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<tr>
<td></td>
<td>Translate Input</td>
<td>Interpretation</td>
<td>Data</td>
<td>Data Gathering</td>
<td>Information</td>
<td>Selecting Parts</td>
<td>Attributes (Cues)</td>
</tr>
<tr>
<td>Study of Problem</td>
<td>Internal Representation</td>
<td>Progress</td>
<td>Hypothesis Generation</td>
<td>Coalesing Cues into Clusters</td>
<td>Interpreting Information</td>
<td>Encoding for Long-term Processing</td>
<td>Identity to a Category</td>
</tr>
<tr>
<td></td>
<td>Change Representation</td>
<td>Searching for Information</td>
<td>Cue Interpretation</td>
<td>Possible Dx (Hypothesis)</td>
<td>Clustering Information</td>
<td>Retrieval of Information</td>
<td>Selection Strategies (Order of Inquiry)</td>
</tr>
<tr>
<td>Resolution of Problem</td>
<td>Apply Method</td>
<td>II. Resolution</td>
<td>Hypothesis Evaluation</td>
<td>Testing Dx Diagnosis</td>
<td>Naming Cluster</td>
<td>Problem Solving</td>
<td>Reception Strategies (Formulating or Altering Hypothesis)</td>
</tr>
<tr>
<td></td>
<td>Affect Environment</td>
<td>III. Resolution</td>
<td>Active Confirmation</td>
<td></td>
<td></td>
<td></td>
<td>Wholistic or Part Strategy</td>
</tr>
</tbody>
</table>
CHAPTER III

METHODOLOGY

Introduction

This investigator first became interested in cognitive strategies of students using computer-based instruction (CBI) several years ago while observing both medical students and nursing students in a computer lab at the University of Rochester (N.Y.). Students who completed the programs in small groups spent more time exploring and discussing the subject area. This investigator wondered how this group activity compared to individual learner activity.

A year ago this investigator had an opportunity to have students complete a computer-based instruction program individually and in dyads while audio-taping their interactions and verbalized thoughts. The students completed a problem solving program entitled NURS-CAPS. The pilot was undertaken to determine if rich enough data could be collected for analysis. With the use of verbal protocol (where both individuals and dyads were asked to say aloud everything that crossed their minds while completing the simulation) this investigator found that students were willing and able to express
their thoughts. The data collected varied in content and strategy sufficiently to rule-out a ceiling effect.

There are few articles and research studies which concentrate on the cognitive strategies of students/nurses identifying a nursing diagnosis. Nursing diagnosis as a recognized part of the nursing process is a relatively new phenomenon in nursing. Therefore, how students approach diagnosis is somewhat unknown. This study attempts to describe those cognitive strategies students use. Techniques of qualitative research permit the study of students' strategies through description of students' activities/choices and allow probing for the reasons behind the choices. It attempts to externalize component steps of cognitive strategy to study patterning.

**Design of the Study**

The study was conducted using a descriptive, exploratory design focusing on the cognitive activities of nursing students in individual and dyadic groupings as they completed a computer-based client simulation. The methodology is naturalistic in that it did not manipulate the student verbalization and/or interaction but rather investigated the cognitive activities of the students engaged in a normal computer activity. The interaction is naturally occurring and has no predetermined course established by the investigator. In conjunction with cognitive research in problem solving, it was assumed that students would use a process approach to nursing diagnosis (note Table 1,
pg. 54 comparing problem solving processes) which can be traced using verbal protocol.

It is useful to digress slightly to consider characteristics of qualitative research as related to this study. Qualitative research varies from a totally open (see what happens) design to a more focused strategy. In naturalistic inquiry the investigator moves from varying degrees of a "discovery mode" to varying emphasis on a "verification mode" in attempting to understand the real world. When research begins the investigator is open to whatever emerges from the data (discovery approach). As research continues and reveals patterns the investigator begins to focus on verifying what appears to be emerging (a more deductive approach).

Since there are few established conventions in qualitative research, results are sometimes suspect. It is important that qualitative researchers make explicit the procedures and thought processes they use in their work. Therefore, this section presents the methodology as conceived and as it evolved during the research process.

A useful way to depict the qualitative methodology in this study is the Mobius strip borrowed from mathematics. In the Mobius strip, the topological space obtained by pasting together the ends of a rectangular strip of paper after giving one end half a twist results in a space with only one side.

The specific design chosen demonstrates the review of raw data, the constant comparison of data, the emergence of trends/summaries, and the
nonlinear nature of qualitative research (see Fig. 8). The strip is viewed as the data field. By entering the data field at a point on the twisting strip, the investigator can begin reviewing the data. This review of data involves not only moving forward a square at a time but also moving sideways (or perhaps diagonally) to investigate all of the squares on the strip. The transparency of the Mobius strip permits data to be viewed from "both sides". At various points in the process, the investigator identifies trends or summarizes findings. These findings lead to further investigation of the data by following the Mobius strip leading to new insights/conclusions. This process can continue in a nonlinear fashion to the point where the investigator identifies consistency in the data/findings. Findings/summaries can be extracted from the Mobius strip to be alternately displayed (grids/matrices) and further analyzed. At any point in this process the investigator may return to the strip for investigation/clarification.

Figure 8. Mobius Strip
In this study analysis emerged as inspection of the data progressed. Matrices were developed for the organization and display of the large amount of data collected. The matrix displays are focused and systematically arranged to assist in drawing and verifying conclusions.

Counting (frequencies) is used in this study to further describe and clarify the data. Miles and Huberman’s (1984) three good reasons to resort to numbers apply to this study: to see rapidly what you have in a large slice of data; to verify a hunch or hypothesis; and to keep yourself analytically honest, protecting against bias. Since humans tend to see confirming instances far more easily than disconfirming instances by considering part of the data, our moments of illumination where things "come together" could be wrong. Therefore, qualitative analysis with the aid of numbers was used in this study as a good way of seeing how robust the insights were.

Pilots

Two pilot studies were conducted. One was completed at the conceptual phase of the study (prior to design) to determine if the proposed verbal protocol would indeed produce viable data. The second pilot was conducted using the first two individual students in the study for analysis of the effectiveness of verbal protocol application by the investigator and for identification of an appropriate coding system.

In the first pilot study there were two (2) individuals and one (1) dyad completing the computer-based simulation in the College of Nursing computer
lab at The Ohio State University. Individuals were asked to stop their work periodically and record on an audiotape their thoughts about the choices they had made. The dyad was audio-recorded while completing the program. The data were transcribed and reviewed by this investigator. Several coding systems were experimentally applied to the data (e.g., Identifying cues and hypotheses; see Table 1, pg. 54). What was evident in the data were Gordon's steps for nursing diagnosis: collecting, interpreting, clustering, naming. It was possible to follow these cognitive strategies of the students. Approaches to problem solving varied from student to student. One student guessed frequently. The dyad students discussed more fully the significance of cues than the individuals.

The pilot was successful in generating sufficient data for analysis. It stimulated further questions regarding cognitive strategies of nursing students (e.g., Do students relate reading and classroom learning to problem solving?) and highlighted problems in methodology. Students had completed the simulation in the computer lab where other people could come and go. This inhibited the verbalization for the protocol. It was deemed more appropriate to have students complete the simulation in a separate, quiet room with a computer. Both individuals and dyads could be recorded while completing the simulation. Coding using Gordon's four steps was appropriate, however, this might not be the only or best coding system to use.

The second pilot included the first two students where data were
collected for the study. After reading the transcripts of these two sessions, the investigator decided that there needed to be a change in the verbal protocol involving the investigator. The investigator gave too much information to the student -- gave too many hints. Therefore, tighter guidelines were instituted regarding what and when the investigator could comment to students. The transcripts were also reviewed for a coding system to use. At this point it became evident that Carnevali’s steps (1984 - see Figure 5, pg. 30) were more useful than Gordon’s steps (1984) because they provided more depth about the strategies students were using. Data were collected in a quiet room in the College of Nursing and students who participated were cooperative and interested in the study.

The Setting and Selection of Respondents

The setting was the College of Nursing at The Ohio State University. There are approximately 350 nursing students in the undergraduate program (sophomores, juniors, seniors) which grants a BSN degree. The College of Nursing also grants an MSN and PhD in Nursing.

Students completed client simulations using computer-based instruction with IBM computers in a quiet room at the College of Nursing. The room is well-lighted and a comfortable temperature. No other activities were conducted in the room simultaneously since students were being audiotaped. The first pilot study revealed that students required a quiet environment away from other students where they would be less self-conscious speaking aloud. Noises in
the room were kept to a minimum because they would be picked up on the recording devices. On 2-3 occasions there were other students in the facility. This did not seem to hinder the interaction because the room is large.

Purposeful sampling was used to identify the population from which typical students would be drawn. The population included female junior and senior nursing students who had completed health assessment, nursing diagnosis content and several quarters of clinical practice. Both junior and senior students were included in the study to provide some comparison of strategies used by students at different levels of the nursing program.

The demographics of the subjects are presented in Table 2. The majority of the subjects were in their early 20's. GPA ranged from 2.4 to 3.8. Computer experience was generally minimal and limited to wordprocessing. A majority of students worked while attending classes.

Within the available pool, students were asked to participate voluntarily in the study. Students were given the choice of working either individually or in dyads at the computer to help maintain a naturalistic environment. Students chose the method they would feel most comfortable with if no study were being conducted.

This investigator found that nursing students were very busy with classes, clinical experience, jobs, families and friends. While they were willing to participate in the research study, they did not have much time to spare. Completion of the study required about 1 1/2 to 2 hours of time. A study
<table>
<thead>
<tr>
<th>Ind / Dyads</th>
<th>Subject</th>
<th>Age</th>
<th>GPA</th>
<th>Computer Experience</th>
<th>Work Experience</th>
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<tr>
<td>Individual</td>
<td>I-9</td>
<td>20</td>
<td>3.3</td>
<td>Some-varied</td>
<td>ER at OSU</td>
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<td></td>
<td>I-13</td>
<td>28</td>
<td>2.7</td>
<td>Uses at work</td>
<td>Med. Lab Tech.</td>
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<td></td>
<td>I-15</td>
<td>20</td>
<td>2.5</td>
<td>None-not like</td>
<td>Nurses Aide</td>
</tr>
<tr>
<td></td>
<td>I-19</td>
<td>20</td>
<td>2.8</td>
<td>Some-varied</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I-21</td>
<td>21</td>
<td>3.2</td>
<td>Not much</td>
<td>Nursing home &amp;</td>
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<td>Creative Living</td>
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<td>Center</td>
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<td>D-16 a</td>
<td>21</td>
<td>2.4</td>
<td>Word processing</td>
<td>Nursing Assistant</td>
</tr>
<tr>
<td></td>
<td>D-16 b</td>
<td>22</td>
<td>2.4</td>
<td>Word processing</td>
<td>Nurses Aide</td>
</tr>
<tr>
<td></td>
<td>D-18 a</td>
<td>21</td>
<td>2.96</td>
<td>Word processing</td>
<td>Rehab. Center</td>
</tr>
<tr>
<td></td>
<td>D-18 b</td>
<td>20</td>
<td>2.18</td>
<td>Took computer class</td>
<td>Not working</td>
</tr>
<tr>
<td></td>
<td>D-20 a</td>
<td>21</td>
<td>3.02</td>
<td>None</td>
<td>Not working</td>
</tr>
<tr>
<td></td>
<td>D-20 b</td>
<td>20</td>
<td>3.00</td>
<td>Mod amount-varied</td>
<td>Nursing Assistant</td>
</tr>
<tr>
<td></td>
<td>D-22 a</td>
<td>21</td>
<td>3.63</td>
<td>Word processing</td>
<td>Nurses Aide</td>
</tr>
<tr>
<td></td>
<td>D-22 b</td>
<td>21</td>
<td>3.46</td>
<td>Lots-varied</td>
<td>Nursing Assistant</td>
</tr>
<tr>
<td></td>
<td>D-24 a</td>
<td>21</td>
<td>2.80</td>
<td>Little</td>
<td>Rehab. Center</td>
</tr>
<tr>
<td></td>
<td>D-24 b</td>
<td>21</td>
<td>2.81</td>
<td>Word processing</td>
<td>Not working -</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>summers as Nurses</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Aide</td>
</tr>
<tr>
<td>Individual</td>
<td>I-5</td>
<td>25</td>
<td>2.95</td>
<td>Frequent use</td>
<td>Vet Hospital</td>
</tr>
<tr>
<td></td>
<td>I-7</td>
<td>23</td>
<td>2.7</td>
<td>Small amount</td>
<td>Nursing Assistant</td>
</tr>
<tr>
<td></td>
<td>I-11</td>
<td>21</td>
<td>2.8</td>
<td>Word processing</td>
<td>Not working</td>
</tr>
<tr>
<td></td>
<td>I-23</td>
<td>44</td>
<td>2.7</td>
<td>Little</td>
<td>Manufacturing Plant</td>
</tr>
<tr>
<td></td>
<td>I-25</td>
<td>23</td>
<td>3.47</td>
<td>Data entry</td>
<td>Nurse Technician</td>
</tr>
<tr>
<td>Dyads</td>
<td>D-2 a</td>
<td>21</td>
<td>2.98</td>
<td>Little-Word processing</td>
<td>Emergency Room</td>
</tr>
<tr>
<td></td>
<td>D-2 b</td>
<td>21</td>
<td>3.10</td>
<td>Word processing</td>
<td>Labor &amp; Delivery</td>
</tr>
<tr>
<td></td>
<td>D-4 a</td>
<td>22</td>
<td>3.36</td>
<td>Word processing</td>
<td>Skills Lab Assistant</td>
</tr>
<tr>
<td></td>
<td>D-4 b</td>
<td>39</td>
<td>3.70</td>
<td>Word processing</td>
<td>Not working</td>
</tr>
<tr>
<td></td>
<td>D-10 a</td>
<td>21</td>
<td>2.97</td>
<td>Word processing</td>
<td>Obstetrics</td>
</tr>
<tr>
<td></td>
<td>D-10 b</td>
<td>22</td>
<td>3.02</td>
<td>Word processing</td>
<td>Pediatrics</td>
</tr>
<tr>
<td></td>
<td>D-12 a</td>
<td>22</td>
<td>2.85</td>
<td>Word processing-some</td>
<td>Obstetrics</td>
</tr>
<tr>
<td></td>
<td>D-12 b</td>
<td>23</td>
<td>2.50</td>
<td>Word processing</td>
<td>Nursing Assistant</td>
</tr>
<tr>
<td></td>
<td>D-14 a</td>
<td>22</td>
<td>3.80</td>
<td>Word processing</td>
<td>Nursing Assistant-Pediatrics</td>
</tr>
<tr>
<td></td>
<td>D-14 b</td>
<td>22</td>
<td>3.47</td>
<td>Word processing</td>
<td>Nursing Assistant-Pediatrics</td>
</tr>
</tbody>
</table>
summary was mailed to students at the completion of data collection and analysis. Returns were 40%. From this return rate, it seemed apparent that student commitment to the study ended when they completed the computer program. This is understandable given their various responsibilities.

Subjects were generally able to express their thoughts appropriately using the verbal protocol. After the first 10-15 minutes subjects became comfortable verbalizing with each other or aloud to the investigator.

The study was reviewed by the human subjects committee. Consent was obtained from each student included in the study (see Appendix D for consent form). Confidentiality was maintained by separation of the name and code number on the computer trace, transcript, interview, and demographic sheet. Audiotapes did not include names and were stored in a secure place. This investigator was the only person present for the collection of data and for the transcription of data. Students benefitted from the computer-based instruction by practicing nursing diagnosis in a low risk environment.

Data Collection Procedure

A computer-based program entitled NURS-CAPS designed and published by the Health Sciences Consortium (HSC) was used for the study. There are eight (8) available simulations in medical/surgical content which were randomly chosen by students in individual or dyad use (see list in Appendix E). Ten (10) individuals (5 juniors and 5 seniors) and ten (10) pairs of students (5
junior pairs and 5 senior pairs) completed client simulations. In the following
discussion, the dyad is considered a single entity (a single "student").

Data were collected in the following formats:

1. An audiotape was made of verbalized student choices during the
   simulation. Individuals and dyads were asked to verbalize about
   their thoughts and choices during completion of the program
   ("Think-aloud technique").

2. A behavior trace was recorded by the investigator. The behavior
   trace is a record of all of the choices the student makes in the
   simulation.

3. An interview was conducted by this investigator with all students
   following their use of the Nurs-Caps simulation. The interview
   focused on the choices they made during the simulation.

4. A demographic sheet was completed by students.

5. A session summary sheet was completed for each session by the
   investigator. This included conditions in the room at the time of
   data collection and any factors influencing data collection.

Students were oriented to the computer-based program prior to use. An
orientation to both the IBM computer and to NURS-CAPS is included on the
computer disk. Students were also oriented to the "think-aloud" protocol.
Students were instructed to say aloud everything that crossed their minds while
they completed the computer program, no matter how trivial the thought
seemed (Hayes, 1982). Individuals and dyads were asked to verbalize as they completed the case study. If there were problems or silences during the recording session, the investigator would prompt students only to continue verbalizing or to solve equipment/computer questions. Students were instructed to ask the investigator questions before becoming frustrated with the instructions or the program operation.

Prior to the collection of data for the students included in the study, the investigator completed one practice simulation with a student to check the equipment/room set-up. Corrections in positioning, recording, and instructions were made as needed.

**Instruments/Materials**

Instruments/materials used in this study include the NURS-CAPS computer program, audiotaping, interview questions, the behavior trace, the session summary sheet, the demographic sheet, verbal protocol and the human instrument.

**NURS-CAPS**

NURS-CAPS (Nursing Computer-Assisted Problem Solving) is a computerized simulation designed to promote the concept of nursing diagnosis. The student is presented with a client simulation. The reason for the client's admission or visit is briefly described. The student uses the nursing process (review of data contained in the chart and interview/examination of the client) to make an assessment and determine the most appropriate nursing diagnosis for
a specific point in time. A unique feature of NURS-CAPS is that the assessment interview/examination is not cued. The student must determine what is important to ask/examine.

The NURS-CAPS simulations have been reviewed by a peer review system supervised by the Health Science Consortium (HSC). Each program has been reviewed by several experts for accuracy of assessment content and nursing diagnoses.

**Audiotaping**

Audiotaping replaced the human recording instrument during data collection. This provided an accurate record of interaction for transcription by the investigator. Interviews were also recorded for comparison with the investigator's notes.

**Session Summary Sheet and Demographic Sheet**

This researcher completed a summary sheet for each audiotape session. This summary noted conditions of the session which may influence the data such as student familiarity with computers, comfort conditions of the room, distractions, and students responses to the simulation (see Appendix G).

Subjects completed a demographic sheet (see Appendix F) including questions regarding age, GPA, clinical experience (as a cross-check for junior/senior status), computer experience, and work experience. The work experience question was included to determine whether students work in nursing care related positions or other positions.
Interview

At the end of each session, an interview was conducted by this investigator. Open-ended questions were asked and probes were used as needed.

