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UNIVERSITY OF SAN DIEGO
Philip Y. Hahn School of Nursing
DOCTOR OF NURSING SCIENCE

Testing a Theoretical Model of Critical Thinking and Cognitive Development

by

Jane Rapps, RN, MS, MEd

A dissertation proposal presented to the
FACULTY OF THE PHILIP Y. HAHN SCHOOL OF NURSING
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In partial fulfillment of the
requirements for the degree
DOCTOR OF NURSING SCIENCE

May 1998

Dissertation Committee

Mary Jo Clark, PhD, RN, Chair
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ABSTRACT OF THE DISSERTATION

Testing a Theoretical Model of Critical Thinking and Cognitive Development

The goal of nursing education is to educate individuals in such a way that they become self-determining, independent thinkers who are prepared to keep pace with the rapidly changing demands of today's health care system. Nurses must utilize critical thought and reasoned action in clinical practice in order to render state of the art health care for individuals, families, groups, and communities. The purpose of this study was to test a proposed theoretical model of critical thinking and cognitive development. Perry's theory of adult cognitive development and Kataoka-Yahiro and Saylor's Critical Thinking Model for Nursing Judgment guided this research. Data were collected from 233 participants who have been in nursing practice for a minimum of two years or were presently enrolled in graduate nursing education. Multivariate analysis with latent variables was used to test a theoretical model of critical thinking and cognitive development.

A two-step approach for testing the hypothesized model was used in this study. The first step involved testing the measurement model by confirmatory factor analysis to determine the relationship among the concepts being investigated. The second step involved testing the structural model by examining the relationships among the latent variables. The results obtained in this study showed that the indicators of the latent variables in the measurement model were not sufficient to measure the constructs. The hypothesis that the

model of critical thinking and cognitive development would fit the sample data was not able to be tested. This study did not validate or refute a model of critical thinking and cognitive development. The study did highlight the need for instruments that can measure these constructs in a reliable and valid manner.

DEDICATION

To my parents,
Robert and Natalie Anglemeyer,
who taught me the value of an education.

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CHAPTER 1

Introduction

For over two decades the National League for Nursing (NLN, 1992) has advocated substantial changes in the nursing education system in an effort to advance and upgrade the standards of nursing education and nursing practice in general. This call for educational modification is a result of dynamic, rapidly occurring changes taking place in the health care delivery system which require professional nurses to have an up-to-date knowledge and practice base, skills, and a motivation for life-long learning. Nurses need to possess the cognitive knowledge and experience necessary to make independent nursing decisions and sound judgments in practice; they also need to possess the ability to transfer new knowledge and skills into nursing practice in order to render state of the art health care for individuals, families, groups, and communities (American Association of Colleges of Nursing, 1986; Heaslip, 1994; Valiga, 1983).

Given the diversity and complexity of professional practice in today's health care arena, nursing schools must prepare nurses to think critically; nursing practice must encourage and promote critical thinking in registered nurses in order to plan, problem-solve, and manage the health care needs of their clients. Critical thinking has been included as a specific criterion

(Criterion 20) for the accreditation of baccalaureate programs by the National League for Nursing (NLN, 1989). This criterion states that the curriculum must emphasize the development of critical thinking skills that will engender progressively independent decision-making.

Emphasizing critical thinking skills solely in nursing courses is not sufficient; the NLN requires documentation of critical thinking as an outcome of nursing education (NLN, 1989). In order to accomplish this, nursing students must be taught and must demonstrate the ability to interpret, analyze, synthesize, infer, explain, and evaluate information. Nursing faculty are compelled to facilitate students' educational experiences by assisting them in the utilization of these skills in didactic and clinical practice environments. Through this process, students should develop the ability to define problems accurately, differentiate relevant from irrelevant data, draw valid conclusions, and choose the best alternatives among an array of possible solutions to make accurate and pertinent clinical judgments. Then nursing schools will produce graduates who are well prepared to keep pace with the rapidly changing demands of today's health care system (Bandman & Bandman, 1988; Miller & Malcom, 1990).

In the past, researchers have focused primarily on the skills required to think critically. Today, a prevailing attitude among many critical thinking theorists is that knowledge about critical thinking and skill in its application are just two of several components necessary to be a critical thinker (Kataoka-Yahiro & Saylor, 1994; Paul, 1993). Researchers in nursing, education, and psychology have limited their investigations to questions of whether skills develop over time when

exposed to education. Few, if any, studies show whether certain criteria (e. g. general grade point average, domain specific grade point average, reading, and/or writing abilities, personality, or self-concept) influence critical thinking skills in students, or whether different teaching methods applied to the educational process effect changes in these skills. Relative to critical thinking, empirical studies in nursing have examined the attributes of locus of control (Maebius, 1990), self-concept (Beeken, 1997; Brooks, 1990), cognitive growth (Givens, 1990), confidence (Haffer & Raingruber, 1998), performance (Sullivan, 1987), exposure to curricula and faculty (Brigham, 1989; Saarmann, Freitas, Rapps, & Riegel, 1992; Shaw, 1993), professionalism (Brooks & Shepherd, 1990), creativity (Sullivan, 1987), accuracy of assessment skills (Maciorowski, 1989), learning styles (Hamilton, 1993), teaching strategies encompassing critical thinking skills (Kemp, 1985), and professional nursing competence (Maynard, 1996).

Most of the studies of critical thinking in nursing have shown mixed results, with a range from no change to significant change in students' abilities to think critically. The only consensus is that an integral approach to the development of good critical thinkers should include not only skill development but also the nurturing of dispositions toward critical thinking (Browne & Keeley, 1990; Gray, 1993; Kurfiss, 1988; Oxman-Michelli, 1992; Paul, 1993; Siegel, 1988). In addition to dispositions and skills, other components identified in the literature as influencing critical thinking include experience, knowledge base, and standards or quality of thinking. (Oxman-Michelli, 1992; Siegel, 1988).

Recently, many critical thinking experts have placed increasing amounts of attention on the importance of dispositions in the field of critical thinking (Facione, Sanchez, & Facione, 1994). They contend that the process of defining and shaping critical thinking dispositions is central to developing higher order cognitive abilities in students (Resnick, 1987). The dispositions component of critical thinking encompasses attitudes and tendencies rather than abilities. It involves those aspects of one's character that motivate a person to think critically (Perkins, Jay, & Tishman, 1993). Critical thinking dispositions are thought to consist of such attributes as inquisitiveness, persistence, self-confidence, open-mindedness, intellectual responsibility, truth-seeking, respect for others, and judiciousness in one's decision making (Facione, Facione, & Sanchez, 1994; Oxman-Michelli, 1992; Paul, 1993).

Another aspect of nursing education of interest to the National League for Nursing is the concept of cognitive development (NLN, 1992). McGovern and Valiga (1997) defined cognitive development as the ability of an individual to employ reason, manage diversity of opinions or conflicting points of view, and engage in contextual decision-making. They contended that nursing students who demonstrate these abilities are able to think critically, make independent decisions, and provide nursing care to patients in hospital and community settings despite ambiguous or conflicting information. Notwithstanding the influence of nursing education, studies related to cognitive development of nursing students have revealed that the majority of nursing students graduate

from baccalaureate nursing programs at the lower end of the cognitive development continuum (Frisch, 1987; McGovern & Valiga, 1997).

Presently, very few empirical studies in nursing have examined the factors that influence critical thinking in practicing registered nurses. No studies have been conducted concerning the process of cognitive development in nurses. Several factors may account for this dearth of original research. One is related to the definition of critical thinking . It has long been recognized that the varied and divergent conceptualizations of critical thinking have hindered efforts to move development of the construct forward in both curricular and research arenas. In the late 1980s, researchers from a Delphi research project sponsored by the American Philosophical Association presented a consensus definition that represented views across a broad spectrum of perspectives from a variety of academic disciplines, including philosophy, education, and psychology. They articulated an understanding of critical thinking and identified critical thinking skills and affective dispositions germane to the concept. From this definition, two measurement instruments were developed--the California Critical Thinking Skills Test (CCTST) and the California Critical Thinking Dispositions Inventory (CCTDI) (Facione, Facione, & Sanchez, 1994).

A second reason for the lack of research in the area of factors influencing critical thinking relates to confusion about measurement of outcomes related to the process of critical thinking. Many investigators have set the improvement in critical thinking skills as a desired outcome. Other theorists, especially those interested in adult intellectual development, have proposed that cognitive

development is an expected result of exposure to education (Frisch, 1987; Gamino, 1995; McGovern, 1995; McGovern & Valiga, 1997). To date, there has been little investigation into the influence of critical thinking skills and dispositions on cognitive development in adults.

A third reason for a lack of research in this area relates to the development and testing of a critical thinking theoretical model. Although several different critical thinking models have been proposed, none has been tested to date (Kataoka-Yahiro & Saylor, 1994). This lack of model testing contributes to a lack of clarity about what encompasses the phenomena of cognitive development and critical thinking as outcomes expected from exposure to education, experience, and other influencing factors in domain-specific practices. It is imperative that model testing be performed to better understand the concepts of cognitive development and critical thinking, with the goal being to positively influence both nursing students and practicing nurses to better handle a rapidly changing health care environment.

Purpose

The overall aim of this research was to use model development methodology to explore several relationships in a proposed theoretical model of cognitive development. Theoretical models differ from conceptual models in that they include causal links and therefore can be tested. Structural equation modeling has been developed as a method to test and substantiate theory (Schumacker & Lomax, 1996). Model development is a strategy for structural equation modeling that allows exploration, testing, and model respecification for

the purpose of model improvement. The first step in model development is to specify a model from a review of the literature. Once the model has been identified, data are then collected and used to assess whether the hypothesized model fits the data. In this study, interrelationships among four variables that influence cognitive development were examined. These variables include knowledge base, cognitive and intellectual functioning, critical thinking skills, and critical thinking dispositions.

Conceptual Framework

The conceptual basis for this study was derived from Perry's (1970) theory of young adult intellectual development and Kataoka-Yahiro and Saylor's (1994) Critical Thinking Model for Nursing Judgment. Perry (1970) stated that intellectual growth and development occur in a progressive manner throughout the college years. This scheme of development is characterized by nine positions. Individuals move on a continuum from a position of dualism through relativism to commitment (see Figure 1). Individuals transition from one position to the next when they encounter situations or experiences that are incongruent with their intellectual way of thinking.

Figure 1. Perry's Model of Cognitive Intellectual Development

Positions one and two describe the adult who sees the world in polar terms (good vs. bad, right vs. wrong). In position one, individuals believe that right answers to all questions exist somewhere and that authorities provide those answers. Position two describes the person who acknowledges that different opinions exist but that “true authorities” must be right, and individuals who provide differing opinions are frauds. In position three, the emerging adult sees that multiple perspectives exist but believes that this diversity, although legitimate, is temporary until a right answer is found by those in authority. In position four, the individual accepts a diversity of opinions, believing that there are no right answers to a situation and that opinions are relative to the context of the situation.