Questions included the following (see Appendix H for form):

1. Tell me briefly why you chose each indicator or diagnosis (from the behavior trace).
2. Reflect on how you went about determining the nursing diagnosis and why.
3. How do you usually determine a nursing diagnosis? (How do you proceed?)
4. How is this the same or different as you do on the clinical unit?
5. If you were doing this as an individual (or dyad) would you do it differently?
6. What did you like about the program?
7. What did you dislike about the program?

Behavior Trace

A behavior trace was completed during each simulation (see Appendix I for example). The investigator recorded all choices entered into the computer that the students made while completing the simulation (e.g., parts of the chart chosen, assessments chosen, diagnoses chosen). This trace was used as a guide to transcribe the audiotape. It was analyzed for agreement with general
strategy steps. Behavior traces of all of the students were compared for characteristics of assessment including steps of the assessment strategy and type of assessments (systems assessment vs. head-to-toe assessment).

**Verbal Protocol**

A verbal protocol method was used to collect the data related to cognitive strategies. The verbal protocol was used with beginners verbalizing the processes they normally use when completing nursing diagnosis. It is an attempt to identify the cognitive processes occurring between the instructional events (presentation of the simulation) and performance (the nursing diagnostic label). For this study, it is assumed that this verbal protocol provides basic information about cognitive thought processes.

**Computer Questions**

Questions regarding the use of the computer as a medium were distributed throughout the questionnaires in an attempt to determine any influence of the computer/computer program on the student. The student interview included the questions: (1) If you were doing this as an individual (or dyad) would you do it differently? (2) What did you like about the program? (3) What did you dislike about the program? A question on the demographic sheet asked students how much experience they had with computers. Any comments regarding computer use made during the audio-taping were noted.
Human Instrument

The human as an instrument was utilized during the simulation protocol and during the interview. This application of the human instrument permits adaptation to the variability of the subject responses and encourages opportunities for clarification during the collection of data.

Data Analysis

Data were analyzed through the use of traditional qualitative procedures (Lincoln & Guba, 1985; Miles & Huberman, 1984; Patton, 1990). These procedures are described in three sections: handling raw data, data reduction, and data analysis.

Handling raw data

A behavior trace was recorded by the investigator for each individual/dyad to be used with the interview to trace student choices. This trace was also used during transcription to guide this investigator in progress through the simulation. The audiotape was transcribed verbatim using word processing. This was done by this investigator as a means of achieving familiarity with the data. Sounds from the students in addition to spoken words were noted on the transcription (e.g., vocal tone, sighs, etc) as they might be significant to interpretation. Half-page word processing was done to allow for notations and coding on the right side of the page. An original and two copies were made of the transcript. One copy of each transcript was kept in a second
place for safety against loss. One clean copy was maintained and a second
copy was used for coding.

The interview was hand-written and audio-recorded by the investigator.
The audiotape was reviewed for agreement with the investigator's written
answers to the questions.

Raw data for each student were assembled in a folder for analysis
including: the transcript of the interaction during diagnosis, the behavior trace,
the transcription of the interview, the demographic sheet and the session
summary sheet (see Appendix I for an example of a behavior trace and
transcript).

Data reduction

The quantity of data generated from qualitative data collection can be
cumbersome and must be reduced to a manageable amount. This can be
accomplished by coding and data organization procedures such as the
development of matrices.

This investigator first reviewed the behavior trace for a general
impression of student progress through the program. The next step was to
read each transcript for a general impression of student cognitive
strategies/process and natural breaks in the process. These activities provided
an overview of the total process and served as advanced organizers.

The first step in data reduction is to divide the transcript into units of
information (called unitizing). These units become the basis for defining
categories and should be the smallest piece of information about something that can stand alone (Lincoln & Guba, 1985; Garvin, Kennedy, & Cissna, 1988). For this study, the unit of information was a sentence of the transcript that reflected a single comment about cues, feelings, or decisions occurring during the computer-based instruction. Units were left intact as sentences to aid understanding out of context.

Codes were assigned to units of information for identifying, retrieving, and comparing units within the same transcript and between transcripts. Coding proceeded under the premise that students used some problem solving process whose cognitive strategies can be recognized and labeled. Carnevali’s steps of the diagnostic reasoning process provided the best "fit" with the data. These steps include: considering pre-encounter data, entry to the data search field and shaping direction of data gathering, coalescing of cues into clusters, activating possible diagnostic hypotheses, data directed search of the data field, testing diagnostic hypothesis for goodness of fit, and diagnostic labeling (see Figure 9 for final coding categories).

Since coding in this study is a process identification activity (identifying cognitive strategies), it was important to consider each unit as part of a whole. Units of information became patterns of cognitive strategies when considered together. Larger units were identified as those strategies leading up to a diagnostic label (see Appendix K for an example of coding).
<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1        | Pre-encounter Influences  
  a) Discipline or orientation  
  b) Chart  
  c) Life experiences |
| 2        | Entry into the search field and shaping direction of data gathering (Meets client) Assess cues |
| 3        | Coalescing cues into clusters |
| 4        | Activating possible diagnostic explanations (diagnostic hypothesis)  
  Note early or late hypothesis generation. How many cues are considered prior to hypothesis generation? |
| 5        | Hypothesis and data directed search of the data field (Guided Search)  
  Gather data to test hypothesis. |
| 6        | Testing diagnostic hypothesis for goodness of fit (Hypothesis Evaluation) |
| 7        | Diagnostic label |

Figure 9. Final coding categories.

During the coding process the investigator first read each transcript for an initial impression of cognitive strategies used. Then each sentence was considered for content and coded in the right hand space. Brackets were used for each separate code and comments made as needed if content did not fit into the coding system (e.g., discussion of last night's TV program). Finally, segments prior to each labeled nursing diagnosis were considered a larger unit for analysis of process. A copy of the coded transcript was retained on file for reference.
To establish unitizing reliability and interpretative reliability in the category coding system, another reviewer with expertise in qualitative methodology reviewed and coded 5 (25%) of the transcripts. (Washington & Moss, 1988; Topf, 1986; Garvin, Kennedy, & Cissna, 1988). An explanation of the coding categories from Carnevali (1984) accompanied the transcripts. Generally, coding disagreement involved clarification of the labeling of strategies within the Carnevali framework (e.g., When is the strategy guided search?) With discussion, 100% interrater reliability was achieved. With this general agreement, coding on the remaining transcripts was re-examined to assure consistency in identifying units and applying codes and patterns across all data. Re-coding was done as needed.

Answers from the interview were reviewed and summarized. Special note was made of the resources students stated they had used when choosing an answer (e.g., read in book, heard in lecture, clinical experience, guessed). Comments about the likes and dislikes of the computer/computer program were noted.

For easier comparison of data between students, a summary of findings was transferred to descriptive grids or matrix sheets. The summary of each student was kept in the front of the folder including pertinent findings related to the behavior trace, the transcription, and the interview (see Table 3 for an example). The summary sheet for each student was further summarized onto a composite sheet for each group (junior individuals, junior dyad, senior
Table 3. Example of summary data for individual.

<table>
<thead>
<tr>
<th>Behavior Trace</th>
<th>Transcript</th>
<th>Interview</th>
<th>Demographics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choose chart because physician has all ultimate decision about patient. Physician has all the information.</td>
<td>Pre-encounter data and data gathering are somewhat minimal.</td>
<td>Looks at abnormals. See what patient perceives as a problem.</td>
<td>Junior</td>
</tr>
<tr>
<td>NANDA list helped focus and check-off in mind.</td>
<td>Lots of hypothesis activation and evaluation based on minimal data.</td>
<td>Goes to chart first -- then assess.</td>
<td>GPA: 2.7</td>
</tr>
<tr>
<td>Influenced by combination of lecture, clinical, and readings.</td>
<td>Some cue clustering. Mostly guided search.</td>
<td>Helps to study with another. Learns by mistakes and discussion.</td>
<td>Age: 28</td>
</tr>
<tr>
<td></td>
<td>Early hypothesis activation. Did not gather data to evaluate, but made sweeping evaluations.</td>
<td>Dissatisfied that not get &quot;right answer&quot; first time. Tells me not thorough enough. Feels must always be right.</td>
<td>Job: Medical Lab Technician in Hematology. Testing Samples.</td>
</tr>
<tr>
<td></td>
<td>Many hypotheses without checking out data supporting each.</td>
<td>Uses computers at work -- Medical Lab Technician. Testing.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Guided search used in some areas.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
individuals, senior dyads). From these four sets of reduced data, it was possible to compare the strategies that students used to determine a nursing diagnosis (see Tables 4 through 7 in Presentation and Analysis of Data).

For retrieval of specific units of process from individual transcripts, a word processing system was used to isolate and print-out specific sections. These representative sections were used for specific comparison of cognitive strategies. It was particularly helpful to print what was considered the most representative segment of each transcript for comparison and store this with the composite matrices.

**Content Analysis**

With the completion of organization of the data and data reduction, content analysis began. An in-depth study of each student contributed to comparing and contrasting all students (constant comparison method). Through inductive analysis the patterns, themes, and categories of analysis emerged from the data. The Mobius strip model is useful to visualize this process.

Analysis proceeded with review of the matrices of data and of the most representative sections of cognitive strategies used by students. This organization and description of the data highlighted the patterns, themes, and processes. Cognitive strategies that students use in the diagnostic process emerged. There were frequent references back to the original transcript to
clarify statements or contextual information. The investigator kept notes of initial thoughts and the refinements of thoughts about the data as the analysis proceeded.

With a comparison of the four matrices (junior individuals, junior dyads, senior individuals and senior pairs), it became evident that all students did use aspects of all steps of the cognitive strategies for diagnostic problem solving. To further delineate these strategies, the investigator used worksheets to compare and contrast strategies.

To answer question four (factors influencing cognitive strategies), resources students mentioned were tallied for significance and comments regarding the importance of the various factors to students' decisions were noted. Likes, dislikes, and comments about the computer or the computer program were summarized. These data were analyzed for general trends and possible effects on the student completing the program.

**Fisher Exact Probability Test**

To support the textual findings related to comparisons between juniors and seniors and between individuals and dyads, the Fisher Exact Probability Test was applied to the data to determine significance within this sample as a triangulation of analysis.

The Fisher Exact is a nonparametric technique for analyzing data when the frequencies are small. The test determines whether the two groups differ in proportion with which they fall into the two classifications (Siegel, 1956).
For this test juniors/seniors were compared on each step of the diagnostic process and on the amount of data explored. Individuals/dyads were also compared on each step of the diagnostic process and on the amount of data explored. Transcripts were re-analyzed to determine ways students were applying the identified strategies. Students' applications were found to "fit" into one of two categories:

Simple:

* Little evidence considered (verbal mention of one cue).
* Some evaluation of evidence (discussion that one cue could be important).
* Consideration of only one cue, sometimes related to a second cue.
* Random use of strategy.

Complex:

* Evaluation of evidence (more than one cue) involving detailed discussion reviewing the significance of subject to client.
* Evaluation of evidence (more than one cue) involving detailed discussion of relevance to client including reasons that subject is important.
* Systematic use of strategy.
Each transcript was coded in each step where differences were identified from the content analysis: coalescing of cues into clusters, data directed search (guided search), testing diagnostic hypothesis for goodness of fit, and amount of exploring. The Fisher Exact Test was applied to the data using this format:

<table>
<thead>
<tr>
<th></th>
<th>Simple</th>
<th>Complex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dyads</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The number in the box indicated the frequency of transcripts in the category.

**Trustworthiness**

Trustworthiness was addressed according to the guidelines in Lincoln and Guba (1985) including credibility, transferability, dependability, and confirmability.

**Credibility**

Credibility was established by the use of persistent observation, triangulation, peer debriefing, and member checks. Persistent observation occurred during data collection, audio-tape transcription, and coding to identify those characteristics and elements that were most relevant to cognitive strategies and factors affecting cognitive strategies (Lincoln and Guba, 1985, p. 304). Tentative coding was completed on two transcripts of the second pilot.
This coding was compared with the possible coding methods (noted on Table I, p. 56) for best fit with the data. Data fit best with Carnevali's strategies. To develop consistency in coding, the investigator reviewed and coded the two pilot transcripts with the coding from Carnevali. As data collection/analysis progressed, this coding was evaluated for continued relevance.

Two other methods of observation were used to confirm factors affecting data collection and validate strategies used by students. The investigator completed a session summary sheet on each individual or dyad (see Appendix G). Summary sheets were reviewed prior to transcription. This helped identify those factors of the situation which might influence data distortion. The investigator also recorded each choice the students made (a behavior trace) during the computer simulation. Study of these traces indicated basic strategies that students used and traces were compared to the in-depth transcript.

Triangulation of multiple data sources and different methods was used. Data from the behavior traces, the transcripts, the interviews and questions about work and computer experience from the demographic sheets were compared. This comparison of the data from these methods demonstrated consistency in cognitive strategies and perceptions of students in relation to the nursing diagnosis process and factors affecting the process. The Fishers Exact Test was used for triangulation of analysis.
Member checking was completed at the end of each interview with an individual or dyad. Data and interpretations were discussed with students. Comments were solicited regarding accurate representation of their strategies and factors affecting strategies. This investigator weighed the comments or criticisms for meaningfulness and incorporated them in the findings.

A written summary of the findings from the study was mailed to each subject with a return envelope and a request for comments (see Appendix L). There was a 40% return rate with comments that were noted. These comments were incorporated into the findings.

Peer debriefing was used to review the study design and clarify the coding categories. The study was described to a group of ten nurse educators who were taking a class in qualitative methodology in The College of Nursing at The Ohio State University. They were asked to critique the study and each educator was asked to code one transcript. Three different transcripts from the study were used. Their coding was compared to coding by the investigator. There was general consensus on "chunk coding" of the transcripts (meaning that the coders used the same general categories of the investigator but not detailed coding). This provided the investigator an opportunity to validate consistency of general coding with other nurse educators (see Appendix M for peer review coding).
Transferability

Transferability was addressed by the inclusion of description of the cognitive strategies of students. This description takes the form of the inclusion of two transcripts in the Appendices (see Appendix I and J), representative excerpts from transcripts in the Presentation and Analysis of Data, and a demographic summary of the subjects under The Setting and Selection of Respondents in this section.

Dependability and Confirmability

An audit trail was kept to promote dependability and confirmability. Raw data and data reduction notes were kept by the investigator for the students along with the session summary sheets in a case folders. Categories that emerged were noted and additional comments regarding thoughts and trends of the data were kept in a notebook. Both process and methodological notes were kept. Periodic summaries of findings and trends were recorded. All transcripts, audiotapes, interviews, summaries, matrices, and schedules were kept in file boxes.

Summary

This study was conducted using a descriptive, exploratory design focusing on the cognitive activities of nursing students in individual and dyadic groupings as they completed a computer client simulation to determine a nursing diagnosis. Qualitative research methodology allowed the investigator to
discover strategies and identify patterns in strategies. The Mobius strip is a useful way to visualize the process of qualitative research including the review of raw data, the constant comparison of data, the emergence of trends/summaries, and the nonlinear nature of qualitative research.

Junior and senior nursing students in the College of Nursing at The Ohio State University were the subjects who completed a computer client simulation to determine a nursing diagnosis. Verbal protocol and interviews were used to collect raw data. Audiotaping provided a permanent record of the data. Transcripts of the simulations were coded using Carnevali’s categories to identify cognitive strategies. Matrices were developed to summarize coding strategies for comparison and contrast of content. The Fisher Exact Probability Test was applied to the data for triangulation of analysis. Factors affecting strategies were identified from student interviews.
CHAPTER IV
PRESENTATION AND ANALYSIS OF DATA

Introduction

One of the dangers of qualitative research is that the data overload taxes the analytic abilities, communication strategies and patience of the investigator. It is important to communicate to others the depth and trends of the qualitative data collected. The purpose of this section is to present the data and the data analysis related to cognitive strategies of nursing students completing nursing diagnosis. The presentation format follows the research questions:

1. What cognitive strategies do female nursing students demonstrate when completing a computer simulation in dyads and individually?

2. Do students working in dyads demonstrate the same or different cognitive strategies than students working individually on the same computer simulation?

3. Do Senior students demonstrate the same or different strategies than Junior students working either individually or in dyads on the same computer simulation?

4. What factors can be identified which influence cognitive strategies?

The focus of the presentation is to present as complete a picture of the data as feasible. This includes presentation of selected raw data, reduction of raw data, and emergence of trends in the data.
Research Question One

What cognitive strategies do female nursing students demonstrate when completing a computer simulation in dyads and individually?

Students used a general strategy to approach nursing diagnosis (diagnostic reasoning) that was consistent with the steps described by Carnevali. Strategies varied in amount and/or depth of structure. Steps where differences were especially evident included coalescing of cues into clusters, data directed search (confirmation, elimination, exploration, discrimination) and testing diagnostic hypotheses for goodness of fit. The nonlinear characteristic of thinking was also apparent in the transcripts. Tables 4 through 7 present a summary of the data from all of the transcripts (junior individuals, junior dyads, senior individuals, and senior dyads). From these summaries and worksheets developed by the investigator various trends were identified. In the following discussion the dyad is considered a single entity (a single "student").

Pre-encounter Data

All students used pre-encounter client data to define or set limits on the data space. These limits on the data space provided a direction for further data search. Specific pre-encounter influences which shaped the data field identified in this study included the discipline or orientation of the student (medical or nursing focus), the chart information, and student life experiences. Eight students used "bounding" of pre-encounter data. "Bounding" refers to a
Table 4. Junior individual composite.

<table>
<thead>
<tr>
<th>Student #</th>
<th>Behavior Trace</th>
<th>Transcript</th>
<th>Interview</th>
<th>Demographics</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Experience important in choices</td>
<td>Pre-encounter data had strong influence</td>
<td>Not go in without much format. Subjective data Interview Objective data &amp; Assess Not enjoy studying without someone else</td>
<td>Age: 20 GPA: 3.3 Some computer exp. Works in ER at OSU</td>
</tr>
<tr>
<td></td>
<td>Clinical Instructor - questions</td>
<td>Psychosocial not important</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lecture - not tell when due</td>
<td>Data gathering with hypothesis act</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Psychological not important</td>
<td>Little cue clustering with guided search</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Fear of being wrong</td>
<td></td>
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<tr>
<td>13</td>
<td>Chose chart because physician has all the information. NANDA list helped checkoff Influenced by lectures, clinical, without reading</td>
<td>Pre-encounter data &amp; data gathering are somewhat minimal Lots of hypothesis activation &amp; evaluation based on minimal data Some cue clustering --&gt; guided search Early hypothesis activation - rudimentary</td>
<td>Looks at abnormalities Goes to chart first-then assess See what pt. perceives as problem Helps to study without another Feels should be &quot;right&quot;</td>
<td>Age: 28 GPA: 2.7 Uses computers at work Medical Lab Tech Hematology</td>
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<tr>
<td>15</td>
<td>Didn't read screen enough or pay attention to data Had pt. similar to this - rules Learned post-op in class. Experience in clinical</td>
<td>Early dx based on minimal data. Had good dx early Makes many dx after guided search with evaluation Guessing! Collecting, clustering and dx not match</td>
<td>Look at what's wrong with the pt. and whatever is abnormal would be dx Look at chart. See pt. Do assessment Visual learner Studies by self</td>
<td>Age: 20 GPA: 2.5 No computer experience Works as aid in nursing home Not like computers Tired from clinical</td>
</tr>
<tr>
<td>Student #</td>
<td>Behavior Trace</td>
<td>Transcript</td>
<td>Interview</td>
<td>Demographics</td>
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<tr>
<td>19</td>
<td>Like to assess often know about pt hx Activity based on experience with elderly Learned in class</td>
<td>Spent a lot of time evaluating pre-encounter data Did data gathering and cue clustering Hypothesis based on cues and clustering Hypothesis testing and guided search Problem: Not know NANDA def. -classic</td>
<td>Experiences in nursing home: Listened and observed nurses doing dx. Included in process - esp. assessment Class not as helpful Find out hx and changes. Not really have steps Not study with other - knowledge</td>
<td>Age: 20 GPA: 2.8 Not much computer exp. Worked two summers in nursing home Elderly care</td>
</tr>
<tr>
<td>21</td>
<td>Likes to get background info Looked for immobilized r/t nursing home experience Combination of work, and clinical helped Also class Learned a anxiety in Psych.</td>
<td>Made early dx of current problem area. NANDA is a problem Did thorough pre-encounter info and found cues to guide dx Did guided search and cue clustering Used hypothesis evaluation -rudimentary -classic</td>
<td>Get all the info about client from chart and assessment Look for highest priority Put problems down as I see them Not study with others if not know material</td>
<td>Age: 21 GPA: 3.2 Not much computer experience 2 summers in nursing home Creative living - helps quadriplegic Psych clinical now</td>
</tr>
</tbody>
</table>
### Table 5. Junior dyad composite.

<table>
<thead>
<tr>
<th>Student #</th>
<th>Behavior Trace</th>
<th>Transcript</th>
<th>Interview</th>
<th>Demographics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class and job influence assess</td>
<td>Shifted topics freq. Pre-encounter influences-post-op and elderly home care</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clinical experience important</td>
<td>Data gathering - hap-hazard</td>
<td></td>
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<tr>
<td></td>
<td>Books/reading help</td>
<td>Little cue clustering</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Many hypotheses Switch focus freq.</td>
<td></td>
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<tr>
<td>18</td>
<td>Started with chart - find out what has</td>
<td>Classic use of strategy Pre-encounter data</td>
<td>Reads chart before goes to see pt. (Like as a pair) Go in and talk to client and assess them. Interact with them Look for biggest problem</td>
<td>Age: 21 &amp; 20 GPA: 2.96 &amp; 2.18 Some use of computer Works at rehab center 1-Not working</td>
</tr>
<tr>
<td></td>
<td>happened General post-op assessment</td>
<td>Data gathering/cue clustering</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Learned in class and clinical</td>
<td>Hypothesis activation</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Don't get much from readings</td>
<td>Guided Search</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Actually doing it in clinical helps</td>
<td>Hypothesis eval. <em>classic</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>One section of chart first</td>
<td>Classic use of strategy Pre-encounter - emotional aspect of pt. important</td>
<td>Believe that emotional state of pt. influences physical state Reads chart Evaluate physical and emotional Like doing together</td>
<td>Age: 21 &amp; 20 GPA: 3.02 &amp; 3.00 1-No exp. w/ comp 2-Mod exp. w/ comp 1-Not working 2-Cardiac stepdown</td>
</tr>
<tr>
<td></td>
<td>Tend to look for emotional health of pt.</td>
<td>Data gathering/cue clustering</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>- nurses ignore Combination of class &amp;</td>
<td>Hypothesis activation</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>experience Had good clinical instructors</td>
<td>Hypothesis evaluation</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Looked at uses and evaluate</td>
<td>Guided Search</td>
<td></td>
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<td></td>
<td>Psych lecture helped clarity</td>
<td><em>classic</em></td>
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Table 5 (continued)

<table>
<thead>
<tr>
<th>Student #</th>
<th>Behavior Trace</th>
<th>Transcript</th>
<th>Interview</th>
<th>Demographics</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>Started with chart - know @ pt. Worked on ortho with surgery floors Not learn assess in a book. Learn in clinical. Physio class helped. Learn more working than in clinical. Learn thinking process at work.*</td>
<td>Pre-encounter - not like ortho Data gathering - general assess Not a lot of cue clustering Possible dx Guided search - some Hypothesis eval. - some</td>
<td>Look at chart first. Assess physical first, psychosocial next. Go down list and choose. Do for care plan.* Like to do in pairs. Study together.</td>
<td>Age: 21 GPA: 3.63 &amp; 3.46 Exp. with comp. Both work in hosp.</td>
</tr>
<tr>
<td>24</td>
<td>Started with chart - tells @ pt. Learned in clinical. Lecture &amp; experience helps in assessment. Learn to look at assessment in clinical. Have had clients that were anxious. Psych class/clinical helpful.</td>
<td>Pre-encounter data - looked at most of chart. Data gathering - physical and psychosocial. Did --&gt; cue clustering Early dx Guided search Hypothesis eval. Classic strategy Rudimentary</td>
<td>Look at chart before and after see pt. Baseline. Do assessments and ask pt. Look at progress notes Make dx. Like to do as pair - feedback.</td>
<td>Age: 21 GPA: 2.8 Little exp. with comp. Use for papers. Works in aide jobs.</td>
</tr>
</tbody>
</table>
Table 6. Senior individual composite.

<table>
<thead>
<tr>
<th>Student #</th>
<th>Behavior Trace</th>
<th>Transcript</th>
<th>Interview</th>
<th>Demographics</th>
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<tbody>
<tr>
<td>Student #</td>
<td>Behavior Trace</td>
<td>Transcript</td>
<td>Interview</td>
<td>Demographics</td>
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<td>----------------------------------------------------------------------------</td>
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<tr>
<td></td>
<td>Assessment choices from combination of class &amp; clinical. Logic helps.</td>
<td>Data gathering - did post-op assessment.</td>
<td></td>
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<tr>
<td></td>
<td>Job helps-dealing with different types of people.</td>
<td>Cue clustering - looked for patterns.</td>
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<tr>
<td></td>
<td></td>
<td>Did a lot.</td>
<td></td>
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<td></td>
<td></td>
<td>Hypothesis activation - post-op problems.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Guided search - considered NANDA.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Hypothesis evaluation - reviewed data.</td>
<td></td>
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<tr>
<td></td>
<td>Reinforced.</td>
<td>Data gathering - post-op assess.</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Work on clinical unit with elderly.</td>
<td>Cue clustering - reviewed status.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Taught in theory but clinical aspect helps.</td>
<td>Hypothesis activation - early.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Guided search.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Hypothesis eval - Classic</td>
<td></td>
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</tbody>
</table>
Table 7. Senior dyad composite.

<table>
<thead>
<tr>
<th>Student #</th>
<th>Behavior Trace</th>
<th>Transcript</th>
<th>Interview</th>
<th>Demographics</th>
</tr>
</thead>
</table>
Table 7 (continued)

<table>
<thead>
<tr>
<th>Student #</th>
<th>Behavior Trace</th>
<th>Transcript</th>
<th>Interview</th>
<th>Demographics</th>
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</table>
conscious recognition on the part of the student of the relationship between
client data available prior to the encounter with the client and knowledge stored
in long-term memory which influences data search (e.g., this client has
symptoms which indicate a potential problem about which I have studied).

The following excerpt from a transcript demonstrates pre-encounter
influences including the orientation of the student (medical, in this instance), the
chart information given (urinary and emotional), and student life experiences
(impact of "real" nursing experiences):

R = Researcher

OK. I was looking at aaa his urinary
output and they do not seem to
be very concerned in the nursing
notes. They're more concerned
with his stress and coping
responses. So, I don't really
feel like I got much there.
So, I'm going to go to assessment
again.

OK. This is giving me his past history
and his voiding patterns. The
bladder is not palpable. That's
good.

I'd like to go back to reviewing the
chart.

R: Are there any cues that you are
looking for?

I'm looking for urinary distention,
altered elimination to see if
I can find anything on that.
But they ...they're more
concerned with his psychosocial
aspect. In my mind that's never
very important. You deal with
the real stuff first; then we
get to that later. So..
I'm going to look at the nursing admission and physical exam.

------------------------
Oh, my gosh. Now that would not be something that I would prioritize. As being number one.
R: Why?
Because realistically from being on the floor in nursing I think that the very metabolic related diagnoses are very good. They really help you get your act together and do your intervention but as far as like the psychosocial, that stuff... I don't feel that we have enough contact with the patient that they are in for a long enough time that enough emotional support is given to a patient. At least that's what I see in real life. They are very task oriented in the hospital setting. Stuff like that is just not done. I guess it's not in my mind...that's just not what I would think of.

A contrast to the above pre-encounter comments is the following transcript excerpt which demonstrates "bounding" of pre-encounter data:

[Student reading text]
R: After you read that, what did you think?
Since she's two weeks post-op, I want to go see how far along she is after her surgery because she's ready to go home and I want to look at discharge planning and what will be necessary to send her home.
L: Did you have any initial thoughts about discharge planning?
Umm - whether she'll need a walker, whether the surgery.
after two of the hip surgery
I don't know enough to figure
out whether they still walk
on their own or if they need
a wheelchair at home. If
they'll need help with their
bath...if she has help at home
to help her.

The importance of the pre-encounter client data itself and the
pre-encounter influences on student data search and interpretation were
evident in varying degrees in all of the transcripts. Stereotypes of clients and
nursing, misinterpreted cues, and "bounding" were demonstrated in the data
as characteristics of pre-encounter strategies. During interviews and member
checks all students discussed consulting the chart for information about the
client during their clinical experiences. All behavior traces demonstrated
retrieval of chart data from the computer program.

Entry to the Data Search Field and Shaping Direction of Data Gathering

All students gathered cues. Four students used a technique of random
assessment of the client. Students used various approaches to cue gathering
including body systems assessment, evaluation of a specific area, and
concentration on the "chief complaint" of the client. The following excerpt
demonstrates cue gathering focused on the primary health problem of the
client:

B: Normally after surgery you retain
water, don't you? But if the
intake is equal to the output,
that's what you would expect.
That's a normal finding.
A: Yep. I would think so.
A: She seems to be having, you know,
clear yellow urine that's not
concentrated or anything. So
she is not dehydrated, supposedly.
Cause I would think that would
be something you would note. I
would note myself if the urine
was concentrated.

A less focused approach to assessment and cue interpreting is demonstrated
by the following excerpt:

[Student just started assessments.]
Just her blood pressure was high.
Umm. I'm concerned about her
family. She lives alone and she
just has two female friends and
her husband died suddenly two
years ago. That might be bothering
her since he died suddenly. She
has ...I forget which family
members...but they live out of
state. So she may need help.
That's a great concern.
Umm. But she seems to be in
good physical shape. aah.
So I think I am going to
assess her family.
[Did not do family assessment.]
I'm going to assess her exact
pain that she has in her hip.
[ pain assessment requested]
OK. I was wondering. She has this
pain all the time but here it
just says weight bearing and
movement. So I am assuming that
she is OK.
I assessed for past surgeries but that would probably be in her chart if she did have some. Another thing that stuck out in her chart was her mom had cancer. Um. That would run in the family.

[arthritis--activity/exercise assessment chosen] OK. It says that she had arthritis up until a year ago. That could have a lot to do with her hip being like it is. Seeing she didn't have any accidents or any thing to cause her to come into the hospital. I am assuming that she came into the hospital because it got so bad she couldn't walk on her leg.

Students used various approaches to cue gathering -- some focused and some random. Three (3) students collected minimal pre-encounter data and cues prior to hypothesizing the primary nursing diagnosis. The behavior traces indicated that 18 students used an organized body-systems approach to collecting assessment cues. Two (2) students collected cues in a random body-systems approach. Nine (9) students chose physical cues before psychosocial cues during assessment. Four (4) students used a body-systems approach that focused on post-operative assessments.

Coalescing of Cues into Clusters

All students completed cue clustering. Seven students used a less effective strategy meaning that they missed cues important for clustering or failed to
recognize significant patterns that existed. The following excerpts from two
different cases demonstrate cue clustering:

[reading activity assessment]
OK. She's not having any trouble
with ADLs, walking with a walker.
She has full range of motion except
where she had the surgery. There she
only has flexion up to 90 degrees.
She getting her exercise and she is
concerned about being able to prepare
her meals while using a walker.

----------

B: About the mobility assessment-- this
activity/exercise assessment.
A: Seems like there's a lot there.
B: And I would say that ...everything
else has looked pretty normal.
I think for mobility...it's
probably a priority.
A: Considering that she is 72....older
people's skin is usually more
fragile. Have to watch for
breakdown, make sure...get
her out of bed. That's important
with hip replacement. Get her
moving. Watch when you turn her.
Turn her in bed and get her out
of bed.

The student in the following transcript assessed all of the cues for anxiety but
due to pre-encounter influences (medical problems are more important) the
anxiety pattern was not evaluated as the most significant.

Hum. It seems like he got enough
teaching at this time. Something
is wrong. It's not connecting with
him. He's worrying about something
he shouldn’t be worried about yet. He wants to make sure he can urinate and ahh he may not even have the fluid in his bladder to urinate from the sounds of it. since they palpated it. 

Deals with stress by eating and worrying. What’s the problem with that? I couldn’t think of any way anyone could help him if he were stressed.

In this study coalescing of cues into clusters involved identifying the significance of the individual cues and their possible relationships by the students. The objective and subjective meaning of individual cues contributed to the clustering activity. Meanings of cues were evident in the transcripts as students made comments about the cues (e.g., he must be worried about that or I had a client like this last week and he had the same symptoms). Students identified clinical experience and work-related experience as important in their evaluation or clustering of cues during interviews and member checks (see Appendix N for member check data).

**Activating Possible Diagnostic Explanations**

All students activated multiple possible diagnostic explanations. Eighteen activated these diagnoses early in the assessment encounter. Two dyads activated possible diagnoses later in the assessment encounter. The following excerpt is an example of activating possible diagnostic explanations:
OK. I think I'm ready to make my diagnoses. Because I'm thinking that he does have altered coping responses and he does seem to be very nervous. He wasn't sure if he should have the surgery now. He's having doubts because he can't urinate if it actually worked. I also think too that potential for infection is important because he has a foley and his sterile system has been invaded. And potential for urinary retention would be another. So those are the three that I am thinking. My priority I haven't decided yet.

**Hypothesis and Data Directed Search of the Data Field**

Hypothesis and data directed search of the data field is gathering data to systematically test the hypothesis (shortened to Guided Search). The data gathered assists in either confirming or ruling out the hypothesis. When considering the significance of a piece of assessment data, specific strategies may be used including confirmation, elimination, exploration, and discrimination.

All students in the study completed data directed searches of the data field. Six (6) students demonstrated less developed techniques in these searches: they requested information but did not recognize the significance of the information or they failed to request important assessment data. All students did not use all strategies for evaluating data requested: 7 used discrimination strategies; 17 used elimination strategies; 10 used exploration
strategies; and 18 used confirmation strategies. Five (5) students used all four strategies in data-directed searches. An example of a confirming data-directed search is:

Go back to...mobility. I think probably the best diagnosis from what I can see would be mobility, impaired physical.
[reading activity assessment] She does have some limited ROM. And she says that she isn't going to be able to prepare her meals which means maybe...she's aaa reluctant to attempt movement. In a way she may not want to attempt to use her coordination too...to prepare her meals. So I think that the diagnosis is relevant.

The following example demonstrates the use of all four strategies in data-directed search:

[already made possible diagnoses]
A: Let's see if we can put everything together.
B: OK. We want to go back. How do we go back? We do this one then? OK.
A: She's got an IV...She's got D5 Lactated.
B: She has a dry sterile dressing. Her skin is warm, pink, and dry. Site is covered with dry sterile dressing. Drains from hip wound. Would it be something about the drains....
A: Why does she have 4? Is it that big of a.....
B: Lets try this. JP drains. Treatment...maybe the nurses
are doing something with the
drains, you know.
B: Nursing care.
A: We need to do something with
assistive devices cause that
was more important than her
skin....cause that just said
....
[typed assistive devices]
A: Why is it elevated?
B: They want to keep weight off
of it. No. that can't be it.
A: Oh, because if it was any lower
she would she would have to
do more than flex.
B: OK.
A: Plus she can't go past 45 degrees.
Two of the assistive devices
are important in making the dx.
Which two?
B: Lets just make a diagnosis.

Behavior traces indicated that students requested data for review after making
a preliminary diagnosis. These data choices followed a pattern in about half
(11) of the students. Juniors demonstrated more random selection of search
data than seniors.

Testing Diagnostic Hypothesis for Goodness of Fit

Testing diagnostic hypothesis for goodness of fit (hypothesis evaluation)

involves matching the presenting data against each profile for competing
diagnoses and determining where the fit is most congruent. All students
completed some type of hypothesis evaluation. Twelve (12) of the students
demonstrated a rudimentary strategy meaning that their comparisons were few
and they tended to "guess" the best fit. The remaining eight (8) students used more complete strategies of comparison.

An excerpt from a dyad transcript demonstrates testing diagnostic hypothesis for goodness of fit:

H: Oh, here we go. It's definitely anxiety.
    Never had surgery before.
J: OK. Let's make a diagnosis.
<reviewing NANDA list>
H: She definitely has an anxiety towards it.
    Do you want to review the diagnoses?
J: Yea. See what they are.
    They're like clear on the last page, I think.
    Cause that seems like it to me.... from the paragraph.
H: That seems like a big concern of hers.
J: Want to go back to like... neuro and review?
H: Could be coping.
J: Now is she fearful or is she anxiety?
    Well... she has fear.
H: That leads to her anxiety.
J: She's never been here before.
H: Do you want to try fear?
J: Well, it's a toss up really.
    Didn't it say something about her inadequacy?
H: Let's look again.
<neuro assessment reviewed>
J: Uncertainty, inadequacy, and distress.
H: She's not sure how she'll be able to manage.
J: Getting pretty jittery about this surgery thing.
H: Does seem like signs of anxiety more than fear.
J: Doesn't really say...I'm afraid.
    Yea, I would say anxiety more than fear.

Another excerpt from an individual transcript demonstrates comparisons of hypotheses:
She's got a self-care deficit...bathing and hygiene probably because she's post-op...but that's not big time because nurses can help with that. That's not something that's going to affect her big time. I discount that one. She's getting fluids though I'm going to have to go against altered nutrition unless we want to figure out calorie vs calorie requirement.

We don't have enough information right now. I suppose we could if we got... they did give us her height and weight, I think. I don't remember what it was... something like 5'7" and 130 or something. I don't remember.

She's got a potential for body temp. alteration. That's not a big one... I don't think. Potential for trauma... I don't go for that. It's either going to be skin integrity or tissue integrity or mobility. It's not potential skin integrity because she's already got it. You've got impaired tissue integrity too. So one of those two or impaired mobility. The rest of them are secondary. To my way of thinking.