Positions five through nine describe the individual's continuing development in making individual choices based on an analysis of alternatives. There is an emergent sense of responsibility, self-control, and commitment on the part of the individual. In position five, individuals begin to see everything as being relative but not equally valid. There is a need for these people to understand the context of a situation and to be more aware of their own thinking. Theories are not perceived as “truths”; they are metaphors from which to interpret data. In position six, individuals begin to understand more about decision-making processes in an uncertain world that does not always provide confirmation of the correctness of decisions made. Individuals who reach position seven begin to make commitments to their way of thinking. In position eight, individuals learn to balance and examine their many values and

commitments. Commitments are prioritized by the individual as to how certainly, how deeply, or how tentatively each commitment is held. In position nine, the highest position of cognitive development, individuals realize that they must wholeheartedly embrace their values; however, they also realize that the views they now hold may be temporary and tentative. They fight for their own values but respect others and believe that their deepest values are right, yet are ready to learn from others who may possess different values.

Perry (1970) proposed alternatives to linear growth in cognitive abilities. He identified these alternatives as retreat, temporizing, and escape. Retreat means that an individual regresses to an earlier position, usually to the dualistic position. Temporizing means to have a pause in growth over a period of time. Escape is defined as alienation and abandonment of responsibility from positions three (multiplicity) to five (relativism) in order to avoid commitment.

Most college undergraduates generally are found in positions two through four when measured prior to beginning their educational experience and at position four at the time of graduation (Kurfiss, 1988; Perry, 1970). Similar findings were noted for nursing students in studies by Frisch (1987) and Guardo (1986).

Kataoka-Yahiro and Saylor's Critical Thinking Model for Nursing Judgment (1994) was developed from the critical thinking theoretical literature and from the work of Benner (1984). Their model defined the outcome of critical thinking as discipline-specific clinical nursing judgments relevant to nursing problems in a variety of settings. The Critical Thinking Model for Nursing Judgment is

comprised of two distinct sections: the components of critical thinking and the levels of critical thinking (see Figure 2).

Figure 2. Representation of Kataoka-Yahiro and Saylor's (1994) critical thinking model for nursing judgment.

Kataoka-Yahior and Saylor (1994) identify five components of critical thinking: specific knowledge base, experience, critical thinking competencies (general and domain specific), attitudes, and standards (intellectual and professional). In addition, there are three levels of critical thinking in this model: basic, complex, and commitment.

Kataoka-Yahiro and Saylor (1994) believed that specific nursing knowledge is required if nurses are to think critically and make safe clinical judgments. Nurses not only must possess general nursing knowledge (anatomy, physiology, technical skills) but also must have formalized knowledge in their clinical practice area. Experience is the second component identified by these authors as an important aspect of critical thinking. Experience enables nurses to

better understand complex clinical situations and make relevant clinical and managerial decisions related to clients' health care needs.

Kataoka-Yahiro and Saylor (1994) identified competency, a third component of critical thinking, as relating to cognitive rather than psychomotor abilities. The three types of competencies important to critical thinking are: (a) general critical thinking competencies, (b) specific critical thinking competencies in clinical situations, and (c) specific critical thinking competencies in nursing. General critical thinking competencies are demonstrated through the use of the scientific process, generating hypotheses, problem-solving, and decision-making. Specific critical thinking competencies in clinical situations include clinical experiences as part of their educational process, with diagnostic reasoning and clinical decision-making as examples. The final critical thinking competency exclusive to nursing involves the nursing process. This process provides a systematic, rational method of assessing needs and planning, implementing, and evaluating nursing care.

The fourth component of Kataoka-Yahiro and Saylor's (1994) model involved attitudes that foster critical thinking. Eleven attitudes are depicted in their model. These include confidence, independence, fairness, responsibility, risk taking, discipline, perseverance, creativity, curiosity, integrity, and humility.

The final component of the Critical Thinking Model for Nursing Judgment incorporates standards. The authors divided this component into two parts-- intellectual standards and professional standards. General intellectual standards, taken from the work of Paul (1993) and discussed later in this chapter

under philosophical perspective, include the criteria nurses must use when assessing either their own or another person's critical thinking. Professional standards embody ethical, evaluative, and professional responsibility criteria specific to nursing; they include the American Nursing Association's (ANA) Code for Nurses, the National League for Nursing's accreditation criteria, the Nurse Practice Act, and ANA's Standards of Practice.

The second part of Kataoka-Yahiro and Saylor's (1994) model incorporated three levels of critical thinking in nursing that were adapted from Perry's work--basic, complex, and commitment. Basic level critical thinking reflects Perry's first position of dualism where individuals see answers to complex problems as either right or wrong, but there exists a willingness to listen and to accept a diversity of positions. The complex level assumes that individuals are in charge of recognizing and accepting diverse opinions by detaching from their own points of view and systematically analyzing and examining alternatives. Kataoka-Yahiro and Saylor's (1994) final level of commitment is equivalent to Perry's concept of commitment which was an ability to be committed to a personal viewpoint while recognizing that others may hold differing perspectives. Individuals at the level of commitment continue to be able to analyze and examine alternatives but, in addition, see the necessity for personal choices in a relativistic world.

Perry's (1970) theory of adult cognitive development and Kataoka-Yahiro and Saylor's (1994) Critical Thinking Model for Nursing Judgment provide an orderly system with which to view the variables identified in the literature as

influencing and enhancing critical thinking and cognitive development. Perry's theory has been used as an underlying framework for numerous nursing studies (Frisch, 1987; Guardo, 1986). To date there have been no published reports using Kataoka-Yahiro and Saylor's (1994) conceptual model. For this study, the two theories were integrated to guide the theoretical model to be investigated.

Theoretical Model

Understanding the concepts of both critical thinking and cognitive development is a starting point for understanding the model studied. Model testing is a comprehensive statistical approach to testing hypotheses about relationships between observed and unobserved variables (Hoyle, 1995). The model proposed is displayed in Figure 3. This study was designed to empirically test specific relationships among knowledge base, critical thinking skills, cognitive and intellectual functioning, critical thinking dispositions, critical thinking skills, and cognitive development.

Figure 3. Hypothesized relationships among knowledge base, cognitive and intellectual functioning, critical thinking skills, critical thinking dispositions, and cognitive development.

Knowledge base and cognitive and intellectual functioning were proposed as the independent exogenous variables in this model. Critical thinking skills and critical thinking dispositions were thought to be associated with the exogenous variables and thus were acknowledged as the endogenous independent variables. Cognitive development was the primary outcome of the endogenous variables and constituted the dependent variable. Exogenous variables are acknowledged to be influenced by causes that come from outside the model. Endogenous variables have at least some of their variance explained by another variable in the model (Munro & Page, 1993).

Research Hypothesis

Analysis of the data allows the researcher to assess and improve the overall model fit through modification of the structural and/or measurement models. Testing of the hypothesized model using structural equation modeling is a prerequisite to interpreting model results. It is important to note that testing of a model ends in the model being either supported or not supported by data. A model can never be confirmed, as other acceptable models also may exist (Glaser & Riegel, 1996).

In using structural equation modeling as a statistical technique, only one research hypothesis is appropriate. For this study, the primary research hypothesis was as follows: the hypothesized cognitive development model will fit the actual data.

Definition of Terms

For purposes of this study, variables were operationally defined as follows:

Cognitive and Intellectual Functioning

Cognitive and intellectual functioning was defined as an individual's intellectual competence and ability to use his or her intellectual capabilities efficiently. For this study it was operationally defined in terms of the scores on the three subscales on the California Psychological Inventory (CPI). These three subscales measure achievement via conformance, achievement via independence, and intellectual efficiency.

Individuals who score high on the achievement via conformance subscale of the CPI are described as ambitious and capable, with the capacity to do well in clearly defined and controlled environments. Lower scores suggest the tendency toward distraction, unreliability, and resistance to rules or any kind of strict control.

Individuals who score high on the achievement via independence subscale of the CPI tend to be clear-thinking, intelligent, independent, and reliable in ambiguous, open, or only partially defined settings. Low scoring individuals tend to be rather narrow in interest, easily discouraged from doing their best, and poorly motivated in both educational and occupational matters.

The third subscale of the CPI, measuring cognitive and intellectual functioning, is the subscale of intellectual efficiency. Individuals who achieve high scores are viewed as being capable, logical, and resourceful; low scorers tend to be low in self-esteem, below average in cognitive ability, and poor at expressing their feelings or ideas (Gough, 1987).

Knowledge Base

Knowledge base was defined as the contents of long-term memory. For this study knowledge base was measured by nursing grade point average, overall college grade point average, and years in nursing.

Critical Thinking Dispositions

Critical thinking dispositions were defined as those attributes which contribute to an individual's ability to be a mindful learner or an ideal critical thinker (Facione, Facione, & Sanchez, 1994; Oxman-Michelli, 1992). These

attributes are viewed in a positive sense and describe such a person as having a “critical spirit”. For this study critical thinking dispositions were operationally defined as the scores obtained on the subscales of the California Critical Thinking Disposition Inventory. Seven dispositions were measured using this instrument: truth-seeking, open-mindedness, analyticity, systematicity, critical thinking confidence, inquisitiveness, and maturity.

An individual who has a disposition for truth-seeking is one who is eager to seek the truth through honest and objective inquiry. Open-mindedness describes an individual who is tolerant of divergent views and perceptive of his or her own biases. Another disposition, analyticity, characterizes a person who values reasoning and uses evidence to support findings in challenging or difficult situations. This individual also is persistent in his or her inquiry, even if difficult obstacles to discovery are encountered or the situation is ill-structured. A person who has a disposition for systematicity is one who seeks relevant information in an orderly and diligent manner and can remain focused on the concern at hand. The disposition of self-confidence describes an individual who is secure in his or her ability to make sound judgments. A person who is inquisitive is one who values being well-informed and values learning. The last of the dispositions, maturity, measures a person’s ability to make reflective judgments and to understand that many situations have more than one plausible option.

Critical Thinking Skills

Critical thinking skills were defined as “cognitive skills consisting of interpretation analysis, inference, evaluation and explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based” (American Philosophical Association [APA], 1990, p. 3). For this study critical thinking skills were measured by the scores obtained on subscales of the California Critical Thinking Skills Test. Five skills were measured: analysis, evaluation, inference, deductive reasoning, and inductive reasoning.

The skills of analysis include an individual's capacity to comprehend and express the meaning of a given situation and the capability to infer a relationship among statements in order to express a belief, reason, or opinion. An individual who can evaluate is one who has the ability to assess the credibility of statements. He or she also can examine and justify that belief, reason, or opinion in terms of evidence upon which the results were based and present the findings in the form of relevant arguments. The skill of inference includes a person's ability to identify and secure elements needed to form reasonable conclusions and to extract the consequences arising from the data. The ability of an individual to use induction and deduction as a method of reasoning is based on the alleged strength of the inference. The stronger the support, the greater the merit of the argument. Inductive reasoning is the ability to make general conclusions from a set of facts or observations. These conclusions are based on the strength of the evidence provided to the individual. Deductive reasoning is

reasoning from general premises to specific conclusions and is based on the truth and validity of the premises.