Coalescing of cues into clusters, hypothesis and data directed search of the data field, and testing diagnostic hypotheses for goodness of fit strategies were less well-developed generally. Interestingly these processes share a common strand. They all require the same cognitive activities of judgment. Judgment involves the process of comparing ideas to find their agreement or disagreement. It includes discernment, discrimination, and decision. These processes are less evident in the data than one might expect for the level of diagnostic reasoning required to determine a nursing diagnosis (see Review of Literature related to Diagnostic Reasoning in Nursing).
Diagnostic Label

All students identified diagnostic problems and with discussion labeled the problems with nursing diagnosis terminology (NANDA labels). Five students expressed particular confusion with the NANDA labeling terminology. Such confusion related specifically to what words to use to label a nursing problem (eg: a skin integrity vs tissue integrity diagnosis; a self-care deficit vs a home health maintenance problem).

Comments from students related to this confusion included:

I'll try home maintenance management, impaired.
Well done. OK. This is the highest priority.
One of the biggest reasons I didn't pick this one when I went through them was I wasn't sure quite what it meant. That was one of the biggest reasons I didn't pick it. I was looking at it but I wasn't sure if that's what it meant.

[picked impaired skin integrity over impaired tissue integrity]

I don't understand why skin wouldn't be. ...
<reading explanation>. mucous membrane, integumentary, OK. I get it. <chuckle>.
Oh, I see. That makes sense. I was thinking of skin along the line of a barrier to infection and stuff.
R: Have you come across the difference between skin integrity and tissue integrity before?
Yea. Because tissue is more than just skin. It's all the underlying parts. It makes more sense.
It's more all including. Considering she had all those drains and things.

Classic Approach

Appendix J presents raw data from a dyad which represents a somewhat "classic" approach to diagnostic reasoning. "Classic" refers to the inclusion of all of the steps of the diagnostic reasoning process in sufficient amount to be deemed effective process. Appendix I presents raw data from an individual non-classic case for comparison. Of the 20 students where data were collected, nine were labeled as "classic".

Student Descriptions of the Diagnostic Process

In the interview students described their assessment and diagnostic processes in various ways. Examples of their descriptions include:

Read the chart before see client.
Go in and talk to the client and assess them. Interact with them.
Look for biggest problem.

Look at the chart first. Assess physical first. Psychosocial next.
Go down list and choose diagnosis.

Look at chart before and after see client for a baseline. Do assessments and ask client. Look at progress notes. Make diagnosis.

Look at chart. Make own assessment.
Look at what's there right now.
The actual problem. Then see what can do. Go to book and pick diagnosis.

Look at abnormals. Go to chart first, then assess. See what client perceives as problem.

Look at what's wrong with the client and whatever is abnormal would be a diagnosis. Look at chart. See client. Do assessment.


Read chart before interview. Do general assessment and look for abnormal. Prioritize.

In the interviews students' descriptions of the process they use to determine a nursing diagnosis were very basic and concentrated upon identifying abnormals. Terms that students used to describe their thinking or problem solving strategies included: "look at," "focus on," "compare to others notes," "sorting out," "ruling out," "find the pieces to fill in," "find what else is happening," "narrow down," "prioritize," and "take in all aspects of the situation." During member checks, students agreed with these descriptions of the process they use for nursing diagnosis.

**Summary**

Findings from this study indicate that students used a general strategy for diagnostic problem solving consistent with those of Carnevali: pre-encounter
data, entry to the data search field and shaping direction of data gathering, 
coalescing of cues into clusters, activating possible diagnostic explanations, 
hypothesis and data directed search of the data field, testing diagnostic 
hypothesis for goodness of fit, and labeling the diagnosis. Strategies varied in 
amount and depth of structure. The most inconsistent strategies involve 
coalescing of cues into clusters, data directed search of the data field, and 
testing diagnostic hypothesis for goodness of fit. NANDA terminology created 
confusion for some students. Students describe the process they use in basic 
terms focusing on identifying abnormals.

Research Question Two

Do students working in dyads demonstrate the same or different 
cognitive strategies than students working individually on the same 
computer simulation?

Tables 4 through 7 present comparisons between all individuals and all 
dyads. From these summaries and worksheets developed by the investigator 
to compare specific aspects of the diagnostic process, trends were identified 
between individuals and dyads.

Individuals

For individuals (n =10) pre-encounter influences were strong ( eg. 
medical/nursing orientation, chart data, and experiences). "Bounding" of data 
was applied by 5 students. Seven (7) of the students completed systematic 
cue gathering in the data field. Two (2) students collected minimal data while
one (1) student randomly searched the data field. While all students completed cue clustering, 5 of the students demonstrated weak strategies (e.g., considering few cues or skipping important cues for clustering). All students did early hypothesis activation.

Individual students all used guided search strategies. Four (4) of the students used a less focused approach to strategies. A tally of the specific strategies of guided search included: 10 students used confirmation, 7 students used elimination, 3 students used exploration, and 2 students used discrimination. All students demonstrated strategies for testing diagnostic hypothesis for goodness of fit. Four (4) students demonstrated more rudimentary strategies (e.g., less positive of their comparisons). Four (4) students had difficulty with the NANDA terminology for labeling the diagnosis.

In summary, the individuals in this study used a general systematic approach to diagnostic problem solving. Inconsistencies of strategies were noted most frequently in coalescing of cues into clusters, data directed search of the data field, and testing diagnostic hypothesis for goodness of fit. Use of discrimination and exploration strategies were minimal. There was confusion with the NANDA labeling terminology.

**Dyads**

For dyads (n = 10), pre-encounter influences were strong. Three (3) dyads applied "bounding" to pre-encounter data. All dyads completed data gathering from the data search field. One (1) dyad collected less significant
data. Coalescing of cues into clusters was a common activity in all cases. Two (2) dyads used minimal cue clustering. Early hypothesis activation was noted in 8 cases. In two (2) cases there was late hypothesis activation.

Dyads all used hypothesis and data directed search of the data field. Two (2) dyads used fewer guided search strategies. A tally of the specific guided search strategies used included: 10 dyads used elimination, 8 dyads used confirmation, 7 dyads used exploration, and 5 dyads used discrimination. All dyads demonstrated strategies for testing diagnostic hypothesis for goodness of fit. Three (3) dyads demonstrated more "rudimentary" strategies (eg. less comparison). One (1) dyad expressed frustration with the NANDA labeling terminology.

In summary, the dyads in this study used a general systematic approach to diagnostic problem solving. One (1) dyad shifted focus frequently. While inconsistencies were still noted in coalescing of cues into clusters, data directed search of the data, and testing diagnostic hypothesis for goodness of fit, these inconsistencies occurred fewer times than with individuals. Use of discrimination, elimination, and exploration strategies increased in dyad interaction. Dyads discussed the NANDA terminology and there was only one case where confusion over terminology became a problem. In reviewing the transcripts, generally, more client data was requested by dyads.
Fisher Exact Test

The Fisher Exact Test was applied to the data (see Methodology section) in the areas of coalescing of cues into clusters, data directed search of the data field, testing diagnostic hypothesis for goodness of fit, and amount of exploring completed. Results of the Fisher Exact Test are indicated in Tables 8-11. Table 17 (see Appendix O) presents coded data from transcripts. Differences between individuals and dyads for cue clustering, guided search strategies, and testing diagnostic hypothesis for goodness of fit were nonsignificant within the sample. Amount of exploring completed was significant at the .05 level for exploring by dyads. Dyads completed more exploring of the data than individuals.

Summary

Individuals and dyads generally use a systematic approach to diagnostic problem solving. There are inconsistencies in the application of the strategies involving coalescing of cues into clusters, data directed search of the data field, and testing diagnostic hypothesis for goodness of fit. From the data there appears to be some advantage to working in dyads including an increase in the amount of data reviewed, increased use of guided search strategies, and less confusion related to the NANDA terminology for labeling.

Students commented during member checks that students may not work effectively in pairs because they are not used to working together. They were not used to making decisions with another person. Students also commented that working with another person did not cause them to change the process they use to approach nursing diagnosis.
Table 8. Coalescing of cues into clusters. Individual/dyad results of the Fisher Exact Test.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Coalescing of cues into clusters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Simple</td>
</tr>
<tr>
<td>Individuals</td>
<td>6</td>
</tr>
<tr>
<td>Dyads</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
</tr>
</tbody>
</table>

Decision

With $B=4$, the observed $D=6$ has a one-tailed probability of occurrence under $H_0$ of ≥ .05. Since this $p$ is larger than the .05 level of significance, the decision is to accept $H_0$ in favor of $H_1$.

Individuals and dyads demonstrate similar ability in coalescing of cues into clusters.

Note:

$H_0$ = Individuals and dyads demonstrate similar ability on the designated strategy

$H_1$ = Individuals and dyads demonstrate different abilities on the designated strategy

Significance Level: Let $a = .05$ $N=20$

Rejection Region: One-tailed test

Table 9. Hypothesis and data directed search of the data field (guided search). Individual/dyad results of the Fisher Exact Test.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Hypothesis and data directed search of the data field (guided search)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Simple</td>
</tr>
<tr>
<td>Individuals</td>
<td>6</td>
</tr>
<tr>
<td>Dyads</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
</tr>
</tbody>
</table>

Decision

With $B=4$, the observed $D=7$ has a one-tailed probability of occurrence under $H_0$ of ≥ .05. Since this $p$ is larger than the .05 level of significance, the decision is to accept $H_0$ in favor of $H_1$.

Individuals and dyads demonstrate similar ability on hypothesis and data directed search of the data field.

Note:

$H_0$ = Individuals and dyads demonstrate similar ability on the designated strategy

$H_1$ = Individuals and dyads demonstrate different abilities on the designated strategy

Significance Level: Let $a = .05$ $N=20$

Rejection Region: One-tailed test
Table 10. Testing hypothesis for goodness of fit (hypothesis evaluation) individual/dyad results of the Fisher Exact Test.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Testing hypothesis for goodness of fit (hypothesis evaluation)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Simple</td>
</tr>
<tr>
<td>Individuals</td>
<td>7</td>
</tr>
<tr>
<td>Dyads</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
</tr>
</tbody>
</table>

Decision

With $B=3$, the observed $D=5$ has a one-tailed probability of occurrence under $H_0$ of $\geq 0.05$. Since this $p$ is larger than the .05 level of significance, the decision is to accept $H_0$ in favor of $H_I$.

Individuals and dyads demonstrate similar ability in testing hypothesis for goodness of fit.

Note: $H_0$ = Individuals and dyads demonstrate similar ability on the designated strategy  
$H_I$ = Individuals and dyads demonstrate different abilities on the designated strategy

Significance Level: $\alpha = 0.05 N=20$
Rejection Region: One-tailed test

Table 11. Amount of exploring of data field individual/dyad results of the Fisher Exact Test.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Amount of exploring of data field</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Simple</td>
</tr>
<tr>
<td>Individuals</td>
<td>7</td>
</tr>
<tr>
<td>Dyads</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
</tr>
</tbody>
</table>

Decision

With $A=7$, the observed $C=1$ has a one-tailed probability of occurrence under $H_0$ of $\leq 0.01$. Since this $p$ is smaller than the .05 level of significance, the decision is to reject $H_0$ in favor of $H_I$.

Individuals and dyads demonstrate different abilities in the amount of exploring of data field with dyads completing more exploring than individuals.

Note: $H_0$ = Individuals and dyads demonstrate similar ability on the designated strategy  
$H_I$ = Individuals and dyads demonstrate different abilities on the designated strategy

Significance Level: $\alpha = 0.05 N=20$
Rejection Region: One-tailed test
Research Question Three

Do Senior students demonstrate the same or different strategies than Junior students working either individually or in dyads on the same computer simulation?

Tables 4 through 7 present comparisons between all juniors and all seniors. From these summaries and worksheets developed by the investigator to compare specific aspects of the diagnostic process, trends were identified between juniors and seniors.

Juniors

For juniors (n = 10) pre-encounter influences were strong. "Bounding" of data was applied by 3 students. Seven (7) students completed systematic cue gathering in the data field. Three (3) students collected minimal data in the data field. One (1) of these three shifted focus of assessment frequently. While all students demonstrated coalescing of cues into clusters, 5 students used less effective clustering (eg. considering few cues, missing cues). All students did early hypothesis activation.

Junior students all used guided search strategies. Four (4) of the students used a less focused approach in strategies. A tally of specific strategies of guided search included: 9 students used confirmation, 8 students used elimination, 6 students used exploration, and 2 students used discrimination. All students demonstrated strategies for testing diagnostic hypothesis for goodness of fit. Four (4) students used more rudimentary strategies. Three (3) students had difficulty with the NANDA terminology for labeling diagnoses.
In summary, the juniors in this study used a general systematic approach to diagnostic problem solving. Inconsistencies of strategies were noted most frequently in coalescing of cues into clusters, data directed search of the data field, and testing diagnostic hypothesis for goodness of fit. Use of discrimination strategy was minimal. There was confusion with the NANDA labeling terminology.

**Seniors**

For seniors (n = 10), pre-encounter influences were strong but were more closely related to the present client problems. "Bounding" of data was applied by 5 students. All seniors completed data gathering from the data search field. One (1) student collected data less systematically. Coalescing of cues into clusters was a common activity in all cases. Two (2) seniors used minimal cue clustering. Early hypothesis activation was noted in 8 cases. In two (2) cases there was late hypothesis activation.

Seniors all used hypothesis and data directed search of the data field. Two (2) seniors used fewer guided search strategies. A tally of the specific guided search strategies used included: 9 students used confirmation, 9 students used elimination, 4 students used exploration, and 5 students used discrimination. All seniors demonstrated strategies for testing diagnostic hypothesis for goodness of fit. Three (3) seniors demonstrated more "rudimentary" strategies (eg. less comparison). Two (2) students expressed frustration with the NANDA labeling terminology.
In summary, the seniors in this study used a general systematic approach to diagnostic problem solving. One (1) senior shifted focus frequently. While inconsistencies were still noted in coalescing of cues into cluster, data directed search of the data, and testing diagnostic hypothesis for goodness of fit; these inconsistencies occurred fewer times than with juniors. Use of discrimination, elimination, and discrimination strategies increased with seniors. Two (2) students expressed confusion with NANDA labeling terminology. In reviewing the transcripts, generally, seniors explored the data more than juniors.

**Fisher Exact Test**

The Fisher Exact Test was applied to the data (see Methodology section) in the areas of coalescing of cues into clusters, data directed search of the data field, testing diagnostic hypothesis for goodness of fit, and amount of exploring completed. Results of the Fisher Exact Test are indicated in Tables 12-15. Appendix O presents coded data from transcripts. Differences between juniors and seniors in coalescing of cues into clusters, data directed search of the data field, and testing diagnostic hypothesis for goodness of fit were significant at the .05 level. This indicates that seniors demonstrate more depth to their strategies than juniors. Amount of exploration was nonsignificant. There was little difference in the amount of exploring completed by juniors and seniors.
Table 12. Coalescing of cues into clusters, junior/senior results of the Fisher Exact Test.

### Strategy

#### Coalescing of cues into clusters

<table>
<thead>
<tr>
<th></th>
<th>Simple</th>
<th>Complex</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Juniors</td>
<td>8</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Seniors</td>
<td>2</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>10</td>
<td>20</td>
</tr>
</tbody>
</table>

**Decision**

With $A = 8$, the observed $C = 2$ has a one-tailed probability of occurrence under $H_0$ of $\leq 0.025$. Since this $p$ is smaller than the 0.05 level of significance, the decision is to reject $H_0$ in favor of $H_1$.

Juniors and seniors demonstrate different abilities in the coalescing of cues into clusters with seniors completing more coalescing of cues into clusters.

**Note:**

- $H_0 = \text{Individuals and dyads demonstrate similar ability on the designated strategy}$
- $H_1 = \text{Individuals and dyads demonstrate different abilities on the designated strategy}$

**Significance Level:** Let $a = 0.05$ $N = 20$

**Rejection Region:** One-tailed test

---

Table 13. Hypothesis and data directed search of data field (Guided Search), junior/senior results of the Fisher Exact Test.

### Strategy

#### Hypothesis and data directed search of data field (Guided Search)

<table>
<thead>
<tr>
<th></th>
<th>Simple</th>
<th>Complex</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Juniors</td>
<td>8</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Seniors</td>
<td>1</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
<td>11</td>
<td>20</td>
</tr>
</tbody>
</table>

**Decision**

With $A = 8$, the observed $C = 1$ has a one-tailed probability of occurrence under $H_0$ of $\leq 0.005$. Since this $p$ is smaller than the 0.05 level of significance, the decision is to reject $H_0$ in favor of $H_1$.

Juniors and seniors demonstrate different abilities in hypothesis and data directed search of the data field with seniors completing more guided search.

**Note:**

- $H_0 = \text{Individuals and dyads demonstrate similar ability on the designated strategy}$
- $H_1 = \text{Individuals and dyads demonstrate different abilities on the designated strategy}$

**Significance Level:** Let $a = 0.05$ $N = 20$

**Rejection Region:** One-tailed test
Table 14. Testing hypothesis for goodness of fit (hypothesis evaluation) junior/senior results of the Fisher Exact Test.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Testing hypothesis for goodness of fit (hypothesis evaluation)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Simple</td>
</tr>
<tr>
<td>Juniors</td>
<td>9</td>
</tr>
<tr>
<td>Seniors</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
</tr>
</tbody>
</table>

Decision

With $A=9$, the observed $C=3$ has a one-tailed probability of occurrence under $H_0$ of ≤.01. Since this $p$ is smaller than the .05 level of significance, the decision is to reject $H_0$ in favor of $H_1$.

Juniors and seniors demonstrate different abilities in testing hypothesis for goodness of fit, with seniors completing more hypothesis evaluation.

Note:
- $H_0$: Individuals and dyads demonstrate similar ability on the designated strategy
- $H_1$: Individuals and dyads demonstrate different abilities on the designated strategy
- Significance Level: Let $a = .05$ N=20
- Rejection Region: One-tailed test

Table 15. Amount of exploring of data field junior/senior results of the Fisher Exact Test.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Amount of exploring of data field</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Simple</td>
</tr>
<tr>
<td>Juniors</td>
<td>8</td>
</tr>
<tr>
<td>Seniors</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
</tr>
</tbody>
</table>

Decision

With $B=4$, the observed $D=6$ has a one-tailed probability of occurrence under $H_0$ of ≥.05. Since this $p$ is larger than the .05 level of significance, the decision is to accept $H_0$ in favor of $H_1$.

Juniors and seniors demonstrate similar ability in amount of exploring of the data field.