Cognitive Development

Cognitive development was conceptually defined as a series of progressive changes in the way individuals think and view the world when faced with experiences that conflict with their intellectual way of knowing (Sternberg & Berg, 1992). For this research study, cognitive development was operationally defined as the scores obtained on the subscales of the Scale of Intellectual Development (Erwin, 1981). This instrument measures four dimensions of cognitive development: dualism, relativism, commitment, and empathy.

The first level of cognitive development, dualism, refers to the way people think. Dualistic thinking reflects individuals who tend to see issues in black and white terms and who look to authority to give them the correct answer. Relativism indicates that individuals have progressed to a position of being able to acknowledge that alternative perspectives and diversities exist; these individuals have the ability to problem-solve but do not trust the derived answers and remain reliant on authorities for solutions. Individuals who progress to the next level, commitment, show an ability to be committed to a personal viewpoint, to understand that their way of thinking is valid, and to maintain their own personal belief system while recognizing that others may hold differing perspectives. The highest level of cognitive development is empathy and manifests itself in individuals who feel responsible to society for their actions and behaviors.

Assumptions

This research is based on the following assumptions:

1. Learning occurs in all facets of nurses' experiences.
2. Nurses are motivated individuals who desire to gain mastery of the knowledge and skills needed for professional practice.
3. Nurses possess both critical thinking dispositions and critical thinking skills.
4. Nurses will reach one of the four stages of cognitive development (dualism, relativism, commitment, or empathy) .
5. Critical thinking skills, critical thinking dispositions, and cognitive development can be fostered.

Significance of the Study

This study is important for the following four reasons: first, it addresses a gap in the research by articulating and testing a model of critical thinking and cognitive development. Second, it draws attention to the idea that the concept of critical thinking encompasses both skills and an individual's disposition to use those skills in relevant situations. Third, this research provides a basis for further investigation of a model identifying variables and specifying relationships with the potential to influence advanced levels of cognitive thinking in individuals. Finally, when nurse educators understand what conditions enhance critical thinking and cognitive development, educational strategies can be developed and tested that foster these conditions in practicing nurses and promote high quality, cost-effective nursing care in a variety of health care settings.

Summary

Facione and Facione (1996) stated that “critical thinking increasingly is being recognized as the cognitive engine driving the process of knowledge development and professional judgment in a wide variety of professional practice fields”(p. 129). The goal of nursing education is to educate individuals to become self-determining, independent thinkers who are prepared to keep pace with the rapidly changing demands of today's health care system. The nursing community needs to know whether nurses who graduated from educational programs which encourage them to think critically will utilize critical thought and reasoned action to grow intellectually in clinical practice. Researchers, educators, and practitioners can best accomplish this goal through a clear understanding of the concepts of critical thinking as they affect cognitive development.

CHAPTER 2

Review of the Literature

The key constructs in the proposed theoretical model are critical thinking, divided into skills and dispositions, and cognitive development. These three constructs are defined and described through a review of selected literature and research related to cognitive development and critical thinking. A discussion is presented focusing on factors that influence critical thinking dispositions and critical thinking skills. Additionally, a review of the literature is included on the relationship among critical thinking skills, critical thinking dispositions, and cognitive development.

Critical Thinking

Critical Thinking Skills

In this century, critical thinking theory has predominated in the fields of philosophy, cognitive psychology, education, and nursing. Various authors have proposed perspectives concerning critical thinking relative to their specific disciplines. Across these disciplines, the concept of critical thinking is viewed from a similar perspective regarding its general nature. A review of the literature suggests that the major differences in viewpoints may lie in how narrowly or

broadly the boundaries of the construct are interpreted rather than what the core issues of the construct involve.

Philosophical perspective. The important elements in the Western tradition of critical thinking were derived from the early Greek philosophers, especially Socrates and Aristotle, who were deeply concerned with the nature of knowledge. By a probing method of questioning, Socrates discovered that many of the sophists of his day could not justify their confident claims to knowledge on rational grounds. He proposed that education required the joining together of both teacher and student in the examination or challenge of the premises under which certain positions were viewed sacred by tradition. This Socratic method of questioning centered on a search for truth through questioning. Truths were not given to the student by the teacher. The student had to discover truth through a logical process of questioning and reasoning. Socrates never described this interaction as one that promoted critical thinking though it clearly embodies some of the criteria for critical thinking (Furedy & Furedy, 1985; Glaser, 1985, Paul, 1993).

Critical thinking traditionally has been closely linked with the discipline of logic. Logic deals with the rules of correct reasoning and concerns itself not with the actual truth of the claim, but rather whether reasons presented for a claim, if true, would support the claim's acceptance. An individual employing critical thinking skills rather than logic is not just interested in discovering whether a claim is supported by its stated reasons, but also must assess the reasons

themselves, determine whether the reasons offered for the claim are worth believing, and then weigh the results to determine whether sound, well balanced reasons actually exist for accepting or rejecting the claim. It is essential to keep in perspective that critical thinking is not infallible nor absolutely rational or rigidly schematic. Critical thinkers do not automatically reach the best decisions, are not immune from making erroneous judgments, and do not rule out feelings and intuition (McKenzie , 1992). Critical thinkers never attain perfection in their decisions, but they do arrive at superior decisions on a consistent basis by incorporating reasoned judgment into their thinking process (Gambriel, 1990; McKenzie, 1992; Paul, 1993).

One of the earliest modern-day proponents for the advancement of critical thinking ability was John Dewey. His work on educational reform began early in the twentieth century, with many of his ideas still serving as guides in education. Dewey (1933) believed that instruction should be structured to produce good habits of thinking. Instructional methods should lead to reflection on the part of the student. Reflective thinking involves a state of doubt, hesitation, perplexity, or mental difficulties in which thinking originates and results in an act of inquiry to find methods or materials that will resolve or dispose of the doubt or perplexity. This type of thinking requires suspending judgment, maintaining a healthy skepticism, and remaining open-minded with respect to the problem at hand. Dewey believed that education should become a purposeful process of growth for the student, enabling him or her to acquire skills and to develop a process of

thinking necessary to function effectively in a democratic society (Handlin, 1959). Therefore, processes involving rote memory or routine operations at someone else's direction are not considered thinking (Barell, 1991).

Dewey distinguished thinking from critical thinking. He believed that thinking involved mental streams of thought that flow uncontrolled through the brain and leave little behind to think about or ponder over. To Dewey critical thinking is reflective thinking. He noted that this type of thinking is not a result of things directly perceived but is sequential, reflecting, foretelling of the next thought, and progressing toward a conclusion. Dewey (1933) proposed that there are three phases to a reflective thought. The first phase begins the discovery process and involves being perplexed, challenged, or curious about something. The second phase involves the drive for resolution of the inquiry. The final phase is reaching a conclusion about the nature of the problem and then reflecting back on the process.

In recent times philosophers have turned their attention to an understanding of the basis of critical thinking, thus identifying the methods that allow an individual to solve the abstract and practical problems of life (Sternberg, 1986; Young, 1980). The Informal Logic Movement began largely as a response to the dominance of formal methods of logic. At present there are four centers for the Informal Logic Movement: The Center for Critical Thinking at California State University at Sonoma, The Foundation for Critical Thinking in Maryland, The National Council for Excellence in Critical thinking, and the International

Center for the Assessment of Higher Order Thinking in California, where education, research, conferences, scholarship, and theoretical development are based solely on critical thinking. Members of the Informal Logic Movement articulated the belief that formal logic helped explain how individuals think under ideal circumstances; however, formal logic courses did little to enhance the reasoning abilities of students. They contended that practical reasoning skills transferred to a setting outside the classroom would enhance students' abilities to think by having them consider the concrete context in which thinking actually took place (deBono, 1976; Glaser, 1985; Smith, 1991).

One of the most comprehensive attempts to define and provide structure to critical thinking comes from Ennis (1962, 1987). He defined critical thinking as "reasonable and reflective thinking that is focused on deciding what to believe or do" (Ennis, 1991, p. 6). This definition reflects both dispositions and abilities. He categorized critical thinking into four components, each consisting of several skills. The four components are: a) defining and clarifying, b) asking appropriate questions to clarify or challenge, c) judging the credibility of a source, and d) solving problems and drawing conclusions.

Ennis (1962) listed twelve categories of skills necessary for critical thinking; these skills are listed in Table 1.

Table 1

Ennis's List Of Critical Thinking Cognitive Skills

Critical Thinking Cognitive Skills
1. Grasping the meaning of a statement;
2. Judging for ambiguity in one's line of reasoning;
3. Judging whether certain statements contradict each other;
4. Judging whether a conclusion follows necessarily;
5. Judging whether a statement is specific enough;
6. Judging whether a statement is actually the application of a certain principle;
7. Judging whether an observation statement is reliable;
8. Judging whether an inductive conclusion is warranted;
9. Judging whether a problem has been identified;
10. Judging whether something is an assumption;
11. Judging whether a definition is adequate;
12. Judging whether a statement made by an alleged authority is acceptable (1962, p. 84).

In addition to skills and dispositions, Ennis believed that the following abilities were essential for a person to engage in critical thinking:

- Being clear about the problem
- Having a reasonable basis for judgment
- Having the resulting inferences be reasonable, and
- Inferring a conclusion or solution to the problem (Ennis, 1989).

Many philosophers believe that critical thinking should remain general in nature, be transferable across disciplines, and guide individuals in their solutions

to the practical problems of life(Ennis, 1990; Paul, 1993). However, subject-specific thinking is gaining acceptance by many critical thinking theorists and educators (McPeck, 1990). There are two approaches to the issue of subject specificity in critical thinking--domain specificity and epistemological subject specificity (Ennis, 1990). To be effective, domain-specific critical thinking is viewed as requiring (a) background knowledge, (b) explicit transfer-inducing instructions in order to shift skills from one domain to another, and (c) more than just instruction in general critical thinking skills. Epistemological subject-specific critical thinking is the view that (a) background knowledge is essential for making justified critical thinking judgments, (b) critical thinking varies from field to field, and (c) the ability to critically think in a specific field requires a full understanding of the field itself (Ennis, 1990). A domain is seen as broad (i.e. nursing, mathematics) whereas a field is seen as narrow (orthopedic nursing, algebra).

Paul (1993) contended that critical thinking is a unique kind of purposeful thinking about any subject, content, or problem in which the thinker improves the quality of his or her thought process by systematically and habitually reflecting on the criteria employed during this reasoning process. Paul pointed out that when individuals choose to become critical thinkers, they do not remain the same individuals who have developed enhanced abilities; they actually become different people. He proposed that individuals engaged in critical thinking take charge of the construction of this thinking, guide it according to standards, and assess its effectiveness according to its purpose and criteria.

According to Paul (1993), the process of critical thinking is comprised of four domains: elements of thought, abilities, affective dimensions, and intellectual standards. Figure 4 shows the four domains of critical thinking and the essential elements, traits, and criteria needed for each domain.

Figure 4. Domains of critical thinking.

The first domain, the elements of thought, provides a logical framework to use in reasoning. Paul (1993) contended that all thinking, to be reasonable thinking, must contain these elements. The following is a discussion of the eight elements of critical thinking:

1. When individuals reason, they do it for a purpose. Therefore, the purpose of the thinking must be stated so it is clear what the reasoning is about and can be distinguished from other related purposes. The purpose for the reasoning also must be significant and realistic.
2. Reasoning is an attempt to figure something out, to settle some question, or to solve some problem. A person's reasoning must include a question. It is necessary to identify the type of question being asked, whether it is factual, preference, or a question requiring reasoned judgment. Through this process the question can be more clearly understood.
3. Assumptions are incorporated into all reasoning. It is important to identify and validate the assumptions. If the assumptions cannot be supported, then the question at hand must be reexamined.
4. All reasoning is done from some point of view. It is necessary to identify the frame of reference of one's thinking. Understanding one's own frame of reference helps to develop a fair-minded evaluation of other expressed points of view.
5. All reasoning is based on data, information, and evidence. Thinking critically requires individuals to restrict themselves to claims that are supported

by sufficient data. It is also important to seek evidence against one's position and explain its relevance.

6. Concepts and ideas shape reasoning. A person needs to be able to identify and define each concept that frames the question at hand. In addition one must be able to explain why the concept is important to the understanding of the question.

7. All reasoning contains inferences by which an individual draws conclusions. It is important for a critical thinker to seek inferences that are consistent and logical and to link these inferences directly from the evidence to a stated conclusion.

8. Reasoning about a question leads to implications and consequences concerning the issue at hand. An individual should investigate both positive and negative implications or consequences and anticipate the consequences that may come from other expressed points of view.

The second domain involves abilities which are defined as the activities an individual uses when employing critical thinking (Paul, 1993). Good critical thinkers use these abilities to assist themselves to reason rationally about complex and sometimes ambiguous issues, problems, decisions, theories and other questions of importance. A thorough assessment of an individual's ability to critically think needs to address the individual's reasoning abilities directly, systematically, and in settings as authentic as possible given the requirements of grading criteria.

The third domain of critical thinking surrounds the affective dimensions or traits which include dispositions, attitudes, and passions. Independent thinking involves the ability to think for oneself even when one's thinking differs from the opinions of other individuals. This is discussed in greater detail later in this chapter in the section on critical thinking dispositions.

The fourth domain of critical thinking involves intellectual standards. This domain encompasses the principles by which reasoning can be judged and is a pervasive part of critical thinking. Paul (1993) pointed out that standards are implicit where assessment is taking place, and that critical thinking embodies thinking that meets universal standards. He believed that teachers must make the standards of thinking explicit whenever engaging students in higher order thinking. As an example, teachers should not allow students to simply identify assumptions, but rather to accurately identify significant assumptions.

Lippman (1988), like Ennis, defined critical thinking as reflective thinking that is concerned with criteria, sensitive to context, and self-correcting. Other philosophers have described critical thinking as less a set of prescribed procedures than an attitude of inquiry with a particular set of abilities for critical thinking. Many critical thinking theorists believe that this type of thinking is essential in order to transcend the self-centered, narrow perspective that characterizes the type of thinking employed by most people (Paul, 1993).

Psychological perspective. From a functional standpoint, psychologists interested in critical thinking emphasize cognitive structure (long-term and short-term memory) and processing activities that occur in the brain which allow for the output of specific intellectual responses (Kail & Bisanz, 1992). In contrast to the philosophical approach, cognitive psychologists consider the conditions that influence thinking (personal and environmental) and are interested in how well one thinks under specific circumstances. Leading this tradition was the Swiss psychologist, Jean Piaget, whose perspective is presented later in this chapter under the concept of cognitive development. Piaget did not use the word "critical" in his discussion of cognitive development, although many similarities exist between his category of formal thought and critical thinking skills (Skinner, 1976).

Educational perspective. Leading educational theorists believe that critical thinking is not just another educational option but rather an indispensable part of education (McPeck, 1981; Norris, 1985; Siegel, 1988). Many of their premises have focused on the thinking skills needed by students when problem-solving, decision-making, or concept learning within the objectives of formal education (Young, 1980). Opinions differ as to what these skills are. Most observers agree, however, that critical thinking is involved in the process of problem-solving and that this ability, in addition to reasoning skills, can be taught or enhanced (Gambrill, 1990; Paul, 1993; Smith, 1991; Young, 1992).

Bloom and his associates (1956) developed the Taxonomy of Educational Objectives which classifies objectives within four domains--cognitive, affective, psychomotor, and perceptual. The first three have been developed and widely used in education, while the perceptual domain has not been fully developed at this time. The cognitive domain of the taxonomy concerns itself with intellectual outcomes. These intellectual outcomes are divided into two major classes--knowledge and intellectual abilities or skills. The outcomes are arranged in order of increasing complexity, beginning with the simple process of knowledge (recall), proceeding to the lowest level of understanding (comprehension), and then advancing through increasingly complex levels of application, analysis, synthesis, and evaluation. These levels are not necessarily sequential; rather, once the foundation of knowledge, comprehension, and application has been attained, the three remaining skills flow naturally from one to the other without definite boundary lines to differentiate them.

Of the six levels of the cognitive domain taxonomy noted by Bloom, some educators conceptualize his upper three levels (analysis, synthesis, and evaluation) as higher order thinking skills (Baron & Sternberg, 1987; Resnick, 1987). Critical thinking is defined as a process that actively utilizes these skills to evaluate information and provide guidance for belief and action (Scriven, 1992). Many educators believe that the first three levels are used most often in teaching, with little attention given to analysis, synthesis, or evaluation (Resnick, 1987). The six levels of Bloom's taxonomy are conceptualized as steps that

correspond to one's level of development in a discipline throughout the curriculum. The lower three levels (recall, comprehension, and application) are viewed as educational objectives during early exposure to the knowledge content of a discipline. The latter three (analysis, synthesis, and evaluation) are expected to be educational objectives during the later courses in a discipline. Many educators contend that regardless of what level of learning an individual has achieved, Bloom's taxonomy views learning as a process that brings comprehension, analysis, synthesis, and evaluation into every cognitive process involving the examination of new knowledge or the acceptance of beliefs or claims to truth.

Three different educational views exist on how critical thinking skills should be taught to students. One view advocates an explicit instruction approach. Educators following this view see critical thinking as a set of skills or cognitive decision-making steps taken to assess whether a statement is valid or correct (Beyer, 1987; Browne & Keeley, 1990; Paul, 1993). The underlying assumptions are that these skills (a) are specific, (b) can be taught through explicit description of each skill with exercises for practicing the skill, and (c) are general enough to be used for thinking critically about a wide variety of issues across different disciplines (deBono, 1976; Ennis, 1989; Gray, 1993; Sternberg, 1986).

Other educators approach the teaching of critical thinking from an immersion style. They believe that students learn to think critically only if they

are immersed in a social environment that offers interesting ideas to think about, are exposed to other individuals who model critical thinking, and are allowed to actually engage in critical thought as they study subjects other than critical thinking . Moreover, the steps are implicit; critical thinkers focus attention on the issues and information that they are considering, not on a set of learned steps for thinking (Ennis, 1987; Gambrell, 1990; Gray 1993; McPeck, 1990).

A third method, a combination of the explicit and immersion approaches, is one of infusing critical thinking instruction into subject-matter instruction. Students are encouraged to think critically in the discipline, while the general principles of critical thinking skills, dispositions, and abilities are made explicit (Glaser, 1985, Resnick, 1987).

The responsibility for improving a nursing student's critical thinking ability lies with nursing educators who must provide the environment and the role modeling necessary to produce this outcome. In a survey of deans and directors of baccalaureate and higher-degree programs accredited by the National League for Nursing, Jones and Brown (1991) found that there was a lack of clarity about the concept of critical thinking. Respondents felt that critical thinking was integrated into their programs through such methods as discussion groups, term papers, and case studies. They often operationalized it as a rational linear process, a function of deductive logical thinking, and as synonymous with the nursing process. It has become evident that critical thinking remains a concept without a clear understanding of it's nature or it's place in

education. For some educators it is seen as an outcome of exposure to education, while others debate exactly how it should be taught to students. This is not adequate; it is time to move forward and bring clarity to the concept.

Conceptual definition of critical thinking. It has long been recognized that the varied and divergent conceptualizations of critical thinking have hindered efforts to move it forward in both curricular and research arenas. In 1988, a two-year Delphi research project sponsored by the American Philosophical Association was started at Santa Clara University, under the direction of Professor Peter Facione, an expert in critical thinking. The panel of experts for the Delphi project included forty-six individuals active in critical thinking education, research, and assessment. They represented views across a broad spectrum of perspectives from a variety of academic disciplines, including philosophy, education, and psychology. Nursing was not represented in the Delphi study. This group of experts articulated an understanding of critical thinking, identified critical thinking skills and affective dispositions germane to the concept, and stipulated that the goal of baccalaureate education is to produce graduates who are willing and able to skillfully engage in critical thinking (Facione, Sanchez, & Facione, 1994).

The Delphi panel characterized critical thinking as "purposeful, self-regulating judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based"

(American Philosophical Association [APA], 1990, p. 3). The panel came to a consensus on the skills and sub-skills required for critical thinking (see Table 2 for a list of these skills and sub-skills).

Table 2

Critical Thinking Cognitive Skills and Sub-skills

Critical Thinking Cognitive Skill	Related Sub-Skills
Interpretation	<ul style="list-style-type: none"> • Categorization • Decoding significance • Clarifying meaning
Analysis	<ul style="list-style-type: none"> • Examining ideas • Identifying arguments • Analyzing arguments
Evaluation	<ul style="list-style-type: none"> • Assessing claims • Assessing arguments
Inference	<ul style="list-style-type: none"> • Querying evidence • Conjecturing alternatives • Drawing conclusions
Explanation	<ul style="list-style-type: none"> • Stating results • Justifying procedures • Presenting arguments
Self-Regulation	<ul style="list-style-type: none"> • Self-examination • Self-correction

The experts contended that the list of sub-skills neither exhausts the concept of critical thinking in breadth or detail nor categorizes these skills into permanent groupings or sub-classifications. They also believe that core

cognitive critical thinking skills are non-linear and interact recursively. The critically thinking person should be able to apply the cognitive skills to the problem at hand as well as to each of the sub-skills. For example, one should be able to analyze one's interpretation or evaluate one's inference (APA, 1990).

Critical Thinking Dispositions

A prevailing attitude among many critical thinking advocates is that knowledge about critical thinking and skill in its application are only two of the three components necessary to be a critical thinker. The third component, critical spirit or disposition, consists of a willingness to approach ideas, issues, and problems in a thoughtful, critical manner (Oxman-Michelli, 1992; Siegel, 1988).