Note:
- $H_0$: Individuals and dyads demonstrate similar ability on the designated strategy
- $H_1$: Individuals and dyads demonstrate different abilities on the designated strategy
- Significance Level: Let $a = .05$ N=20
- Rejection Region: One-tailed test
Summary

Juniors and seniors generally use a systematic approach to diagnostic problem solving. There are inconsistencies in the application of the strategies involving coalescing of cues into clusters, data directed search of the data field, and testing diagnostic hypothesis for goodness of fit. Growth occurs in the applications of strategies in the diagnostic process from junior to senior level. Seniors demonstrate more structure and depth to their problem solving. They include more guided search strategies of elimination, confirmation, and discrimination. There are problems with NANDA terminology labeling with both juniors and seniors. Seniors explore more of the data field than juniors.

Students commented during member checks that as seniors they were more comfortable with nursing diagnosis related to more clinical experience/practice with nursing diagnosis than they had been as juniors. Juniors commented that nursing diagnosis was easier now than when they were sophomores. Students expressed a recognition of their growth in nursing diagnosis.

Research Question Four

What factors can be identified which influence cognitive strategies?

Factors influencing cognitive strategies were identified from the student interviews. Experience (either work-related or college clinical) was rated as the most important influence on diagnostic problem solving. All students discussed the role of experience in their decision-making. Lecture classes were also
evaluated as important (discussed by 15 students). Reading assignments and care plans were mentioned as helpful by 4 students. The use of common sense or logic was mentioned by 4 students as a part of their problem solving. Specific comments made by students included:

- I learned the thinking process at work.
- A combination of class and experience is the most beneficial. I had clinical instructors with a strong base in nursing diagnosis early in my program. I learned to look at cues and evaluate them.
- Clinical provides application.
- The experience you have helps. Class gives you background. What you "key in on" comes with experience.

The value of experience emerged as the single most important factor influencing the diagnostic reasoning process. During member checks students agreed that experience (work/clinical) is most important in learning nursing diagnosis (see Appendix N for member check data).

The value of sharing thoughts and experiences was mentioned by 13 of the students as an advantage in determining a nursing diagnosis. Twelve (12) of the students stated that they like working with others on a computer program. Eight (8) of the students stated they like working alone.
Half of the students stated in the interviews that they consider comments and diagnoses of other health workers when they read the chart or kardex and that these influenced the assessments and diagnoses that students made. Two students stated that they prefer to do their own assessments without looking at comments from others about the client.

Four students mentioned the clinical instructor as an important resource. Students discussed cues and diagnoses with the instructor.

Five of the students demonstrated difficulty with terminology and/or labeling with NANDA labels. All of the dyad transcripts contained discussions by students to clarify definitions and characteristics of nursing diagnoses. During member checks five (5) students expressed confusion regarding labeling with NANDA.

The use of the computer as a teaching tool was new to most students in this study. Computer experience was primarily related to word processing. Most students responded positively to using this computer program for learning. There were four students who did not like using a computer for this type of learning. Twenty-eight of thirty students stated that completing the computer program was not different than completing nursing diagnosis in the clinical area.

Two factors emerged from the study as influences on diagnostic reasoning in nursing: cognitive development and common sense. These
emergent factors were recognized in the data analysis stage as unexpected factors. Study of these factors would be interesting to pursue at a later time.

Twenty-eight of the thirty subjects in this study were in their early 20's. Their knowledge, experience, and development level most likely influenced their strategy. Level of cognitive development was not measured in this study. Some relationship can be assumed from the literature and from the differences in cue clustering, guided search, and hypothesis identification evident between juniors and seniors (note Discussion section). Students verbalized growth in nursing diagnosis from sophomore to junior to senior levels.

During cognitive development the student changes from the dualism approach (Right answers exist for everything,) to relativism (Knowledge and values are contextual). In a review of the transcripts it was noted that 4-5 students verbalized frustration when they chose a "wrong" answer. Obtaining the "right" answer was more significant than the exploration of the data field or testing the various hypotheses. Such comments may be indicative of their level of cognitive development or a reaction to the computer program.

From interviews and member checks, two (2) students mentioned their use of "common sense" as a factor in their decision-making. Two (2) additional students mentioned the "logical approach" to problem-solving. Further study of the role of common sense or logic in the development of strategies is important.
From an analysis of the interviews, transcripts, and demographics the following factors were identified that influence cognitive strategy:

* Complexity of NANDA definitions (Difficult to discriminate)
* Clinical instructor
* Clinical experience
* Work-related experience
* Readings/assignments/care plans
* Environment
* Completion of own data collection vs use of others data.
* Sharing information (dyads)
* Computer experience
* Classroom presentation of information

Emergent factors were identified as:

* Level of cognitive development
* Common sense

Summary

The major findings from this study include:

* Students use a general strategy approach to nursing diagnosis including consideration of pre-encounter data, entry to the data search field and shaping direction of data gathering, coalescing of cues into clusters, activating possible diagnostic explanations, hypothesis and data directed search of the data field, testing diagnostic hypothesis for goodness of fit, and labeling.

Steps where differences were noted in strategy used by students include coalescing of cues into clusters, hypothesis and data directed search of the data field, and testing diagnostic hypothesis for goodness of fit.

* Dyads do more exploring of the data than individuals. Differences in strategies were not
apparent.

* Seniors complete some steps with more depth than juniors including coalescing of cues, hypothesis and data directed search of the data field, and testing diagnostic hypothesis for goodness of fit.

* Various factors influence cognitive strategies. Clinical experience and work-related experience are most significant. The combination of experience with classroom presentation is important. The complexity of the NANDA terminology is problematic to some students. Cognitive development level of students probably influences strategy.

A qualitative study generates large amounts of data. The reduction of data to matrices and the application of the Fisher Exact Test were useful for the analysis of the data in this study to determine trends and strategies. The findings of this study have interesting implications for nursing education.
CHAPTER V
SUMMARY, DISCUSSION, AND RECOMMENDATIONS

Summary

This study was a process tracing study of diagnostic reasoning in nursing, specifically the process leading to labeling a nursing diagnosis. The aim of process tracing is to observe the process of thinking in as natural an environment as possible. To this end, a computer-based case simulation of a client was used to simulate clinical problem-solving. Using qualitative methodology employing verbal protocol, this investigator attempted to extract from the subjects some representation of the process they were using to determine a nursing diagnosis.

There are no claims that the findings from this study are generalizable to any group except those in this study. Readers must decide for themselves if the situation, subjects, and characteristics described are similar to their own institutions and determine the degree of transferability.

The major findings from this study reveal that students used a general strategy approach to nursing diagnosis including consideration of pre-encounter data, entry to the data search field and shaping direction of data gathering, coalescing of cues into clusters, activating possible diagnostic
explanations, hypothesis and data directed search of the data field, testing diagnostic hypothesis for goodness of fit, and labeling. Steps where differences in strategies were noted included coalescing of cues into clusters, hypothesis and data directed search of the data field, and testing diagnostic hypothesis for goodness of fit. Dyads did more exploring of the data than individuals. Differences in strategies were not apparent. Seniors complete some steps with more depth than juniors including coalescing of cues into clusters, hypothesis and data directed search of the data field, and testing diagnostic hypothesis for goodness of fit. Various factors influenced cognitive strategies. Clinical experience and work-related experience were the most significant influences on diagnostic strategy. The combination of experience with classroom presentation was important. The complexity of the NANDA terminology is confusing to students. Developmental level of students probably influences strategy.

These findings generated ideas, recommendations, and concerns for nursing education. While based on findings of this study, discussions can be projected to address the general concerns of nursing education regarding problem solving. These concerns have been presented in various journal articles related to teaching critical thinking: model for teaching critical thinking (Malek, 1986), effects of teaching cue recognition (Thiele, Baldwin, Hyde, Sloan, & Strandquist, 1986), improving teaching critical thinking (Klassens, 1988), development of a computer program for patient assessment (Hirsch, Chang, &
Gilbert, 1989), hypothesis testing using simulations (Plunkett & Olivieri, 1989), concept teaching before clinical practice (Kinnick, 1990), computer-based learning activities (Heims & Boyd, 1990), guided design and lecture teaching strategies (Newsome & Tillman, 1990), and promoting critical thinking (White, Beardslee, Peters, & Supples, 1990).

Discussion

In this discussion section topics considered include methodology issues, cognitive strategies, cooperative learning, cognitive development of students, and factors affecting cognitive strategies.

Methodology Issues

NURS-CAPS

Nurs-Caps (Nursing Computer-Assisted Problem Solving) is a computerized simulation designed to promote the process of nursing diagnosis. The student is presented with a simulation and asked to determine the highest priority nursing diagnosis (see Methodology for further description). This particular design forces the student to set priorities on the nursing diagnoses that they determine are important in the simulation. Such prioritizing may or may not reflect what students must do in the clinical setting. In the clinical setting students are most often asked to identify several nursing diagnoses related to the client and may or may not have to prioritize them. NURS-CAPS does reinforce the idea that there are several nursing diagnoses appropriate for
the simulation if the student accesses the hints section related to diagnoses present in the client simulation:

The characteristic of determining the highest priority diagnosis in NURS-CAPS is important related to the study findings. Students may or may not have continued to evaluate diagnoses if they had been permitted to identify several significant diagnoses in the case. Prioritizing encouraged further strategies. Perhaps the amount of data-directed search of the data field and/or testing diagnostic hypothesis for goodness of fit would have varied or not existed without prioritization.

Twenty-eight of the thirty students completing the computer case simulations commented that they approach nursing diagnosis in a similar fashion both in the computer simulation and in the clinical area. The major area of frustration was identified as agreement with the expert opinion of the most important diagnosis in the case.

Interestingly, this could have some implications for clinical experience. If we encourage students to identify multiple diagnoses without prioritizing them, do we discourage cognitive strategy development? Perhaps the equal multiple diagnoses approach with the addition of comparative analysis among the competing diagnoses has more merit than the highest priority diagnosis approach for development of critical thinking.
Verbal Protocol

The validity of this method of data collection in portraying actual thought processes has been debated in research and evaluation literature. Nisbett and Wilson (1977) argue that the act of reporting distorts the processes being studied. Lichtenstein (1982) comments that experts are least able to verbalize their thought processes and beginners are more likely to be able to verbalize their thoughts. Proponents of the method (Hayes, 1982; Kassirer, Kuipers, and Gorry, 1982) suggest that verbal reports do provide at least some incomplete evidence of the strategies underlying them. Ericsson and Simon (1980) suggest that verbalizing information changes the cognitive processes only if the student is asked to complete a task that would not be attended to in the normal process. Smith and Wedman (1988) comment that a read-think-aloud protocol provides hints about the thought processes that are occurring within the learner and show how (or if) new information is being linked to prior knowledge.

Verbal protocol was used in this study to collect data about the application of cognitive strategies. There is no assumption on the part of this investigator that the data collected by the verbal protocol reflect the complete strategies utilized by students. Verbal protocols reflect at least some incomplete evidence of the strategies underlying them. Therefore, it is assumed that the use of verbal protocol in this study reflected basic information about cognitive thought processes of these students. Students were perceived by the investigator to be sufficiently comfortable with the verbal protocol to express
their decisions/strategies. Individual students were less likely to fully express their thought processes than dyads. Informal member checking validated strategies of individuals and dyads. The behavior trace also served to validate the basic strategy.

Cognitive Strategies

An important finding of this study was that students do use a strategy to determine nursing diagnoses. The decision regarding the final coding categories reflecting Carnevali's (1984) description of the diagnostic process emerged from the data. The final coding categories were useful for analyzing and comparing processes in transcripts because it permitted the investigator to pinpoint specific areas in the process where students used less effective strategies (note Presentation and Analysis of Data).

Stating that students use a process to determine a nursing diagnosis does not negate previous presentations of the nonlinear nature of problem solving. Both Newell and Simon (1972) and Carnevali (1984) discuss the belief that activities within the problem solving process may shift from one to another but there will be a rational organization of process within itself. Gale and Marsden (1983) comment that the problem with diagnosis is that it begins with whatever the patients presents and ends when the clinician judges that he has enough information. The Mobius strip may be useful here to visualize the problem solving process as nonlinear and shifting yet retaining structure.
The importance of process/structure is reinforced by Bruner (1962). He comments that the use of a planned strategy increases the opportunity to obtain information appropriate to the objectives of one's inquiry, increases or decreases the cognitive strain involved in assimilating information, and controls the degree of risk involved.

With these comments in mind, the value of understanding strategies that students use and identifying the weak areas of their strategies becomes apparent. Faculty can develop learning experiences to strengthen the strategy for more efficient goal attainment, less cognitive strain, and less risk.

Steps of the Process

Pre-encounter influences (including the environment, client data, and the orientation of the student) shape the search field as noted by Newell and Simon (1972), Bruner, et. al, (1962), Tanner (1984), and Gordon (1982). The clinical environment is an arena of complex cues bombarding the student. Students commented that a clinical instructor who highlights the significance and interpretation of cues is valuable in this confusing environment. As identified from the transcripts, the experiences of the students (work, clinical, and family) and their orientation to nursing (medical/nursing) influenced their approach to the data field. Identifying and evaluating these influences for the individual student could increase the efficiency of their strategy.

The entry into the data field involves a direct encounter with the client. Students determine the approach to assessment they will use. The students in
this study used varying approaches to assessment including body systems assessment, post-op assessment, and random assessment primarily to determine which cues were abnormal. Recognizing attributes (cues) is an important first step in concept attainment/diagnosis (Bruner, et. al, 1962; Gordon, 1982; Carnevali, 1984). The value placed on attributes at this stage is significant to later judgments. One of the characteristics of novices is that they do not realize the full information value from cues or they miss cues (Tanner, 1984).

Coalescing of cues into clusters is one of the steps identified in this study that was used less effectively by students. Recognizing and establishing a relationship between various cues is basic to the ensuing processes. Membership in a category is inferred not from a single attribute but by the observance of several attributes taken together (Bruner, et. al, 1962). How attributes are combined is significant. The three modes of combining attributes include conjunctive, disjunctive, and relational (note definitions in Introduction). Earlier we established that nursing diagnoses can be disjunctive concepts. This whole realm of the complex concept creates problems for the student who has a cognitive development level three or four (refer to Perry [1970] and Frisch [1987] in Review of Literature). Grasping the relationship of cues may be difficult. Application of the defining characteristics from the NANDA list of diagnoses to the identified cue cluster is also difficult since the characteristics reflect expert values.
When activating possible diagnostic explanations, students generally activated multiple diagnoses (hypotheses) early in the assessment encounter. This finding agrees with Radwin's findings (1989) that multiple hypothesis testing leads to greater accuracy in the diagnostic process than does single hypothesis testing. Early diagnoses help limit the size of the search field and decrease cognitive stress (Carnevali, 1984).

Both short and long-term memory are important in the phase of cue clustering leading to hypothesis activation (Newell & Simon, 1972; Carnevali, 1984). Retrieval of knowledge (both factual and experiential) is crucial. When particular cues are perceived in the clinical situation, appropriate knowledge must be retrieved. The implication is that the indexing and cross-referencing of information to be retrieved must be a conscious process of storage. Such information must be able to be retrieved to short-term memory for processing. The implication of this retrieval for nursing education involves a conscious effort to identify critical features of information (both factual and experiential) and index and cross reference them for retrieval. The defining characteristics of nursing diagnoses and the experiential component of nursing diagnoses must be cross referenced for retrieval. Processing in short-term memory cannot occur without the appropriate informational component.

Hypothesis and data directed search of the data field consists of searching the data field for those cues associated with the problems being considered and evaluating those cues for relevance. This search and
evaluation involves strategies of exploration, elimination, confirmation, and
discrimination which require retrieval of knowledge from the long-term memory
as well as analysis. Gordon (1982), Carnevali (1984), Newell and Simon (1972),
Gagne (1985), Bruner, et. al, (1962), and Gale and Marsden (1983) all describe
the continued development of these strategies as necessary for problem
solving. The relationship or links of these strategies to the knowledge in
long-term memory is a necessary component to success.

Students in this study used rudimentary strategies of exploration,
elimination, confirmation, and discrimination. Perhaps this is related to their lack
of knowledge (both factual and experiential) in long-term memory or their
inability to retrieve knowledge because it is not indexed and cross-referenced.

Students in this study evaluated hypotheses that they had formulated.
Analysis in this step was applied inconsistently. It is probable that student
comparisons of hypotheses lacked retrieval knowledge (factual and/or
experiential) to weigh each diagnosis effectively. The probability that many
nursing diagnoses are disjunctive concepts adds to the confusion of
comparing/contrasting diagnoses (Bruner, et. al, 1962; Matthews & Gauj, 1979).

From the above discussion, the three strategies that were identified in
this study as inconsistent or weak strategies all share a common relationship.
They each require the student to apply judgment. Judgment is defined as the
act or process of the mind in comparing its ideas to find their agreement or
disagreement. Judgment may include perception, concept formation, thinking,
memory, discrimination, decision-making, and creative imagination (Beiri, et.al., 1966). Contributing to the effective application of these strategies is the ability to retrieve knowledge (factual and experiential) from the long-term memory. These are challenging and time-consuming cognitive activities/strategies to teach and evaluate.

**Nursing Education and Process**

Nurse educators have been working hard to improve the nursing curriculum as professional education. A new model for nursing education (*The Caring Curriculum* - Bevis & Watson, 1989) incorporates four major principles for renewed emphasis including: (a) maximum learner maturity is the aim of all higher education, (b) a typology of learning exists, (c) certain types of teacher-student interactions move students forward on the learner maturity continuum, and (d) learning episodes or experiences that meet specified criteria support educative learning.

The new curriculum emphasis in nursing highlights types of learning. These include:

1. **Item learning** - learning separate pieces of information.


3. **Rational learning** - provides the rationale for why one nursing intervention is better than another.
4. Contextual learning - provides cultural framework for field of nursing.

5. Syntactical learning - logical structure or arrangements of data into meaningful wholes.


(Bevis & Watson, 1989, p. 91-94)

Bevis & Watson (1989) state "The typology of learning can be used to determine curriculum content and to provide the teacher with help in structuring or selecting learning episodes so that learning is educative and learners move forward on the learner maturity continuum" (p. 96). Thus, nursing education recognizes the importance of developing a plan for teaching "thinking". Application to the findings from the present study could help strengthen the judgment strategies.

**Metacognition**

From the comments that students gave this investigator when asked to further describe their thinking strategies (see Presentation of Data), it is evident that most students demonstrate little insight into how they make a decision. By structuring learning episodes to strengthen weak strategies, faculty can help students develop this metacognition. (Metacognition involves both an awareness of what is needed and the ability to use appropriate strategies.) Worrell (1990) stresses the development of metacognitive skills in nursing education. She comments that students must develop optimal cognitive
performance which requires knowledge, appropriate selection, and use of metacognitive skills.

**Cooperative Learning**

When students completed the case simulation in dyads, they did more exploring of the data than individuals. Part of this phenomenon could be a reflection of the inability of the verbal protocol used with individual students to detect strategy which is not verbalized. Dyads and individual students commented that they consider more information about a client when they discuss the simulation with another person. They stated that discussion is beneficial because the other person may mention aspects of the simulation that they did not consider. Students stated that they perceive that they would approach the simulation the same way regardless of whether they would do the simulation alone or with another person.