The dispositions component encompasses attitudes and tendencies rather than abilities. Dewey (1933) noted that if one had to make a choice among (a) critical thinking dispositions, (b) knowledge about the principles of logical reasoning, and (c) the skills to utilize that knowledge, the dispositions would be most important. The individual possessing a strong "critical spirit" indicates the willingness, the inclination, and the readiness to employ reasoned judgment (Perkins, Jay, Tishman, 1993).

Ennis (1991) characterized the ideal critical thinker as one who has both the disposition for and the ability to think critically. Some of the aptitudes include abilities to identify the focus of the question being asked, to analyze arguments, to ask and answer questions of clarification or challenge, and to make and judge

value statements. Dispositions held by the ideal critical thinker encompass such traits as willingness to seek clarity, trying to be well informed, using credible resources, focused on the main point, and looking for alternatives.

Paul (1993) considered dispositions as one of the four component domains of critical thinking. He believed that these affective dimensions are essential to the effective use of critical thinking in real settings. Nine traits are considered essential for the critical thinker (see Table 3).

Table 3

Critical Thinking Dispositions

Critical Thinking Dispositions

- Independent thinking
- Intellectual empathy
- Intellectual humility
- Intellectual courage
- Intellectual integrity
- Intellectual perseverance
- Faith in reason
- Intellectual curiosity
- Intellectual civility
- Intellectual responsibility

(Paul, 1992, p. 12)

Independent thinking, also called intellectual autonomy, entails a commitment to analyze and evaluate beliefs on the basis of reason and evidence. People have intellectual empathy when they can put themselves into the place of others in order to genuinely and accurately understand their viewpoints. They also may remember occasions when, despite an intense conviction that they were right, the premises that they held were wrong.

Intellectual humility involves knowing what a person does and does not know. It implies a lack of intellectual pretentiousness or conceit. It includes knowing both the logical or illogical foundations of a person's own beliefs. A person has intellectual courage when he or she has a conscious need to fairly address ideas, beliefs, or viewpoints that are counter to personal beliefs. This trait also involves an individual's ability to actively seek evidence and not passively or uncritically accept what others have proposed as true. When an individual applies intellectual standards to his or her own thinking as consistently and rigorously as is demanded of others, the individual possesses the trait of intellectual integrity. An individual with this type of integrity also will admit discrepancies and inconsistencies in his or her own thoughts or actions.

Intellectual perseverance reflects an ability to maintain firm adherence to rational principles despite difficulties, obstacles, frustrations, and the irrational opposition of others. This trait also characterizes people who acknowledge a need to struggle with confusion and unsettled questions over a period of time to achieve deeper understanding or insight into a situation or belief. People who

have faith in reason believe that using the elements of thought to think critically about issues and to encourage others to do the same will enhance and benefit not only their own personal understanding of issues and beliefs but other individual's understanding as well. Another important trait is intellectual curiosity, as it can lead to knowledge, understanding, and insight. This type of curiosity also can broaden, deepen, and sharpen a person's mind.

An individual who gives respect and full attention to another individual and honors his or her views and capacity to reason is said to possess the trait of intellectual civility. When a person is fair-minded, he or she consciously needs to treat all viewpoints alike regardless of personal inclinations. The last intellectual trait is intellectual responsibility. The individual who has this trait is one who feels strongly obligated to meet the intellectual standards required for rational, fair-minded thought.

Members of the Delphi project also addressed the character profile of an individual who would be disposed to think critically. They defined the ideal critical thinker as a person who is:

habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in

seeking results which are as precise as the subject and the circumstances of inquiry permit (Facione, Facione & Sanchez, 1994, p.6).

The literature reveals a general consensus that an integral approach to the development of good critical thinkers should include nurturing of the dispositions toward critical thinking (Browne & Keeley, 1990; Gray, 1993; Kurfiss, 1988; Oxman-Michelli, 1992; Paul, 1993; Resnick, 1987; Siegel, 1988; Watson & Glaser, 1984). Educators who emphasize the development of the critical spirit focus attention on the kind of person one is rather than on what a person can currently do. The development of both one's disposition to critically think and the skill with which to do so is dependent on the educational environment in which the student is nurtured (Oxman-Michelli, 1992). This environment should motivate students, encourage them, support their efforts, and validate the activity of critical thinking. This type of environment helps students to recognize and search for opportunities to apply their critical thinking skills. In addition, encouraging the development of critical dispositions teaches students that they have the ability, the permission, and even the obligation to engage in the critical thinking process (Resnick, 1987).

It was noted earlier in this chapter that many critical thinking skills are subject-specific. Critical thinking dispositions may be seen as general and subject-neutral. These dispositions are transferable from one situation to another if they are encouraged and found useful. Both social environment and interaction with other individuals will have a strong influence on whether the

critical spirit will be freely expressed. This author firmly believes that any study that examines the concept of critical thinking must include the concept of critical thinking dispositions. An individual must have the knowledge base and critical thinking skills to make rational judgments about what to do or believe. Without the passion to want to examine issues or to investigate differing points of view or to judge whether logical inferences and conclusions are made, the essence of critical thinking will be missing. The end result will be a non-critical examination of the everyday personal, social, historical, and professional events that govern one's life, along with a failure to adapt to the incessant and accelerating changes that surround an individual in the world today.

Critical Thinking and Nursing

The National League for Nursing (1992) has stated that nursing schools must be held accountable for demonstrating graduates' abilities to think critically and to make decisions. The faculty at the Indiana University School of Nursing have developed outcomes and competencies to demonstrate this ability (Halstead, Rains, Boland, & May, 1996) (See Table 4). Their focus is on the individual critical thinker rather than on acquiring the skills needed to think critically. The Program Outcome document also stated that faculty need to foster the development of critical thinking skills in students by (a) promoting opportunities for discussion and analysis of issues, (b) validating knowledge and examining how information is processed in reaching conclusions, and

(c) developing and refining skills consistent with life-long learning and professional growth.

Table 4

Indiana University's School of Nursing Program Outcomes Related to Critical Thinking

Outcome	Program Outcomes
A critical thinker who is able to demonstrate intellectual curiosity, rational inquiry, problem-solving skills, and creativity in framing problems.	<ol style="list-style-type: none"> 1. Evaluates decisions through logical organization, validation of information, critical examination of assumptions underlying the processing of information, and the analysis of conclusions drawn from the information. 2. Presents reasoned arguments to support stated views. 3. Guides own thinking process toward positive personal and professional development. 4. Applies previous/current knowledge to various contexts and new situations. 5. Analyzes arguments to determine their context and validity. 6. Critiques professional and research literature for use in nursing practice. 7. Examines multiple potential approaches to health issues. <p>(Halstead, Rains, Boland, & May, 1996, p. 414).</p>

In nursing, much of the review and research on the concept of critical thinking has occurred in the field of nursing education (Bauwens & Gerhard, 1987; Berger, 1984; Frederickson & Mayer, 1977; Gross, Takazawa, & Rose, 1987; McMillan, 1987; Sullivan, 1987). However, few nursing authors have attempted to define "critical thinking". Bandman and Bandman, in their book, Critical Thinking in Nursing (1988), defined critical thinking as "reasoning in which we analyze the use of language, formulate problems, clarify and explicate assumptions, weigh evidence, evaluate conclusions, discriminate between good and bad arguments, and seek to justify those facts and values that result in credible beliefs and actions" (p. 5). They believed that critical thinking in nursing involves visualizing the differences that exist in situations of certainty, near certainty, or uncertainty.

Most of the current nursing research literature that addresses the concept of critical thinking does so from the perspective of Watson and Glaser (1984) and how they defined critical thinking in their Critical Thinking Appraisal Tool (WGCTA). They defined critical thinking as a composite of attitudes, knowledge, and skills. This composite included: (a) attitudes of inquiry that involve an ability to recognize the existence of problems, an acceptance of the general need for evidence in support of what is asserted to be true, and selecting relevant hypotheses and drawing conclusions; (b) knowledge of the nature of valid inferences, abstractions, and generalizations in which the weight or accuracy of different kinds of evidence is logically determined; and (c) skills in employing and

applying the above attitudes and knowledge (Watson & Glaser, 1984). This definition is closely related to the nursing process through its problem-solving approach and therefore appears to be well accepted by nursing educators (Hickman, 1993).

However, Kurfiss (1988) contended that critical thinking is greater in scope and complexity than problem-solving. Problem-solving develops and moves from an unsatisfactory state to one that is more desired. While problems can be complex, a correct answer usually can be found using only a limited number of approaches that follow sequential steps. In contrast, critical thinking is not a strategy to produce a product or solution, nor does it consist of a sequence of operations (Beyer, 1987; McPeck, 1981). Rather, it is a process with the goal of thinking critically to construct a plausible representation of the situation or issue which then can be presented in a convincing argument in order to make more informed and reasonable judgments (Kurfiss, 1988).

Reasoning in nursing practice, as well as in other professions, combines characteristics of both problem-solving and critical thinking. Nurses are frequently confronted with complex problems that demand resolution within a given time frame. It is vital for nurses to know when to end thinking, conclude the evaluation of various alternatives, and make a decision using their knowledge and experience. They can take a course of action with the realization and knowledge that the decision, itself, still may be flawed or imperfect. While

still self-assessing their thinking, nurses who analyze, evaluate, and make inferences concerning the results of their actions are using critical thinking skills.

Epistemology-based Critical Thinking

Critical thinking is a complex construct that is based on the logic of the academic discipline (Paul, Nosich, & Fisher, 1992). This logic, or epistemology, is what establishes the agenda for how a discipline is taught; it influences the approaches individuals take when solving complex thinking tasks in that discipline (Kurfiss, 1988). The epistemologic considerations of a discipline comprise an assemblage of concepts, logical relationships, criteria, assumptions, empirical evidence, interpretive beliefs, and recognized implications by which one organizes, guides, and structures the reasoning, knowledge, and beliefs of the domain (McPeck, 1981, Meleis, 1985, Paul, et al., 1992).

Critical thinking in nursing must embody not only abilities and dispositions but also include the epistemologic structures of nursing. When teaching critical thinking, one must be clear about the basic concepts of the discipline as well as the logic that nurses use in dealing with issues and problems. Knowing the facts is not enough; people need domain-specific ways of organizing perceptions and attacking problems. Paul (1992) encouraged educators to discover what those who work in their discipline actually do, "where they start, how they approach their subjects, how they correct their own thoughts, how they gather and assess information and so on" (p. 18).

Inherent in practice disciplines such as nursing is the belief that knowledge develops, for the most part, from clinical practice. Experience then becomes the essential component for knowledge development (Meleis, 1985). Nursing knowledge ranges from the intuitive "knowing" of the expert nurse to the systematically verified knowledge of empirical researchers.

Carper (1978), through review of the nursing literature, identified four patterns of knowledge most valuable to the discipline of nursing: empirical, aesthetic, ethical, and personal. Empirical knowledge, or the "science" of nursing, requires factual and theoretically-based explanations that can be validated. The pattern of aesthetics, referred to as the "art" of nursing, leads to joining significant but dissimilar human experiences to some deeper level of meaning which engender the basis for compassion combined with a holistic perception of the situation.

For Carper, the ethical pattern of nursing knowledge is based on understanding differing philosophical perspectives regarding matters of moral judgments and obligations. Personal knowledge is paramount in order to understand the meaning of health and individual well-being; yet it is the most difficult to master and to teach. This pattern is concerned with the quality of interpersonal contacts, promoting therapeutic relationships, and individualized care. Chin (1989) extended Carper's concepts further when she introduced product and process dimensions that were associated with each pattern of knowing.

The products of empirics include describing, explaining, and predicting; it involves the scientific method of inquiry. Esthetics is characterized by representing, interpreting, and envisioning; it is seen as the art of nursing. Clarifying, valuing, and advocating are dimensions found in ethics and are reflected in the professional code of conduct. Personal knowledge is expressed by experiencing, centering, and realizing. The use of the authentic self in nursing practice is the process through which personal knowledge is expressed. None of these patterns alone achieves the goals of nursing or the enhancement of critical thinking and intellectual development. Instead, it is the interrelationship among the four that defines the richness and complexity of nursing knowledge and intellectual development of individuals in this discipline. Chin and Jacobs (1978) contended that once all patterns of knowing are recognized as legitimate methods of developing new knowledge, what is known or understood about nursing's knowledge base will change and expand significantly.

Critical Thinking and Intuition

Relevant to the concept of critical thinking is the concept of intuition. Intuition is defined as "the immediate apprehension that something is so without benefit of conscious reasoning" (Suralnik, 1985). It involves responding to information that is not consciously represented but which can guide inquiry toward productive and often profound insights (Gambrill, 1990). This is compatible with the differences Benner (1984) found between expert and novice nurses. Experts no longer rely on analytical practices and rigid rules as a guide

for practice. Instead, they have internalized rules, cues, and knowledge found in the common experiences of practice that they may no longer be able to describe. Intuitively, the expert nurse comprehends and understands without benefit of conscious reasoning.

Quality nursing practice does not rest solely on the use of intuition. Although much may be known intuitively in nursing situations, when placed in unfamiliar circumstances, proficient and expert nurses may need to use analytical skills, rules, and protocol to think through a situation. The thinking nurse is a reflective practitioner who has learned the art of critically "noticing" unusual circumstances that deviate from the norm. This nurse constantly reviews knowledge for accuracy and relevance in new situations and knows when to activate disciplined reasoning in order to provide safe nursing practice. Sound nursing practice involves much that is and should be automatic and intuitive in order to free the mind to be more attentive and critically aware of the individual needs of the client. Novice nurses can begin the process of developing nursing intuition by using the logic of the nursing discipline to transform information into knowledge. This knowledge then becomes the basis of sound, intuitive, and critically monitored nursing practice (Paul & Heaslip, 1995).

Critical Thinking and Nursing Education Research

In the last decade, nursing researchers have demonstrated an increased awareness of the concept of critical thinking and a heightened interest in its influence on nursing education and clinical practice. The nursing research

studies relevant to critical thinking can be divided into three areas: the impact of nursing education on critical thinking; the influence of critical thinking on clinical performance, in particular, the ability to make clinical judgments; and the effect of critical thinking on achievement and accomplishment in nursing education. Following a discussion on these three areas, an analysis of the research findings will be presented.

The impact of nursing education on critical thinking. Five studies presenting longitudinal data showed mixed results regarding the impact of nursing education on critical thinking. Four of these studies found no significant change in critical thinking abilities over the periods of their studies. Berger (1984) administered Watson and Glaser's Critical Thinking Appraisal (WGCTA) instrument to 137 generic baccalaureate students in the sophomore and senior years of study. No significant gains were found in scores. Bauwens and Gerhard (1987) administered the WGCTA to baccalaureate students as they entered and exited upper division course work in the program. For the 53 students who took both of the tests, no significant differences were found between entry and exit. Sullivan (1987) administered the WGCTA to nursing students at the beginning and end of their baccalaureate program. Of the 46 students who took the test on both occasions, entry and exit results showed no significant differences. Kintgen-Andrews (1989) looked at changes on the WGCTA over an academic year. Subjects in her study included practical nursing students (n=55), university pre-health science freshmen (n=38), two-year

associate degree nursing students (n=55), and university generic nursing program sophomores (n=29). None of the groups made a significant gain over the academic year.

In contrast, the study done by Gross, Takazawa, and Rose (1987) is the only one identified in the present literature review that showed gains in critical thinking over time. They administered the WGCTA to two different groups of students on both entry and exit from their nursing programs. Both the two-year associate degree program students (n=37) and the generic baccalaureate nursing students (n=34) showed significant improvements between entry and exit scores.

Ten studies presented in the literature show cross-sectional data concerning nursing education and critical thinking. Six of these studies supported the impact of nursing education on critical thinking. Frederickson and Mayer (1977) administered a general critical thinking test to 27 second-year associate degree students and 28 baccalaureate senior students. Results of the study revealed that the baccalaureate students scored significantly higher than the associate degree students. Lynch (1988), in a later study using a larger sample size (87 two-year associate degree and 74 baccalaureate graduating seniors), showed similar results. Brooks and Shepherd (1990) administered the WGCTA to 50 students in their last year of nursing school from each of four programs: generic baccalaureate program, RN to BSN program, two-year associate degree program, and hospital diploma program. Results of the study revealed that the

generic baccalaureate and the RN to BSN students had higher scores than the other two groups. Scoloveno (1981) also studied students from three different nursing programs. She administered the WGCTA to 97 third-year hospital diploma students, 93 second-year associate degree students, and 90 senior baccalaureate students. The students finishing the baccalaureate program scored significantly higher than students finishing the other two programs.

The sixth cross-sectional study, by Beeken (1997), examined the impact of nursing education on critical thinking. The California Critical Thinking Skills Test was administered to 100 staff nurses. Results showed that scores for nurses with a baccalaureate education were statistically and significantly higher than the scores of nurses with an associate/diploma degree.

The four remaining cross-sectional studies failed to support the impact of nursing education upon critical thinking. Matthews and Gaul (1979) found no significant differences in scores when they analyzed the results of the WCCTA taken by 26 graduate and 22 undergraduate students. Dungan (1986) found no significant differences among the Cornell Critical Thinking Test scores of 23 entering nursing freshman, 31 two-year associate degree nursing students, and 43 senior generic baccalaureate nursing students. Brigham (1989) administered the WGCTA to 111 generic baccalaureate nursing students using a stratified random sample from each class level and found no significant differences among any groups. Saarmann, Freitas, Rapps, and Riegel (1992) found no significant differences in critical thinking abilities, when the influence of age was

controlled, among equal sample size groups($n=32/\text{group}$) of registered nurses newly graduated from a baccalaureate program, associate degree prepared registered nurses, sophomore college students entering a baccalaureate nursing program, and nursing faculty prepared at the master's or doctoral level.

Critical thinking and clinical judgment. Studies reviewed were limited to those that measured both critical thinking and clinical judgment. Seven studies of critical thinking and clinical judgment present mixed or contradictory results. Of the studies previously cited, only Scoloveno (1981) showed both critical thinking and clinical judgment to be influenced by nursing education. Frederickson and Mayer (1977) and Pardue (1987) showed that higher education level is related to higher critical thinking ability but not to better performance in clinical judgment. In contrast, Matthews and Gaul (1979) and Dungan (1986) found that higher educational level is related to better performance in clinical judgment but not to higher critical thinking ability.

Two other studies reported no relationship between critical thinking and clinical judgment. Tanner (1977), in her study of 54 senior baccalaureate nursing students, found no relationship existed between WGCTA and any of the seven dependent measures related to clinical judgment. From her study of 66 senior baccalaureate nursing students, Gunning (1981) found no significant relationship between critical thinking ability and clinical problem-solving ability, as measured from nursing performance simulation tests.

Critical thinking and achievement in nursing education. Three of the studies discussed previously also looked at the correlations between critical thinking scores and measures of nursing achievement. The results, again, proved to be mixed. Berger (1984) found no significant relationships between scores obtained on the WGCTA and cumulative nursing grade point average. Kintgen-Andrews (1989) found correlations between these two measures to range from .24 to .65. In Sullivan's (1987) study, no correlation was reported between clinical skills of graduating RN to BSN students and either entering or exiting WGCTA scores. Bauwens and Gerhard (1987) reported a .31 correlation ($p=.002$) between entry level WGCTA scores and National Council Licensing Examination (NCLEX) scores. Kintgen-Andrews (1989) related similar results.

Summary of studies on critical thinking and nursing. It is not the intent of this section of the paper to analyze the above studies with regard to sample size, design, or adequacy of the instruments, except for the Watson and Glaser Critical Thinking Appraisal instrument. Instead, a summary of the results and some general insights will be given as to why the conclusions, for the most part, indicate a lack of support for the impact of education on critical thinking, the impact of critical thinking on clinical judgment, and the impact of critical thinking on achievement in nursing.

Analysis of the preceding studies indicates that the influence of education on critical thinking, both in longitudinal and cross-sectional data, has mixed results and that strong support for its impact is lacking. This conclusion also

appears true for studies that tested critical thinking as it relates to clinical judgment.

One interpretation for these findings may be the utility of the Watson-Glaser Critical Thinking Appraisal (WGCTA) tool. The WGCTA was developed to provide a sample of the ability to think critically about statements found in daily work, magazines, and newspapers. McMillan (1987) concluded that "...it is not surprising that it would be difficult to show how a specific curriculum, course, or teaching strategy affects such general critical abilities in a different context from what was studied in class" (p. 10).

A second reason that nursing education may have had little impact on critical thinking can be found in adult development theory. Studies have indicated that students who enter college believe that knowledge is a collection of discrete facts, that learning is simply a matter of acquiring information delivered by the professor, and that development to higher levels of thinking is slow to come to fruition. Since nursing research studies have shown mixed results as to factors that influence the enhancement of critical thinking, Tanner (1993) and McGovern and Valiga (1997) contended that in light of the thinking required to make reasoned decisions in nursing practice, the relationship between critical thinking and cognitive development needs to be explored.

Cognitive Development

The terms intellectual development and cognitive development have been used interchangeably in the literature. In this study cognitive development will

be used, as it better denotes a change in how one thinks rather than a change in intelligence. The concept of cognitive development is defined as the ability to forgo more state-dependent, systematic, personal experiences for ones that are abstract, conceptual, stable, and impersonal (Werner & Kaplan, 1963). Cognitive development also has been described as a transformation in thinking which occurs when situations become increasingly complex or which can be applied to novel situations (Adams & Zhou-McGovern, 1983).