The above findings are consistent with the findings of the two cooperative learning studies completed using college juniors (Carrier and Sales, 1987; Okey and Majer, 1976). Students working in pairs chose more elaborate feedback on practice items and interpreted questions in more depth than individuals. Carrier and Sales (1987) noted that one fourth of the verbal interactions between members of pairs did not relate to the task. In the current study, students stayed on task for nearly the total simulation. The Hawthorne Effect or the participation of this investigator as an observer may account for this phenomenon.
Several of the studies (Trowbridge, 1984; Johnson & Johnson, 1985, 1986; Mevareach, Stern & Levita, 1987; Webb, Ender, & Lewis, 1986; Sharan, 1980) present findings related to the positive influences of the group process on learning. While it is difficult to pinpoint the exact effect of the group dynamics on the learning process, there are positive effects of cooperation and improved attitudes toward learning. The present study supports the above findings.

Findings from several studies (Cox & Berger, 1985; Johnson & Johnson, 1985, 1986; Webb, 1980) suggest that the group process encourages more successful problem solving. Students work with each other and discuss questions. Dyads in the current study explored client data in more depth than individuals.

Various studies on cooperative learning were completed using students in grades 6-12 with varying results. Whether the findings from these studies are applicable to college students might be debated. However, there are some interesting issues to consider. Webb (1980) presented findings that could be of interest to nursing education. He concluded that neither group nor individual setting is best for all persons. The benefits of the particular setting depend upon the experiences of the learner within that setting. Medium-ability students may learn most when working with others of similar ability. High-ability and low-ability students may do best when working with each other. Webb (1980)
comments that learning was maximized in groups that developed norms encouraging explaining.

The findings of the present study create an interesting comparison with Webb's (1980) findings. This investigator would also conclude that neither group nor individual setting is best for all persons. The finding that learning/strategy application can occur equally as effectively with individuals or dyads using the computer simulation is important for nursing education. It means that the nurse educator can use the benefits of each method of learning to accomplish goals.

The dyads in the present study were not grouped by ability but this would be an interesting follow-up study to determine if there are additional effects of working in pairs grouped by ability (the composition of the dyads was noted in the Presentation of Data). Swing and Peterson (1982) and Webb (1980) present findings suggesting differences in learning related to the grouping of students by ability. It cannot be determined if learning was maximized in the dyads, but group discussion was certainly viewed as positive by the students. It seems that there can be more questions asked about the effects of dyad interaction from this study than it answered.

From the current study dyads spent more time discussing the simulation; however, differences in specific strategies were not evident. Research by Matthew and Gaul (1979), Cianfrani (1984), and Radwin (1989) indicate that the value of each cue, rather than the number of available cues relates to the
accuracy of nursing diagnosis. Further research to clarify this relationship is needed.

As indicated by Allan (1991) and Slavin (1991a), one problem in cooperative learning research is the insensitivity of measurement to pick up effects of grouping. The development of ways of measurement to detect group dynamics, achievements, and strategies deserves attention. In the present study, it is possible that the verbal protocol is not directive enough to detect more specific dyadic interactions. It relies on the students to report what they believe is important. With a basic understanding of the cognitive strategies that students use, it would now be possible to return to the dyads and probe the interactions more fully.

**Cognitive Development and Experience**

Findings from this study indicate that seniors demonstrate more depth to their strategies than juniors, especially in the areas of cue clustering, guided search, and hypothesis evaluation. There was little difference in the amount of exploring of the data between juniors and seniors. Factors that could account for some of these differences include cognitive development and amount of experience.

**Cognitive Development**

Since most of the students are in their early twenties, age per se was not a factor. Maturity, specifically cognitive maturity, could be a factor. This study did not measure cognitive maturity or development from junior to senior level. It
would be assumed that some growth in cognitive development probably occurs. From Perry's (1970) description of stages of growth in cognitive development and Frisch's (1987) study of nursing students, it is probable that the nursing students in this study are operating at the levels 3 or 4 (Multiplism). Which students are at what level is not determinable here, but there was a general trend in the data for seniors to express less fear of being "wrong" and more interest in exploring why the expert chose a particular diagnosis.

In relation to Belenky's (1986) five categories of women's perspective on knowing, it would be difficult to categorize students from this study. Most of them would appear to be in the received knowledge category, perhaps developing in subjective knowledge. Seniors were generally more self-confident about their opinions. Several of the seniors commented that some of the decisions they made were based on "common sense" or past experience.

These extrapolated generalizations about students can be compared to the studies on nursing judgments described by Pyles and Stern (1983) and Young (1987). These researchers found that intuition played a role in the judgments of experienced nurses. What role intuition plays in the undergraduate student is still to be explored. The purpose of this study was not to explore intuition per se in the diagnostic reasoning process; however, the strategy emerged in the data and cannot be ignored.
Experience

The amount and types of experience both with the diagnostic process and with clients on the clinical units can contribute to differences between juniors and seniors. Tanner (1984) discusses the differences between novices and experts (see chart in Appendix B). There is no assumption in this study that seniors become experts; however, there is an assumption that all students strive toward becoming more expert than they are presently. Therefore, the growth demonstrated from junior to senior is significant.

Seniors demonstrated more growth in the diagnostic process specifically in coalescing of cues into clusters, hypothesis and data directed search of the data field, and testing diagnostic hypothesis for goodness of fit. This growth compares favorably to progress toward expert status. Experts are characterized as recognizing patterns in cues, using cue patterns or clusters as triggers for hypotheses, using cue characterization as a means to test or refine hypotheses, and using hypothesis testing more efficiently and more thoroughly (Tanner, 1984).

Benner’s (1984) five levels of proficiency can be used more effectively to characterize individual students growth toward expert status (novice, advanced beginner, competent, proficient, and expert). Using Benner (1984) as a guide, this investigator would probably place junior students at the early advanced beginner stage and seniors at the late advanced beginner stage. Perhaps some seniors could be at the Benner’s early competent stage. Benner (1984)
characterizes competent as the nurse who has been on the job in a similar situation for two to three years. The influence of work-related experiences and cognitive development may influence this tentative categorizing.

Benner (1984) also comments that students have little understanding of textbook information. Experience is needed before students can apply guidelines to clients. Infante (1985) is a proponent of planned experiences in the clinical area to promote specific learning. She discusses the importance of practicing psychomotor and cognitive skills in a practice laboratory (college laboratory) before moving to the clinical laboratory. A nonthreatening or low-risk environment contributes to more effective learning prior to entry into the "real" world. In this study the use of the computer simulation serves as that nonthreatening or low-risk environment to promote exploration for learning. Students commented that it would have been valuable to have completed a couple of the NURS-CAPS programs prior to the initial clinical experience.

Students mentioned clinical experience and work-related experience as the most important influences in their understanding and application of the diagnostic process. They refer to similar experiences when evaluating the computer simulation client. Juniors and seniors both refer to how much less they realized about nursing diagnosis in their sophomore or junior year.

One of the characteristics of the IPS (Newell & Simon, 1972) is the task and the knowledge about it that the problem solver gradually accumulates. In diagnostic problem solving this knowledge may come from experience,
classroom presentations, readings, and/or discussions. In interviews with students experience appears to create stronger links with long-term memory strengthening retrieval for processing in short-term memory. Specifically, retrieval would relate to those strategies of hypothesis activation, guided search and hypothesis evaluation where students make comparisons and discriminations. Carnevali (1984) comments that individual differences in use of diagnostic reasoning will be influenced by the way in which knowledge and experience are stored in long-term memory for diagnostic purposes.

Summary

The above discussion highlights the significance of experience and maturity in the diagnostic process. The differences between juniors and seniors may be influenced by both cognitive development and experiential factors. This investigator would hesitate to conclude that these were the only factors that influence the differences between these two groups.

From this discussion of the relationship of cognitive development and experience to the development of diagnostic reasoning arise some perplexing problems for the nurse educator. It appears that students are not at the maturity level that faculty assume them to be. Frisch (1987) stated that nursing students are developmentally similar to other students, though their level of cognitive growth may be less advanced than educators expect. Matthew and Gaul (1979) concluded that nursing students' ability to deal with abstract
concepts was below the national average and their ability to think critically was consistent with the mean score of a national sample. Such a discrepancy between faculty expectation and student performance creates dissonance.

Factors

There are other factors besides experience and cognitive development that influence cognitive strategies (note Presentation and Analysis of Data section). Others identified from the study included classroom presentations, NANDA terminology and the learning environment.

During the study students commented that classroom presentations were helpful but not as helpful as experiences in learning nursing diagnosis. Explanations in classes seemed to help some students. Classroom teaching is a necessary but not sufficient condition for the learning of nursing diagnosis. It is most likely that the link to long-term memory is weak from the classroom presentations. Retrieval is more difficult when there is little to associate with the content. Gagne (1985) commented that students' cognitive strategies can be learned through verbal instruction or by discovery by the students. Students may not actually use a strategy that was taught. A lecture that contains "all of the information necessary to solve the problem" may not be all that is needed. Faculty can frequently be heard to comment that they discussed that content in lecture but students don't seem to remember it.

The definitions and defining characteristics of the NANDA classification of nursing diagnosis were identified as confusing to many students. In
considering this finding it is useful to explore several possibilities related to the problem. The confusion may come from the labels themselves. These were designed by expert nurses and may not reflect everyday usage. NANDA may need to consider this issue. It is also probable that since nursing diagnosis is a complex concept, students have difficulty with concept identification strategies. Students (and perhaps graduate nurses) may need practice to develop more effective strategies in concept identification. Matthew and Gaul (1979) label nursing diagnosis as a disjunctive concept. Strategies for disjunctive concept identification is more difficult for students with less developed cognitive strategies.

Students identified characteristics of the environment as beneficial or detrimental to the diagnostic process. If clinical was viewed as stressful, the diagnostic process was viewed as difficult. Some students commented that their jobs were more helpful in learning problem-solving and "doing" nursing diagnosis. Thus, it would appear that the student's definition of the task environment is important. Is the task to solve the problem for themselves, to get a grade from the instructor, to complete the written care plan, or to complete the job assignment for the day? If work-related experiences are viewed as more beneficial to learning than clinical experiences, faculty might want to re-evaluate their clinical emphasis and incorporate work-related experiences into discussions. Newell and Simon (1972), Bruner, et. al, (1962),
Gordon (1982) and Carnevali (1984) all comment that the environment has an important impact upon the reasoning process.

Tanner (1984) discusses characteristics of the task environment and the characteristics of the diagnostician as significant factors influencing the diagnostic process. Appendix C presents a comparison of these characteristic in the novice and expert. The significance of experience, strategies, and retrieval from long-term memory can be noted in this table.

Recommendations

From this investigation of a group of female nursing students at the junior and senior-year level using diagnostic reasoning strategies to determine a nursing diagnosis, various recommendations can be made. These recommendations fall into categories including the need for further research in the area of cognitive strategies, the need for the application of teaching strategies to strengthen student problem-solving, the need for the design of instructional materials that will challenge students, and the implementation of various technologies to enhance instruction.

Research

There is a continual need for research to learn more about "thinking" and specific strategies that students use. As nursing diagnosis evolves and changes, this affects the strategies needed for students to determine a nursing diagnostic label. The strategies students are using as they make judgments
becomes more significant. The relationship between knowledge, experience, and cognitive development level of the student needs to be explored. The role of intuition in this process challenges the status quo of knowledge-based decisions. The study of cognition never ends.

Continued investigation into cooperative learning with college students would be valuable. From the present study there are many unanswered questions about the composition and interaction of dyads. Exactly what is accomplished in interaction remains unanswered.

Investigators have a responsibility to develop/improve research methods in the study of cognition. The verbal protocol can be effectively used but must be continually re-evaluated or changed to unearth deeper data. Improvement of the method can improve the data collected. A follow-up to this study might include a single case design probing each step of the identified strategy with a student/expert. The refinement of qualitative research methodology and the communication of this methodology to the reader is important.

Teaching and Learning

Nursing education has entered a new era where curriculum is viewed as those transactions and interactions that take place between and among faculty and students with the intent that learning occurs. Learning must illuminate, must awaken, must liberate the human mind and harness its potential (Bevis & Watson, 1989). Thus, it becomes important that teachers and learners develop skills that support learner-maturity, not dependence. This charge from the NLN
National League for Nursing) presents challenges to faculty and students. To meet this challenge involves the application of multiple teaching strategies that can strengthen problem solving skills.

**Instructional Design**

To the instructional designer, the findings of this study indicate that more care must be taken to design materials that "fill the gaps" in the teaching of problem solving. The challenge is to design materials to raise the cognitive developmental level of the student and incorporate an experiential component. The design of low-risk clinical simulations with problem solving components geared to encourage cross-referencing in long-term memory would be beneficial. Recognizing that materials could be designed to enhance specific judgment strategies provides some guidelines for design. Such designs could encourage students to retrieve information from long-term memory and cross-reference it for more efficient retrieval at a later date.

**Technology in Nursing Education**

The implementation of technology in nursing education has lagged behind the capabilities of the media available. As demonstrated in this study, the computer can supplement or complement instruction appropriately. Faculty need to become more familiar with the availability and applications of technology to utilize it effectively. Computer programs and interactive videodisc programs demonstrate much promise for nursing education. The video portion
of interactive video is especially helpful for extending clinical experience.

Technology must be used to be effective.
REFERENCES


APPENDIX A

Examples of Nursing Diagnoses from NANDA
5.1.1.1 COPING, INEFFECTIVE
INDIVIDUAL
Definition
Impairment of adaptive behaviors and problem solving abilities of a person in meeting life's demands and roles.

Defining characteristics
* Verbalization of inability to cope or inability to ask for help; inability to meet role expectations; inability to meet basic needs; inability to solve problems; alteration in societal participation; destructive behavior toward self or others; inappropriate use of defense mechanisms; change in usual communication patterns; verbal manipulation; high illness rate; high rate of accidents.

Related factors
Situational crises; maturational crises; personal vulnerability.

1.5.1.2 AIRWAY CLEARANCE, INEFFECTIVE
Definition
A state in which an individual is unable to clear secretions or obstructions from the respiratory tract to maintain airway patency.

Defining characteristics
* Abnormal breath sounds (rales [crackles], rhonchi [wheezes]); changes in rate or depth of respiration; tachypnea; cough, effective/ineffective, with or without sputum; cyanosis; dyspnea.

Related factors
Fatigue/decreased energy; tracheobronchial infection, obstruction, secretion; perceptual/cognitive impairment; trauma.
APPENDIX B

Diagnostic Strategies:

The Novice and The Expert
Table 4-1
Diagnostic Strategies: The Novice and the Expert

<table>
<thead>
<tr>
<th>Phase of Diagnostic Process</th>
<th>Novice</th>
<th>Expert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrowing the Search Field</td>
<td>1. Stereotypes on basis of pre-encounter information</td>
<td>1. Uses pre-encounter data to expedite early directed data search. Validates with data in presenting situation</td>
</tr>
<tr>
<td></td>
<td>2. Uses general systematic search; relies on memory of past experiences to narrow search field</td>
<td>2. Begins with general systematic search to avoid premature narrowing</td>
</tr>
<tr>
<td></td>
<td>3. Looks for data that confirm pre-encounter influence</td>
<td>3. Looks for data which differ from pre-encounter expectations</td>
</tr>
<tr>
<td></td>
<td>4. May miss patterns in cues</td>
<td>4. Recognizes patterns in cues</td>
</tr>
<tr>
<td></td>
<td>5. Does not realize full information value from cues to narrow search field</td>
<td>5. Extracts maximal information from cues to narrow search field</td>
</tr>
<tr>
<td>Hypothesis Activation</td>
<td>1. Uses single cues to trigger hypotheses</td>
<td>1. Uses cue patterns/clusters as triggers for hypotheses</td>
</tr>
<tr>
<td></td>
<td>2. Hypotheses are very global or very specific; level of specificity may not fit data</td>
<td>2. Seeks hypotheses at level of abstraction necessary to explain as much of the data as possible</td>
</tr>
<tr>
<td></td>
<td>3. May ignore or forget cues that do not fit hypotheses</td>
<td>3. Holds in reserve for later exploration cues that cannot be “chunked” into the hypotheses activated</td>
</tr>
</tbody>
</table>

| Information-seeking | 1. Uses hypothesis testing to a limited degree | 1. Uses hypothesis testing efficiently and more thoroughly than novice |
| | 2. Usually uses routine general questioning strategy when stumped | 2. Uses routine general questioning strategy when stumped and as a means to avoid premature closure |
| | 3. Uses cue characterization or data-driven searches as primary approach | 3. Uses cue characterization as a means to test or refine hypotheses |
| | 4. Has difficulty shifting focus of search and strategy | 4. Can shift focus and strategy with great facility |
| | 5. May be uncomfortable validating with client | 5. Validates with client |
| Hypothesis Evaluation | 1. Uses recency of experience and availability to assess likelihood of hypothesis | 1. Uses more reliable sample (wide range of experience) to assess likelihood |
| | 2. Nonselective in data obtained | 2. Uses data with greatest information value |
| | 3. Tends to gather either too much or too little data depending on initial probability | 3. Efficient in data gathering and hypothesis evaluation |
| | 4. Underestimates value of disconfirming data and overestimates value of confirming data | 4. Information value less influenced by confirming/disconfirming nature |
| | 5. Tendency toward premature closure on favored hypothesis | 5. Recognizes the importance of avoiding premature closure |
APPENDIX C

Factors Influencing the Diagnostic Process:

Comparison of the Novice and Expert
<table>
<thead>
<tr>
<th>Factor</th>
<th>Novice</th>
<th>Expert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perception of Task</td>
<td>1. May not recognize probabilistic relationship between cues and diagnosis</td>
<td>1. Recognizes fallibility of cues as indicators of diagnosis</td>
</tr>
<tr>
<td></td>
<td>2. Observations and inferences are treated equally</td>
<td>2. Seeks multiple, dependable, and redundant cues to make inferences</td>
</tr>
<tr>
<td></td>
<td>3. Once recognizes probabilistic relationship, may seek only highly dependable data</td>
<td>3. Weighs risk to patient before seeking more dependable data</td>
</tr>
<tr>
<td></td>
<td>4. Little tolerance for uncertainty in diagnosis</td>
<td>4. High tolerance for uncertainty</td>
</tr>
<tr>
<td>Use of Experience</td>
<td>1. Little range and depth of experience</td>
<td>1. Wide range and more depth of experience</td>
</tr>
<tr>
<td></td>
<td>2. Limited experience is used to assign probabilities</td>
<td>2. Experiential sample is more likely to be adequate so chance for bias is reduced</td>
</tr>
<tr>
<td>Long-term Memory</td>
<td>1. Categories and subcategories are formed but are limited in number and capacity</td>
<td>1. Hierarchical organization of categories and subcategories</td>
</tr>
<tr>
<td></td>
<td>2. Linkages between categories are few</td>
<td>2. Complex network of linkages between categories</td>
</tr>
<tr>
<td></td>
<td>3. Single cues associated with diagnostic categories</td>
<td>3. Multiple cues and cue patterns cross-referenced to multiple diagnostic categories</td>
</tr>
<tr>
<td></td>
<td>4. Retrieval may be in form of “memorized lists” triggered by a category label</td>
<td>4. Retrieval demonstrates complex network, triggered by category label, subcategory cue, or cue pattern (including risk factors as well as manifestations of problem)</td>
</tr>
</tbody>
</table>

APPENDIX D

Consent Form
I consent to participating in (or my child's participation in) research entitled:

Cognitive Strategies of Female Nursing Students Using Computer Simulation Individually and in Dyads to Identify a Nursing Diagnosis

Marjorie A. Cambre, PhD or his/her authorized representative has (Principal Investigator)

explained the purpose of the study, the procedures to be followed, and the expected duration of my (my child's) participation. Possible benefits of the study have been described as have alternative procedures, if such procedures are applicable and available.