Cognitive development often is segregated into two distinct periods of time—one of child development and the other of adult development (Sternberg & Berg, 1992). More recent developmental theorists are turning away from this dichotomous perspective and are describing and explaining cognitive development as a process that occurs across the life span (Baltes, Dittman-Kohli, & Dixon, 1984; Case, 1992; Sternberg & Berg, 1992). Critics of the child/adult dichotomy contend that these two periods, along with the sublevels of changes in each of them, lack clear criteria on what type of cognitive activity distinguishes one stage from another (Fischer & Pipp, 1984). In fact, many cognitive theorists contend that development is measured by its nearness or distance from the adult or ideal form and is the consequence of a complex set of hereditary and environmental influences that can vary over an enormous range (Bidell & Fischer, 1992; Kessen, 1984). The ability to think critically, which involves the capacity to synthesize multiple and diverse components of an issue and to engage in a process of decision-making that is reflective, reasonable, and

contextual, occurs at the more advanced stages of intellectual development for most individuals (Kurfiss, 1988; Paul, 1993; Thayer-Bacon, 1993).

Theoretical Perspectives on Cognitive Development

Great diversity exists within the theoretical perspectives that guide research in cognitive and intellectual development, with no one viewpoint appearing to dominate the field (Berg, 1992). Presently, six perspectives offer differing points of view on how intelligence is formed, maintained, improved, or diminished across the life-span. These views include the psychometric perspective, the Piagetian perspective, the neo-Piagetian perspective, the information-processing perspective, the learning perspective, and the contextual perspective. Each perspective will be briefly reviewed here.

The psychometric perspective. The psychometric perspective of cognitive development has a long history dating from the work of Sir Francis Galton in the 1800's. This perspective focused on the nature of intelligence by testing the intellectual product (i.e. physical-sensory and higher order intellectual abilities) that characterizes an individual's intelligence at different times during development. Theorists from this perspective analyze a person's optimal performance on a particular measure of intelligent functioning. Intellectual abilities that distinguish differences during adulthood include verbal and mathematical skills, abstract and visual reasoning, components of memory, crystallized intelligence, and fluid intelligence (Gardner & Clark, 1992; Horn & Hofer, 1992). Crystallized intelligence is defined as an ability that is influenced

by acculturation and formal schooling and includes such things as vocabulary and word knowledge. Fluid intelligence encompasses the ability to adapt to new situations and to perform abstract reasoning which depends more on biological and physiological influences than on formal schooling (Berg, 1992). Intelligence tests used to evaluate a person's psychometric cognitive abilities include such measurement instruments as the Stanford-Binet Intelligence Scale, the Wechsler Intelligence Scale, and the Differential Ability Scale.

The Piagetian perspective. The Piagetian perspective focused on the universal changes in mental functioning that occur from infancy into adolescence. Piaget (1972) viewed intelligence as the outcome of constructing knowledge from an individual's interaction with the environment. This interaction results when a person's knowledge no longer represents or adequately explains what is being viewed in the environment, resulting in disequilibrium for the person. New cognitive structures are then developed in order to restore equilibrium between one's existing cognitive structures and the environment. These new cognitive structures represented a particular developmental stage or period. Piaget (1972) identified four broad stages of intellectual development: the sensorimotor stage, the preoperational stage, the concrete operational stage, and the formal operational stage. It is the fourth stage in which the mental structures, such as the ability to abstract, analyze, synthesize, and form true concepts, become increasingly developed and refined by most individuals. This operational stage begins at the age of eleven or twelve, although it is not

necessarily attained by everyone or at that age. Formal thought represents an explicit or implicit orientation toward problem-solving rather than generalized or specific behaviors. Piaget also contended that these abilities, once established, remain stable because they are not modified during an individual's lifespan (Inhelder & Piaget, 1958).

Many present-day developmental theorists believe that Piaget's perspective infers a limited view of adult cognition (Blackburn, 1984; Blackburn & Papalia, 1992; Dixon & Bates, 1986). These critics contend that while Piaget's theory emphasized a uniform process of development until adolescence, he failed to explore whether development actually remains stable from that point into adulthood. In fact, there have been relatively few studies employing formal reasoning measures in adults. A need exists for further research to examine whether an individual's formal operational task development truly remains stable or, as presently believed, reflects a greater complexity in thinking (Blackburn & Papalia, 1992).

The neo-Piagetian perspective. The neo-Piagetian perspective developed from criticism of Piaget's theory as well as from a need to understand how his theoretical concept withstood scrutiny when applied to the more general domain of life-span development. Neo-Piagetian theorists, while maintaining most of Piaget's perspective on intellectual development (i.e. the concepts of cognitive structures) postulated that the search for universal stages needed to be abandoned and replaced with the following: (a) understanding how the

cognitive structures are applied within a specific domain and not universally across domains, (b) understanding how cognitive structures differ with each individual, (c) understanding how individuals differ in their application of cognitive structures, and (d) understanding the effect when cognitive structures are integrated with emotional structures (Berg, 1992). Thus, neo-Piagetian theorizing extends beyond adolescence and the stage of formal operation into adulthood. It describes this period as a time when dialectical forms of thought are integrated with affective and emotional ways of understanding (Labouvie-Vief, 1992). Dialectical forms of thought include contradiction, change, and logical reasoning.

The information processing perspective. Proponents of the information-processing perspective, which had its beginnings in the early 1800's, defined it as a psychological approach that sought to identify what happened during the various stages of information processing. These stages now include acquisition, storage, retrieval, and use of information (Reed, 1996). Today, the information-processing perspective permeates the study of cognitive psychology. Theorists from this perspective characterize human thought in a fashion similar to the way in which computers access and process information. This operation consists of the internal representations of information, the processes that operate over real time on these representations, and the output of specific intellectual responses (Kail & Bisanz, 1992). According to Kail and Bisanz (1992), four major assumptions prevail in this approach. The first assumption is that cognitive

phenomena can be described and explained in terms of mental processes and representations that intervene between observable stimuli and responses. This assumption infers that information is represented and manipulated internally by mental processes. The time it takes an individual to perform this process helps to explain human performance on a variety of cognitive tasks. The second assumption is that a relatively small number of elementary processes underlies all cognitive activity. As with computers, a human can perform multiple tasks with only a small number of fundamental processes that may vary in complexity. Such processes include decoding information and comprehension. Information processing theorists are working on identifying the exact number and the nature of these fundamental processes.

A third assumption is that individual processes operate in concert. Even though there are only a small number of fundamental processes, they are only useful when combined with other operations to form higher-order functioning and task performance. The fourth assumption is that cognitive development occurs by means of self-modification of one's internal environment. This means that mechanisms that enable an individual to develop cognitively occur in one's internal environment rather than by being influenced by mechanisms in the external environment. Although the importance of the external environment is always considered, information process proponents believe that it is the individual's internal environment that ultimately encodes, stores, indexes, and processes information. This process then becomes self-modifying.

Development is viewed as a series of cognitive states connected by transitions and influenced by change. Two types of changes that influence development have been speculated by information processing theorists. One includes a change in mental procedures and rules which become more sophisticated, discriminating, or generalized; the other involves a change in mental effort that increases as individuals increase their mental resources and develop their critical thinking skills (Kail & Bisanz, 1992; Klahr, 1989; Newell, 1988, Palmer & Kimchee, 1986).

Much of the research conducted by information processing theorists focuses on how children process information and how processing speed and accuracy change with the increased knowledge base that develops as children grow and learn. In terms of how processing information changes during adult development, research has focused on the impairment or delay in processing information with advancing age during any given task (Kail & Bisanz, 1992). Other research areas involving adults have examined how mental impairment or physical damage to the brain has affected cognitive processing. In the past ten years, information processing researchers have become interested in the degree to which knowledge and performance are domain specific, in part, because they felt a need to understand why an individual's success in one domain does or does not transfer to other domains.

Domain specific knowledge is defined as knowledge about a specific subject, such as nursing, medicine, or sociology (Reed, 1996). Research findings

have shown that age may produce changes in processing speed in domain specific areas. Such changes include a more rapid access to information due to a more elaborate and more intricately patterned knowledge base and acquisition of more efficient strategies for task solution (Anderson, 1982; Chi, 1977; Roth, 1983). However, this processing speed often slows down in the elderly and accounts for some of the decline in performance in a number of cognitive domains for this age group (Salthouse & Kail, 1983).

Another area of interest for information processing researchers involves identifying characteristics of environmental experiences that contribute to intellectual development. Work in this area has focused on the frequency of an individual's exposure to certain problems, types of contingent reinforcements that individuals receive, and types of environmental conditions (i.e. danger, stress, novelty) that may occur while attempting to process information (Kail & Bisanz, 1992; Siegler, 1989).

The learning perspective. The classical learning perspective on intellectual development had its beginning in the early 1900's, with Thorndike as one of its leading proponents (Berg, 1992). Thorndike and others of his era proposed that successful learning was dependent upon the student's interest in those things he or she did well and dependent upon the tendency to repeat or recall positive experiences while avoiding or forgetting negative or boring experiences. This psychological bent to the learning perspective led to the

infusion of the concepts of exercise (frequency) and effect (reinforcement and operant conditioning) into school curricula (Smith, 1977).

Today, the learning perspective has been revised, retaining some of the concepts of the classical learning perspective, while adopting many of the cognitive constructs of the information-processing perspective. The revised learning perspective is called “resurgent learning theory” (Berg, 1992).

Proponents of a learning approach have concentrated on middle childhood through middle adulthood, while proponents of a developmental approach observe changes that occur during periods of rapid qualitative shifts in abilities, such as infancy or senescence (Canfield & Ceci, 1992). Within the learning perspective, emphasis is centered on the distinction between learning and development.

Both learning and development involve change. Learning is seen as a process associated with relatively small day-to-day accumulations of skills and knowledge that directly or indirectly cause changes in mental content, organization, competence, or performance (Canfield & Ceci, 1992). Learning enables individuals to respond and adapt differently to familiar environmental events.

Development, in particular intellectual development, refers to a form of growth that increases an individual's capacity to learn. It usually is denoted by the number and ordering of an individual's learning experiences and the changes in the amount and organization of knowledge (Baer, 1970, Greeno,

1980). Development often is found to include global or radical psychological changes and is more lasting than learning (Canfield & Ceci, 1992). Learning theorists claim that intellectual development is a process by which people become more competent in their skills or level of expertise over time (Charness & Bieman-Copland, 1992). They also view intelligence as a complex construct and define it as a set of skills or expertise that enables an individual to be a more effective problem-solver (Charness, 1988).

Learning theorists suggest that the content of knowledge and experience must be considered as another catalyst to developmental change (Canfield & Ceci, 1992). It is believed that an individual's knowledge base is the primary cause of intellectual development (Chi & Ceci, 1987) and that this growth results from conflicts that the individual encounters in the environment (Canfield & Ceci, 1992). This process is similar to Kuhn's (1992) concept of paradigm shift. New information is accumulated and stored in one's memory. If the new knowledge conflicts with what is already known by the individual, the structured knowledge then undergoes a "tuning " process so that the new schemata, or organized memory structure, applies to reality in both a general and specific manner. Following this event, learning theorists hypothesized that the old knowledge base is restructured because new conceptual categories are needed or old structures no longer explain the phenomenon at hand (Reed, 1996).