I acknowledge that I have had the opportunity to obtain additional information regarding the study and that any questions I have raised have been answered to my full satisfaction. Further, I understand that I am (my child is) free to withdraw consent at any time and to discontinue participation in the study without prejudice to me (my child).

Finally, I acknowledge that I have read and fully understand the consent form. I sign it freely and voluntarily. A copy has been given to me.

Date: 10/27/90 Signed: ____________________________ (Participant)

Signed: ____________________________ (Principal Investigator or his/her Authorized Representative)

Signed: ____________________________ (Person Authorized to Consent for Participant - If Required)

Witness: ____________________________________________

HS-027 (Rev. 3/67) --(To be used only in connection with social and behavioral research.)
APPENDIX E

Computer-Based Case Simulations

NURS-CAPS
Set 1 — Older Adults in Surgical Settings
1. Mary Dunn — Ineffective Airway Clearance
2. Charles Crane — Sensory-Perceptual Alteration
3. Fred Weatherby — Ineffective Individual Coping

Set 2 — A Complete Surgical Nursing Care Cycle
1. Ruth Morris — Part I — Anxiety Related to Surgery
2. Ruth Morris — Part II — Impaired Tissue Integrity
3. Ruth Morris — Part III — Impaired Mobility
4. Ruth Morris — Part IV — Alteration in Nutrition
5. Ruth Morris — Part V — Impaired Home Maintenance
APPENDIX F

Demographic Sheet
ID #  

Name _____________________________________________

Age ____________________

Current GPA ________

How much experience have you had using computers? Please explain amount and type of use.

Courses you have had: (check)

_____ Health Assessment

_____ Nursing Process

_____ Sophomore Clinical

What other clinical courses have you had?

Do you have a job? Does it involve nursing care? Please describe.
APPENDIX G

Session Summary Sheet
SESSION SUMMARY SHEET

ID # ___________ Individual / Dyad

Date completed __________

Where CAI completed:

Conditions of room at data collection time

Distractions:

Interactions of students:

General feeling tone during completion of program:

Student response to simulation:

Problems with equipment:

Comments:
APPENDIX H

Interview Questions
INTERVIEW QUESTIONS

1. Looking at your printout of choices made in the program, please tell me briefly why you chose each indicator and diagnosis.
   (Review each choice and write why student states she chose it.)

2. Reflect on how you went about determining the nursing diagnosis and why.

3. How do you usually determine a nursing diagnosis?
   (how do you proceed?)

4. How is this the same or different as you do on the clinical unit?

5. If you were doing this study as an individual/dyad would you do it differently?

6. What did you like about the program?

7. What did you dislike about the program?
APPENDIX I

Example of Raw Data
Individual/Non-Classic

Simulation Summary
Behavior Trace
Transcript
The correct nursing diagnosis is usually stated in this format:

**Sensory-perceptual alteration:**
visual input deficit r/t decreased vision.

As is customary, the nursing diagnosis is constructed so that the first part of the statement is the client problem and the second is the etiology.

This older male adult is at risk for falls and confusion related to changes in the amount, character, and interpretation of incoming visual stimuli. Stimuli are decreased and altered due to the eye patch and shield on the left eye, poor vision in the right eye, and the decreased light in the room because of the drawn curtain between the beds.

Sensory-perceptual alteration is the problem which should be the focus of nursing attention. Solution of other problems will follow as this one is resolved. Mobility and self-confidence will increase as Mr. Crane copes more effectively with his current visual restrictions (especially due to the eye patch which will be worn for several days), and his, hopefully, improved vision as a result of his surgery. Clients also profit from information (which may have to be given repeatedly) about the expected duration of various treatments and reassurance that improvement will occur in the not-too-distant future.

Mr. Crane's reduced environmental stimuli are a primary concern. Assessment should include: an eye exam to detect amount and type of vision; an activity assessment/exam including ADL status to determine the limitations placed on his activities by his lack of vision; a self-concept assessment to determine Mr. Crane's view of the problem; and a coping/stress management assessment to determine how he copes with problems. An assessment of discharge plans would provide information for planning home care follow-up.

In an objective assessment, it was found that Charles Crane's vision is significantly limited because of the patch on the left eye and impaired vision in the right eye. He especially has difficulty seeing in dim light or darkness. As a result of his decreased vision, he has difficulty with his ADLs. He can eat independently but needs to have food identified for him. He requires assistance to the bathroom since he sometimes loses his sense of direction in the darkened room. Charles Crane is able to bathe independently except for his legs. He needs verbal cues in transfer from bed to chair and is sometimes unsteady.

In a subjective assessment, Mr. Crane asks, "When does this patch come off? It bothers me so that I can't see clearly." He also comments that he wonders how he will get along at home when his wife works. Frequently Mr. Crane asks the nurse about the source of the noises in the hall.

Thus, it becomes clear that nursing care which deals with the sensory-perceptual alteration as the primary diagnosis will solve many of the problems of Charles Crane. The nurse will deal with the problems created by decreased vision and will help the client cope with hospital environment and discharge concerns.

Mr. Crane was hospitalized for his surgery because of his compromised respiratory status. Most cataract surgery is done in an ambulatory surgical setting. Hospitalization is suggested for those with medical conditions that could influence the positive outcome of the procedure.
Behavior Trace - Indiv. 13
Case: Charles Crane

Chart:
  Physicians History
  RN Progress Notes
  Post-op Orders

Lungs - chest exam (A)

Eye
  NANDA list - no dx. -- back to assessment

Back to eye
  NANDA list - paging

Back to chart
  Progress notes
  Dr. orders
  Lab
  Nursing Admission Hx.

NANDA list - chose Activity Intolerance - Not highest

Hints - assessments
  Activity/exercise assessment

Discharge
  Hints: Diagnoses

Activity/exercise review
  NANDA list - chose self-care deficie - not highest
  NANDA list - Chose correct dx. - Sensory perceptual alteration
Individual #13 - Charles Crane

R = Researcher

[reading introductory comment about patient]
R: So what went through your mind as you read that short comment about the patient?

Just to see what’s on his chart.
I want to look at the assessment on the chart.
Usually when I go on the floor I go to the chart first.
Get a name and get the chart.
Is this where I type in?
R: Push the arrow.
[reading chart - Dr. Hx., RN progress notes, post-op orders]
R: Is there anything that made an impression?

Well, the beginning it spoke of the emphysema more so than the cataracts. That’s the doctor. In the physician notes he really seemed to emphasize the cataracts.
So, I’m more looking at the lungs, but I may change to the eye.
[reading chart]
Would lungs be one?
R: Try it.
[lungs/ chest exam]
R: So what were you thinking there when you decided to choose chest or lungs?

Chest or lungs... Uumm... Just where his lungs were basically.
You know... OK.
[reading - eyes]
I think I am ready to make a diagnosis.
I think....
R: What are you thinking now?
Ummm. Something about the eye, I’m not sure... Ahhmm... what. The vision problem with daily activities of daily living kinda thing. I can’t think of the wording.
[MANDA list]
R: What are you thinking?
I’m looking at self-care deficit and
whether that comes into play.
Feeding-- I don't think that
would be a problem. Bathing and
hygiene-- I was thinking more of
as getting around. So I don't
really see anything here yet.
AAA. Self-care deficit-- dressing
and grooming. I would ... wouldn't
... Are these potential here?
R: If that was the most important here.
Oh, I see. OK. I'm also thinking now
that I should go back and look
at something else.
R: You can do that.
OK. Let me see. Chest exam was OK. so...
Lets go to F4 again. Lets go back
to the eye. [Reviewed eye]
R: Tell me what you are thinking while
you are looking.
I'm looking for something that... I did
see impaired vision in R eye.
Something that would help me to
decide which nursing diagnosis
exactly about the eye as far as
self-care, activities of daily
living.
I'll just go back to the nursing
diagnoses and see. Now they
start all over?
R: Yes, you can page through.
[Paging NENDA]
R: What thoughts did you have?
Still self-care deficit. But,
still looking at that. I
would say maybe dressing
and grooming.
Let's see... let's see here. Let me
go back here. Chart. How
do I get back to the menu
that I had in the very beginning?
R: You want the chart.
Yes, that's what I want. I want to
look at the nurse's admission.
Naa. I don't think I need that.
I already looked at the RN
progress notes -- I want to look
at that again.
Hmm.
R: Do you have any ideas for now?
Not really. It just seems that in
the progress notes he's doing
pretty well on his own. I don't
see any self-care deficit now.
I would think because of the
vision...that's what led me to self-care deficit. The vision problem. Look at Drs Orders again. See what he says. OK.

OK. Didn't see anything.

OK. This one is not easy. Let's look at the lab just to say we looked at it. [chuckling]

OK. OH. Fiddle-faddle.

R: What does that mean?

[laugh] I'm not...I was going to a self-care deficit but now that I look at other things maybe that is not a priority. You know...you initially decide..... Cause he seems to be doing fine. See what the nurses saw.

[reading]

Now I am thinking maybe activity intolerance because of the emphysema and the eye. So I think I saw that in here. I'm going to go back and see.

[NANDA list]

They don't have the related to ss. Well, we'll see.

OK. [Act. Intol--not highest]

R: So, that is not a priority. What are you thinking?

Well, OK. It is not a priority and you reviewed the data.

I'll go to hints and see what they say. I'll go assessment. OK. I got that done. I'll try the exercise assessment. Do I type that in here?

R: You go back to F3 and type.

OK. Activity/exercise. That's not right. [spelling]

[reading]

Well, definately this looks like my first one. What was my first one...aaaa.. Self-care deficit. Basically.

AAAAm. I'm no good with self-care deficit again.

R: So what are you thinking.

Well, self-care deficit but... like... Self-care deficit or is it... he needs assistance. See he can be independent but he needs like someone there to help him as far as putting things somewhere where he can get it. I don't see..
OK. Let's see.
Ohhh, my meter is out. [went to put money in meter] On my way I'll think.
Maybe I should look at the discharge since they had that up there.
Maybe he's ready to be discharged and that can help me with some of the things. If he has some problems maybe it will say what his family needs to help him with, too.

[Discharge - reading]
Does abnormal mean something?
That's the help.
R: Yes.
R: Does that help any? What are you thinking about?
Yea. At first I didn't think he had a coping problem, but reading this maybe he has. Hmm. Anx...I don't know if it's coping. He seems to be anxious about whether or not he'll be able to function on his own...do this all on his own.
So, I thought I'd go back and look at hints and see what they said here.
Try B [Diagnoses section of hints]
R: That's the list of diagnoses you might consider. What does it make you think about?
That maybe self-care deficit was in the right track. AAA. Do you just pick one...it wouldn't be a combination?
R: Yes, just pick one.
OK. I see an anxiety. Let's try....
R: What are you thinking?
Which one to pick. Actually, where should I go next is what I am thinking. Well, the anxiety one...that seems to be more when he goes home. I wouldn't pick that as priority. I am going to go back to aaa...assessment, I think. Activity and exercise...I want to see that again. That should help me.
OK. I think, maybe, self-care deficit related to feeding. If he doesn't eat then the rest of...he needs the nutrition. He's getting DSW I think. Hmm.
Well, I am ready to make a diagnosis, I think. [chuckle]
[NANDA list]
Self-care deficit -bathing. Hmm. Well, let's see.
R: That tells you that they don’t look at that as the highest priority. What do you think?

Well, something else must be. Something that I am not getting from the whole assessment. Something somewhere, but I still think it’s self-care deficit. But then I don’t know, cause .... lets see. [reading explanations]

All right. OK. So that’s what you mean by not being able to feed...OK

Fine...[reading] Yes, I agree.

Hm. OK.

R: What do you think after reading that?

Sensory perceptual alteration....Maybe I missed that in the whole thing. Definitely that’s the problem.

[chuckle] I guess I didn’t focus on that but if you clear up the sensory perceptual problem .. his sensory problem.... or help him in any way then all the other things will fall into place.

So, I am going to go back and see what diagnosis I can come up with here. [NANDA list] exchanging.... This is it.

R: Keep pushing the arrow.

Oh, there it is. I didn’t see that before.

[chuckle] Why didn’t I see that?

Of course, I would have picked..... I don’t know why I didn’t see that. I mean that’s the main problem. I guess I didn’t go further.....

R: So that makes sense?

Yes, very much so.
APPENDIX J

Example of Raw Data
Dyad/Classic

Simulation Summary
Behavior Trace
Transcript
SUMMARY COMMENT FROM SIMULATION

The correct nursing diagnosis is usually stated in this format:

Anxiety r/t impending surgery

As is customary, the first part of the statement is the client problem and the second part relates to etiology.

This elderly client demonstrates objective evidence of sympathetic nervous system stimulation with subjective complaints indicating an overwhelming feeling of unease which together could be either anxiety or fear.

Fear was ruled out in favor of anxiety because Mrs. Morris mentioned surgery, pain, not being able to manage, and so forth related to her impending intraoperative and postoperative experience but she was not able to specifically cite the source of her apprehension. The main difference between fear and anxiety is that, with fear, the person can identify a specific threat, but with anxiety, the person cannot accurately identify a specific threat.

Although Mrs. Morris has several other nursing diagnoses, her anxiety is most important at this time. Her anxiety related to the surgical experience, for example, must be dealt with before her mobility or hip discomfort can be improved by surgical means. Also, her discomfort and decreased mobility must be dealt with before other problems can be resolved, e.g., self-care deficits in dressing and bathing, diversional deficit, activity intolerance, and altered role performance.

As in Mrs. Morris' case, assessment for anxiety must elicit physiological, emotional, and cognitive signs and symptoms which objectively and subjectively support the diagnosis. Additionally, in order to make the diagnosis of anxiety, the client must not be able to identify a specific source of dread.

We could be certain that Mrs. Morris had reduced her anxiety if she stated that she was feeling decreased anxiety/apprehension/dread (or an increased level of psychological comfort), and if she exhibited a decrease in objective signs of sympathetic nervous system stimulation. These two areas constitute desired outcomes for this client.

Mrs. Morris needs to recognize her feelings of anxiety. She should be taught relaxation techniques and preoperative teaching should be initiated. Her anxiety level should then be reassessed. After teaching, she should state that her anxiety has decreased (or that her psychological comfort has increased), and she should demonstrate a decrease in sympathetic nervous system stimulation (e.g., systolic B/P < 140, pulse < 80, respirations < 24. Her two friends might be called upon as support persons for her if additional measures are needed to reduce anxiety.
Behavior Trace - Dyad 14
Case Study: Ruth Morris - Part I

Chart: Nursing history
Physician history and physical
Lab data

Vital Signs (A)
Pain Assessment
Skin Assessment

Mobility -- Activity/exercise assessment
Range of Motion -- Activity/exercise assessment
Cardiovascular
Elimination
Chest exam

Social support - family: social
Musculoskeletal - Activity/exercise Assessment

Diagnosis: Alteration in Comfort - Pain
(Not highest)

Hints: Diagnoses in the case

Diagnosis: Mobility (not highest)

Diagnosis: Tissue Perfusion (not highest)

Hints: Assessments in the case

Diagnosis: to NANDA list
not make a diagnosis

Neuro assessment (A)

Diagnosis: Anxiety (Highest)
DYAD #14 --Ruth Morris --Part 1

R = Researcher

[reading initial description]
H: She’s scheduled for surgery. That’s something to remember.
H: Do you want to assess her or go to the chart?
J: Let’s go to the chart.
J: Let’s just go through them all?
H: Yea. That’s good.

<reading chart - nursing admission>
J: Social support might be important.
   (lives alone, husband died)
J: Two close friends come to visit.
H: Blood pressure up.
J: Hum-hum.
H: Her temperature is all right. She seems to be within her weight.
J: Could be like dehydration type things. She’s using the bedpan a lot.
H: Or she could have oxygenation problems.
<reading>
H: Want to continue with the chart.
J: Yea.
R: What kind of things are you thinking?
J: Everything is pretty normal except for her rheumatoid arthritis in her hip. Her vital signs.
H: B? <physician’s notes>
J: Yea.
J: She’s a little bit pale.
H: Her history isn’t really anything abnormal.
J: Yea.
H: Pain control.
<reading physician notes>
H: Want to look at her lab data?
J: Yea.
H: I never remember the normal of these. Hemoglobin.
   Hematocrit.
J: Pretty good. A little low.
H: Platelet cells fine. WBC fine. RBC little low.
<to assessment section>
H: Could have a UTI.
J: Want to do VS.
H: Sure.
[vital signs]
H: No. Nothing.
   See next page.
   B/P and pulse elevated.
   Could be elevated because of pain.
R: You don’t answer the question on the computer.
   Answer it for yourselves.
H: OK.
[pain assessment]
J: Want to do skin assessment?
H: Yea.
H: Do we just need to type in skin?
R: Yes.
[skin assessment]
J: What about a a a... 
H: Mobilization?
J: Yea. Then R.O.M., I don't know.
[activity/exercise assessment]
H: Activity.....
J: Try R.O.M.
[activity/exercise assessment]
H: We did pain.
R: What are you thinking?
J: Well, I am thinking mainly of her hip as the cause
of her problem right now. But you also need to
think about a a a stuff to assess before she goes
to surgery. So, we need to... like fluid volume
status.
H: Cardiovascular. See her blood pressure....
J: OK.
[cardiovascular exam]
H: What... fluid volume?
J: Yea.
R: Try elimination.
[elimination assessment]
J: Let's see. We did skin. Lungs...
H: That's probably under respiratory. It's chest.
[chest exam]
Do you want to check social?
J: Support?
R: Try social. [asks if want family social]
H: Try family social.
J: They are physically unable to help her with care.
H: That's the one we had before.
J: OK.
H: How can we find out additional support ... like when
she goes home.
J: Her friends really can't help her.
H: We looked under support.
H: Let's try an assessment of musculoskeletal.
Is that how you spell it?
J: That looks good.
H: It's the same thing....activity/exercise.
J: Have we done everything?
R: What are you thinking now?
J: I am ready to make the diagnosis.
H: I think so. I want to think about who's going to
take care of her after she's home.
J: But right now the main thing is the pain and the
immobility, I think.
J: Let's go to diagnosis and see.

<NANDA LIST>

J: None of those.
H: She could have a potential for injury.
J: But we have to make the priority.
H: OK.
J: That's probably not the priority.
H: Keep going. Nope.
J: That wouldn't be a priority. Social might be.
H: In a way, she's isolated from her daughter.
    No one is there to help her. Mobility would be top priority as far as with
    surgery and stuff.
J: Mobility... activity.
H: Are we going to do mobility or are we going
to do pain?
J: I think we should do pain...cause like you said
    that's probably why her vital signs are up...
    because of the pain level. Response to the pain.
    Or do you want to do mobility?
H: I think pain goes with it. This is a definite
decision. The mobility has a lot to do with it.
    If it's between mobility and activity intolerance
    I would like the activity intolerance.
J: Are you going to put pain above mobility or mobility
above pain?
J: What if we don't agree?
H: We can go back.
    Does REV mean we can review stuff?
R: Yes.
H: We can go back and look at her pain again.
J: Yea, she said she complained of severe pain.
H: On weight bearing.
J: Yea. I think pain...
H: That would cause her not to walk.
J: Yea. I think pain is a possibility because she can
    still get around with her walker. She needs a
    walker to get around but she can still get
    around. It's not like she was bedridden.
H: Yea. Cause it would be like pain...if she didn't
    have that she may be more apt to walk.
    We can try it.
H: There we go. <picked pain>
J: Not the highest priority. You assessed the client
    fully enough to rule out the diagnosis.
H: She's not having constant pain. It's just with
    movement.
J: So it's telling us that we assessed the client
    enough that we shouldn't have picked that
category?
R: Yes. They are telling you that's not the highest.
J: Let's go....
H: Do you want to review something or do you want....
J: Let's try that hints category.
H: Sure. We can look at that... Which one do you want to look at?
J: The diagnosis.
R: Those are all the diagnoses in the case. They are not in order of importance.
J: And one of them is the priority?
R: Yes.
J: Not sexual.
H: I wouldn't say ineffective airway clearance. Urinary elimination... either that or potential for injury.
J: Yea.
H: Could be activity.
J: OK. Let's go back to the other page.
H: It's one of those.
J: Physical mobility... potential for injury. Well, you don't put potentials before actuals.
H: Yea. This is probably the one time there's an exception.
J: AAmm. I still think it's impaired physical mobility.
   Let's try that one.
H: What are you thinking?
J: Well, I'll have to argue if that's the highest?
H: Before we pick it, what do you think it is?
J: Well, I thought pain was. Oop, you passed it. There it is.
H: It probably isn't. (mobility - not highest)
J: It's got to have something to do with the vital signs... why they are off.
   Course that could be related to... just like anxiety of being in the hospital. She's now in there anxious about surgery. Anxious and nervous.
   We could try that one but they've always told us physical before psychological... right.
   That could be.
H: There could be infection.
J: I don't know.
H: It's necrotic. That could be potential. . . .
   Like you said... should be an actual.
   Tissue Perfusion. I wonder if it's that?
J: Or volume.
H: Oh, I'm thinking tissue perfusion. She had clubbing in her nails, she's pale.
   Wouldn't that also include her blood pressure and stuff?
   It could alteration in perfusion.
J: Yea. And that... that could even be related to the... the skin turgor. It's dry and wrinkly or something. OK. Let's try that one.
   (chose tissue perfusion)
H: Not the highest priority.
J: Let's go to the hints. Did we do all those?
H: We did the nursing diagnosis.
J: Let's do the first one. (assessments)
   Neuro?
H: We might as well try it.
R: You have to go back to F3.
H: OK.
J: I think we did everything else.
   <Neuro assessment>
J: She can't bear weight on her hip. Focusing on
   surgery...uncertainty. OK.
   <Paged for neuro comment>
H: Oh, here we go. It's definitely anxiety.
   Never had surgery before.
J: OK. Let's make a diagnosis.
   <NANDA list>
H: She definitely has an anxiety towards it.
   Do you want to review the diagnoses?
J: Yea. See what they are.
   They're like clear on the last page, I think.
   Cause that seems like it to me.... from the
   paragraph.
H: That seems like a big concern of hers.
J: Want to go back to like... neuro and review?
H: Could be coping.
J: Now is she fearful or is she anxiety?
   Well... she has fear.
H: That leads to her anxiety.
J: She’s never been here before.
H: Do you want to try fear?
J: Well, it’s a toss up really.
   Didn't it say something about her inadequacy?
H: Let's look again.
   <neuro assessment>
H: Uncertainty, inadequacy, and distress.
J: She’s not sure how she’ll be able to manage.
H: Getting pretty jittery about this surgery thing.
J: Does seem like signs of anxiety more than fear.
H: Doesn't really say...I'm afraid.
   Yea, I would say anxiety more than fear.
   <NANDA list>
J: If that's not it.... we give up.
J: Want to try that?
H: Yea.
   {Anxiety}
J: Good.
H: Well done!
J: We should have done that to begin with. If we would
   have thought to look at neurological, we would have
   seen that.
APPENDIX K

Example of Raw Data with Coding
[reading introductory comment about patient]
R: So what went through your mind as you read that short comment about the patient?
Just to see what’s on his chart.
I want to look at the assessment on the chart. Usually when I go on the floor I go to the chart first. Get a name and get the chart.
Is this where I type in?
R: Push the arrow.
[reading chart — Dr. Hx., RN progress notes, post-op orders]
R: Is there anything that made an impression?
Well, the beginning it spoke of the emphysema more so than the cataracts. That’s the doctor. In the physician notes he really seemed to emphasize the cataracts.
So, I’m more looking at the lungs, but I may change to the eye.
[reading chart]
Would lungs be one? Chest Exam
R: Try it.
[lungs/chest exam]
R: So what were you thinking there when you decided to choose chest or lungs?
Chest or lungs... Uumm... Just where his lungs were basically.
You know... OK.
[reading eyes]
I think I am ready to make a diagnosis.
I think....
R: What are you thinking now?
Umm... Something about the eye, I’m not sure... Ahhmm... what. The vision problem with daily...
ACTIVITIES OF DAILY LIVING
Kinds of thing. I can’t think on the wording.
[HANDICAP]
R: What are you thinking?
I’m looking at self-care deficit and whether that comes into play.

Hypothesis Activation
(Possible Do)
Eye — Vision

Hypothesis Activation
Self-care
Feeding— I don’t think that
would be a problem. Bathing and
hygiene— I was thinking more of
aaa getting around. So I don’t
really see anything here yet.

AAA. Self-care deficit— dressing
and grooming. I would ...wouldn’t
...Are these potential here?

R: If that was the most important here.
Oh, I see. OK. I'm also thinking now
that I should go back and look
at something else.

R: You can do that.
OK. Let me see. Chest exam was OK. so.
Let's go to F4 again. Let's go back
to the eye. [Reviewed eye]

R: Tell me what you are thinking while
you are looking.
I'm looking for something that...I did
see impaired vision in R eye.
Something that would help me to
decide which nursing diagnosis
exactly about the eye as far as
self-care, activities of daily
living.

I'll just go back to the nursing
diagnoses and see. Now they
start all over?

R: Yes, you can page through.
(Paging NANDA)
R: What thoughts did you have?
Still self-care deficit. But...
still looking at that, I
would say maybe dressing
and grooming

Let's see...let's see here. Let me
go back here. Chart. How
do I get back to the menu
that I had in the very beginning?

R: You want the chart.
Yes, that's what I want. I want to
look at the nurse's admission.
Naa. I don't think I need that.
I already looked at the RN
progress notes -- I want to look
at that again.

Hmm.

R: Do you have any ideas for now?
Not really. It just seems that in
the progress notes he's doing
pretty well on his own. I don't
see any self-care deficit now.
I would think because of the
vision...that's what led me to
self care deficit. The vision problem. Look at Drs Orders again. See what he says. OK.

OK. Didn't see anything.

ODD. This one is not easy. Let's look at the lab just to say we looked at it. [chuckling]

OK. OH. Fiddle-faddle.

R: What does that mean?

[laugh] I'm not... I was going to a self-care deficit but now that I look at other things maybe that is not a priority. You know... you initially decide.... Cause he seems to be doing fine. See what the nurses saw.

[reading]
Now I am thinking maybe activity intolerance because of the emphysema and the eye. So I think I saw that in here. I'm going to go back and see.

[NANDA list]
They don’t have the related ss.

Well, we'll see.

OK. [Act. Intol.--not highest] Diagnosis Made Not Highest

R: So, that is not a priority. What are you thinking?

Well, OK. It is not a priority and you reviewed the data.

I'll go to hints and see what they say. I'll go assessment. OK.

I got that done. I'll try the exercise assessment. Do I type that in here?

R: You go back to F3 and type. OK. Activity/exercise. That’s not right. [spelling]

[reading]
Well, definetely this looks like my first one. What was my first one...aaaah... Self-care deficit. Basically...

AAAAA. I’m no good with self-care deficit again.

R: So what are you thinking.

Well, self-care deficit but... like...

Self-care deficit or is it... he needs assistance. See he can be independent but he needs like someone there to help him as far as putting things somewhere where he can get it. I don't see... [reading] OK. Let's see.
OHhh. My meter is out. [went to put money in meter] On my way I’ll think. Maybe I should look at the discharge since they had that up there. Maybe he’s ready to be discharged and that can help me with some of the things. If he has some problems maybe it will say what his family needs to help him with. so...

[Discharge -reading]

Does abnormal mean something?

That’s the help.

R: Yes.

R: Does that help any? What are you thinking about?

Yea. At first I didn’t think he had a coping problem, but reading this

maybe he has. Hmm. Anx... I don’t know if it’s coping. He seems to be anxious about whether or not he’ll be able to function on his own... do this all on his own.

So, I thought I’d go back and look at hints and see what they said here.

Try B [Diagnoses section of hints]...

R: That’s the list of diagnoses you might consider. What does it make you think about?

That maybe self-care deficit was in the right track. Hmm. Do you just pick one... it wouldn’t be a combination?

R: Yes, just pick one.

OK. I see an anxiety. Let’s try....

R: What are you thinking?

Which one to pick. Actually, where should I go next is what I am thinking. Well, the anxiety one... that seems to be more when he goes home. I wouldn’t pick that as priority. I am going to go back to assessment, I think. Activity and exercise... I want to see that again. That should help me.

OK. I think, maybe, self-care deficit related to feeding. If he doesn’t eat then the rest of... he needs the nutrition. He’s getting D5W I think.

Hmm.

Well, I am ready to make a diagnosis. I think.

[chuckles]

[NANDA list]

Self-care deficit - bathing. Hmm. Well, let’s see.

[chuckles] No highest.

Diagnosis Made

Not Highest
R: That tells you that they don’t look at that as the highest priority. What do you think?

Well, something else must be. Something that I am not getting from the whole assessment. Something somewhere. But I still think it’s self-care deficit. But then I don’t know; cause ....lets see. [reading explanations] All right. OK. So that’s what you mean by not being able to feed...OK. Fine...[reading] Yes, I agree. Hmm. OK.———

R: What do you think after reading that?

Sensory perceptual alteration... Maybe.

[I missed that in the whole thing. Definitely that’s the problem. [chuckle] I guess I didn’t focus on that but if you clear up the sensory perceptual problem... his sensory problem.... or help him in any way then all the other things will fall into place.]

So, I am going to go back and see what diagnosis I can come up with here. [NANDA list] exchanging.... This is it.

R: Keep pushing the arrow.

Oh, there it is. I didn’t see that before. [chuckle] Why didn’t I see that? Of course, I would have picked.... I don’t know why I didn’t see that. I mean that’s the main problem. I guess I didn’t go further....

R: So that makes sense?

Yes, very much so.
APPENDIX L

Summary Sent to Subjects
Date: June 1, 1991
To: Research Subjects
From: Linda J. Castner
Re: Member Check

Thank you so much for your participation in my Doctoral research study.

Enclosed you will find a summary of the findings and some interpretations of the data. Please comment in the right-hand column (either negative or positive comments) and return to me in the enclosed envelope. All returns are confidential.

Thanks again. Have a great summer!
MEMBER CHECK

Introduction

In this study emphasis was on identifying strategies that female nursing students use to determine a nursing diagnosis and identifying factors influencing this strategy. Nursing diagnosis case studies were completed individually and in pairs using a computer simulation. The sample consisted of 5 Junior individuals, 5 Junior pairs, 5 Senior individuals, and 5 Senior pairs for a total of 30 students.

Demographics

Age range: 20 - 44 years
GPA range: 2.18 - 3.85

Computer experience:
Ranged from no computer experience to frequent computer use. Word processing most frequent use.

Jobs:
Juniors: 13 of 15 work in medical/nursing oriented jobs.
Seniors: 13 of 15 work;
12 of 15 work in medical/nursing oriented jobs.

Review of Transcripts for Strategies

Audio-taped transcripts were transcribed and reviewed for strategies and patterns of strategies. After reading and studying all of the transcripts, the coding categories from Tanner and Carnevalli were adopted for use. These cognitive strategies include:

Narrowing the Search Field
A. Pre-encounter influences
   (chart, life experiences, orientation)
B. Data gathering -- assess cues
C. Cue clustering
Hypothesis Activation
Guided Search
   (Gather data to test hypothesis)
Explore, confirm, eliminate, discriminate
Hypothesis Evaluation — Goodness of fit

Transcripts were coded to indicate use of these strategies.

FINDINGS

All students in the study (indiv. and pairs) used this basic strategy to determine a nursing diagnosis. The strategies ranged from a minimum of data gathering and guided search to an expanded strategy with cue clustering and guided search activities.

Junior Individuals

3 of 5 subjects demonstrated little cue clustering and guided search activities in their strategies. Early diagnoses were triggered by single cues. Pre-encounter influences (chart/life experiences) guided decisions.

2 subjects made an early diagnosis of the correct problem area but had some difficulty matching NANDA definitions/defining characteristics. They used cue clustering and guided search strategies.

Junior Pairs

3 of 5 pairs followed the "classic" strategy format meaning that they followed the general strategy approach. They did cue clustering and guided search activities including confirming and elimination strategies.

1 pair used a less systematic approach — shifting strategy/focus frequently. Pre-encounter work experiences influenced decisions. They used some confirming, disconfirming, and exploration strategies.

1 pair used a systematic approach with little cue clustering. They used guided search — confirming strategy.

Pairs demonstrated less difficulty with NANDA def/characteristics. They discussed def. and defining characteristics.
All pairs did early diagnosis.

Senior Individuals
All subjects used all parts of the general strategy in varying amounts. All made early diagnoses preceded by cue clustering. All used guided search activities including exploration, confirmation, and elimination. One subject used discrimination strategies. Pre-encounter influences (chart, experience) were related to the present state of the client. 2 subjects expressed confusion related to NANDA definitions/characteristics during decision-making.

Senior Pairs

All pairs used a systematic general strategy approach. They completed cue clustering prior to early diagnosis. 3 pairs engaged in detailed focused data gathering/cue clustering activities. All used guided search activities. 2 pairs used discrimination activity. Hypothesis evaluation was entwined with guided search activities. Pre-encounter influences (chart) were reviewed and evaluated related to present status of the client.

INTERPRETATIONS

All female nursing students use a basic cognitive strategy. This strategy may vary in composition from a minimum of data gathering and guided search to an expanded strategy.

Junior individuals use a general systematic approach with a minimum of cue clustering and guided search strategies. There is a danger that early diagnosis is based on minimal data or strong pre-encounter influences. NANDA terminology and/or defining characteristics create confusion in decision-making.

Junior pairs exhibit an expansion of the cue clustering/guided search strategies. Little discrimination strategy is noted. Discussion of NANDA terminology decreases confusion during decision-making.

Senior individuals use more cue clustering and guided search strategies than Juniors. Pre-encounter influences are used to guide data searches. There is little use of discrimination strategy. NANDA terminology
creates confusion during decision-making.

Senior pairs use a systematic approach with a more focused data collection. Guided search activities are used including discrimination. Discussion of NANDA terminology decreases confusion during decision-making.

**Interview**

Student verbalization of the process they use to do nursing diagnosis is generally consistent across all students. They read the chart, assess the client, look for abnormalities or priorities, and compare findings to the NANDA list. Seniors describe the process in more detail with emphasis on priorities.

Students self-selected to participate as pairs or individuals. All of the pairs like doing the computer study as pairs. Of the individuals--7 like doing it alone and 3 would also like to do it with someone else.

**Influencing Factors**

Students' comments were consistent across levels about factors that influence their strategy. Class content was noted as important and helpful (Psych class and physiology class were mentioned). The value of readings was perceived as both helpful and not helpful. Assignments/care plans were viewed as sometimes helpful. Clinical experience was rated as more helpful. Eg: Actually doing in the clinical helps. Clinical contributes to decision-making. A good clinical instructor who helps look at cues and evaluate them is very helpful. Work experience (jobs) was mentioned as especially significant. Eg: Learn more from working than from clinical. Learn thinking process at work. Work gives more experience.

Confusion related to definitions and/or defining characteristics of the NANDA diagnosis list was mentioned as a problem.
APPENDIX M

Peer Review Coding
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<tr>
<th>Coder</th>
<th>Case</th>
<th>Coding</th>
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<tbody>
<tr>
<td>1</td>
<td>Mary Dunn</td>
<td>Collecting information, making inferences, determining a diagnosis</td>
</tr>
<tr>
<td>2</td>
<td>Mary Dunn</td>
<td>Problem identification, rationale, validation of problem, evaluation, re-evaluation of priorities</td>
</tr>
<tr>
<td>3</td>
<td>Mary Dunn</td>
<td>Searching for information, reasoning with data, possible diagnosis, testing diagnosis, reviewing data, solved problem</td>
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<td>4</td>
<td>Ruth Morris #4</td>
<td>Background data-collecting, determining problem area, thinking through problems, making connections</td>
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<td>5</td>
<td>Ruth Morris #4</td>
<td>Data collection, assessment, problem identification, problem solving</td>
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<td>6</td>
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<td>Assessment data, judgments, making diagnosis</td>
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<td>Ruth Morris #4</td>
<td>Background information, signs and symptoms, diagnosis, prioritizing diagnoses</td>
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<tr>
<td>8</td>
<td>Fred Weatherby</td>
<td>Assessment, draws conclusions, hypothesis, confirms hypothesis</td>
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<td>9</td>
<td>Fred Weatherby</td>
<td>Assessment-collecting data, interpretation, clustering</td>
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<tr>
<td>10</td>
<td>Fred Weatherby</td>
<td>Sees data and makes a decision about data, makes inferences, decision</td>
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APPENDIX N

Member Check Data
Table 16. Member check data.

Factors Identified as Important

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<tr>
<th>STUDENT NUMBER</th>
<th>Agrees with General Process</th>
<th>Job Experience</th>
<th>Clinical Experiences</th>
<th>Class Presentation</th>
<th>Common Sense/Logic</th>
<th>Instructor Helpful</th>
<th>NANDA Terminology Difficult</th>
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APPENDIX O

Coded Data from Transcripts

for Fisher Exact Test
Table 17. Coded data from transcripts for the Fisher Exact Test.

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<th>Student #</th>
<th>Score</th>
<th>Cue Clustering</th>
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Note:

S = Simple
C = Complex