The novice-expert contrast exemplifies the learning perspective. Many studies have shown that in cognitive tasks tied to a specific domain, experts

excel over novices because of their rich, well-organized, domain-relevant knowledge base (Benner, 1984; Canfield & Ceci, 1992; Ceci & Cornelius, 1989; Ericsson & Charness, 1994; Flavell, 1984). Experts demonstrate a superior ability to recall information, a higher reading comprehension, and a greater ability to form new concepts than novices within the same domain, even when the latter are chronologically older or have higher IQ's. When comparing cognitive performances of novices and experts in various domains, experience has been shown to be a major determinant of ability (Anderson, 1982; Benner, 1984), although it will not always guarantee optimal performance or thinking (Berg, 1992).

The contextual perspective. The newest viewpoint on intellectual development, the contextual perspective, comes from a variety of historically prominent educators, such as William James, John Dewey, and George Herbert Mead. They advocated integrating pragmatic philosophy, evolution and development, and psychological issues into developmental psychology (Dixon, 1992). A second influential group, comprised of psychologists such as Lev Vygotsky, Alexander Luria, and Klaus Riegel, contributed to the contextual perspective by emphasizing the historical and contextual roots of all psychological functioning. They were instrumental in developing cross-cultural developmental psychology (Dixon, 1992).

Theorists from this perspective argued that the construct of adult intellectual development contains both multidimensional and contextual

characteristics. Multidimensional characteristics include beliefs that there are multiple aspects of intelligence (i.e. crystallized and fluid, schematic representation, concept formation) that may be both independent and interrelated and may include practical and functional forms of intelligence. Contextual characteristics include biological, psychological, ecological, and sociohistorical events or changes that may affect developmental processes at any level. These include such differences as unique life histories as well as specific social, historical, and educational experiences. Contextual theorists like Dixon (1992) claim that multidimensional and contextual characteristics aid in describing differences in cognitive performance during an individual's life-long intellectual development. Theorists from this perspective contend that adult intellectual performances must be examined and understood in the context of the relationship between changing intellectual abilities and the changing contextual demands present in the adult's environment. Thus, the contextual perspective is one that offers less a new theory of adult intellectual development than a new set of questions, issues, and emphasis (Dixon, 1992).

In summary, when taken together, these six perspectives illustrate a complex and detailed view of intellectual development that occurs across an individual's life-span. They provide a more complete picture of intellectual development than is possible within any single perspective. Each perspective adds an important dimension of intelligent functioning. Several important implications can be generated from these six viewpoints. First, intellectual

development does not end during adolescence, as suggested by the Piagetian perspective, but, in fact, continues into adulthood. Second, there exists enormous variability in the course of cognitive development, and that at any point individuals can differ in their level and form of intelligence. Third, it is important to note that when at least six different perspectives attempt to explain the same construct, the construct itself remains open to interpretation and challenge.

Adult Cognitive Theories

Two additional theoretical perspectives will be discussed in this section, and differ from the six presented above in terms of focus. Like Perry's theoretical perspective presented at the beginning of this chapter, Belenky, Clinchy, Goldberger and Tarule (1986) and Kitchener and King (1981) focus on the progressive stages of cognitive development that adults go through when making meaning of their experiences. Perry studied cognitive development in male college students, while Belenky, Clinchy, Goldberger and Tarule (1986) addressed cognitive development in college women and in women who were clients in human service agencies. Kitchener and King (1981) developed a model of reflective judgment, also based on Perry's work, that involved both male and female college students and adults.

Women's ways of knowing: The development of self, voice, and mind.

Belenky, Clinchy, Goldberger and Tarule (1986) articulated in their book, "Women's Ways of Knowing: The Development of Self, Voice, and Mind",

a cognitive-development theory based on Perry's work. Their focus, however, was on women and the five intellectual development stages they progress through from the lowest stage of Silence to the highest stage of Constructed Knowledge. As psychologists interested in human development, they began their study of women from the theoretical assumption that women shaped their beliefs about knowledge and truth from the male-dominated majority culture. The goal of their project, which began in the late 1970's, was to identify, through extensive interviews, modes of learning, knowing, and valuing that might be common in women.

The first perspective is that of Silence. Although Belenky, et al. (1986) found few women in this stage, many women articulated this outlook in retrospect. While in this stage women view themselves as powerless and disconnected. They hold a dependent view of the self and believe that the source of self-knowledge is held by others. They appear unaware of the power of words in the transmission of knowledge, so instead remain silent. This perspective was not found among women in the college sample.

The second perspective is labeled Received Knowledge. In this stage women are dependent upon authorities as the source of all knowledge. They believe that words are central to the knowing process, but that this knowing is imparted by someone else. They learn by listening but have little confidence in their own abilities to speak. They equate receiving, remembering, and reciting the words of authorities as learning. They use the power of their voices and

minds with friends but turn to authorities for truth, direction, and information.

Women with this outlook hold beliefs that are concrete and dualistic.

Perspective three is identified as Subjective Knowledge. There are two distinct divisions in this position: the inner voice and the quest for self. Women hearing the inner voice begin to view truth as personal, private, and subjectively known or intuited. Although remnants of dichotomous and absolutist thinking remain, there is a significant shift for women. They begin to listen to the “still small voice” within themselves and to build an inner source of strength, thus becoming their own authority. In the second phase of Subjective Knowledge, the quest for self, Belenky, et al. (1986) described women as beginning their developmental journey by walking away from the past. In conjunction with this, however, are the feelings of bewilderment over the sense of loss of who they were and who they will become. Their self-concept will fluctuate considerably at this stage, but in the end these women experience an increase in strength, optimism, and self-value. Remaining from the former position of Constructed Knowledge is their concern about hurting the feelings of their opponents; in fact, women may even hide their true feelings in order to maintain peace.

The fourth perspective, Procedural Knowledge, entails both separate and connected knowing. The basis of separate knowing is critical thinking; thus, this outlook has emphasis on using disciplinary methods of reasoning and looking more objectively at what others present as knowledge. Interviewed women spoke of truth not being immediately assessable, that you cannot just know

something. Instead of looking for what is right, women in this position tend to doubt everything, everyone, and even their own thinking. They often use argument or critical discourse as the form of conversation among friends. The journey through separate knowing is not viewed as progressive because the inner voice gives way to the critical voice. Women tend to remove their feelings and personal beliefs from the process of discovery and are strictly impersonal in their thinking of the information presented. Yet it becomes a necessary part of the journey, because it provides women with the tools and skills necessary to question the reasoning of authorities.

Women in the Connected Knowing position believe that personal experience is intertwined in all knowledge that is considered trustworthy. At the center of this knowing is the capacity for empathy. Since knowledge comes from experience, these women are interested in what people think and how they form their opinions, feelings, and ideas. They view other people's experiences as unique to them, and they do not measure other people's views by some impersonal standard. Connected knowers want to understand and not judge divergent views offered by other people.

The final perspective that Belenky, Clinchy, Goldberger and Tarule (1986) describe is that of Constructed Knowledge. This outlook integrates the knowledge learned from others with the "inner truth" of experience and personal reflection. Individuals understand that the knower and known are intimately intertwined and exist in a particular historical and cultural context. This viewpoint

brings together the interplay of rationality, caring, and commitment. Individuals are able to step outside a particular context and look back on “who” is asking the question, “why” the question is asked at all, and at “how” answers are determined. Women in this stage become engaged in the search for understanding. The self always is included in their knowing process, and these women are committed to nurturing rather than criticizing ideas. Constructed knowers seek integrated, authentic lives that contribute to improving the quality of life in others through empowerment.

Kurfiss (1988) believed that Perry's ideas and those of Belenky et al. (1986) can be merged into a common, complementary model (see appendix A). With the linking of these two models into one common model, the intellectual development process can apply to both men and women. However, several differences between the two models exist. One difference is the identification by Belenky et al. (1986) of a level before dualism or received knowledge. They called this perspective “silence”. Though not found among college women, it was retrospectively identified by some of those women and a few of the non-college women who had been isolated or abused by male authority figures. A second difference can be associated with identification. In Perry's research men tended to identify with the male authority figures, whereas in the Belenky et al. (1986) study, the women tended not to identify with authorities. This was, in part, due to the relative absence of female authority figures and the negative attitudes towards women expressed by many male professors in colleges and

universities (Kurfiss, 1988), A third difference is viewed as women's belief in their responsibility to help others; Perry did not address this difference in his research findings. Another difference is in the gaining of a voice and how this voice changes at each level of development for women.

Women in level one (received knowledge) are unable to listen to their own voice; instead they rely on others to provide knowledge and direction. In level two (subjective knowledge) women begin to listen to their own inner voice; by level three (procedural knowledge) the voice is expressed outwardly as challenging opinions, knowledge, and expressing empathy for others' viewpoints. The fourth level (constructed knowledge) describes the integration of the outer and inner voice in the search for understanding; it favors interaction with others as a way of knowing. In contrast, Perry's research findings showed that male participants identified objectivity and distance as ways of knowing. A final difference has been found in connected knowledge. Women found that establishing supportive relationships allowed them to facilitate the process of honest criticism, while Perry did not acknowledge the development of supportive relationships as part of the intellectual development process.

Reflective judgment. Kitchener and King (1981) have developed a model of reflective judgment that describes a series of changes that occur in the ways adolescents and adults understand the process of knowing. This process strengthens their abilities to evaluate knowledge claims, defend their personal points of view on controversial subjects, and judge the adequacy of alternative

solutions when they are presented. The development of this model was influenced by Perry's work (Kitchener, 1983). This model outlines stages of development in reasoning in terms of seven sets or stages of assumptions about knowledge itself and how it is acquired. Additionally, the roles of evidence, authority, and interpretation are discussed for each stage. In the reflective judgment model, an interview methodology was used to ask students about four dilemmas in the domains of physical science, social science, history, and biology. The dilemmas represent problems that possess a great deal of uncertainty, even for experts of the domains.

Stage one is characterized by a single-category belief system that an absolute relationship exists between what is perceived and what is: what one observes to be true is true (Kitchener & King, 1990). Little or no justification of the belief is required since it is assumed that an individual only needs to observe to know the truth. Knowledge and beliefs are identical. Individual thinking is naïve and simplistic.

Stage two is illustrated by the belief that while there is a true reality that can be known with certainty, it may not be readily available to everyone. Certain knowledge is considered truth when known by indisputable authorities in their domain of expertise (scientist, teacher, priest, or rabbi). Knowledge is gained by direct observation or by what legitimate authorities say to be true. Individuals who recognize that knowledge may not be directly or immediately

known represent an advancement over stage one. The individual has a two-category belief system: some beliefs are right and others are wrong.

Characteristic of the third stage is the acknowledgment that some truths are temporarily inaccessible, because all knowledge cannot be known at once, even by indisputable authorities. At some point absolute truth will become apparent through the discovery of concrete data. During the period of time that the evidence for truth remains incomplete, everyone, even authorities, can only express their personal feelings of what might be true. This stage now has a three-category belief system: right, wrong, and uncertain.

Stage four begins with the understanding that reality cannot be known with certainty because of situational variables. These variables include changes that occur over time with the discovery of new information. Individuals begin to understand that there are many possible answers to every question and that knowledge claims are idiosyncratic. Therefore, what is true for one person is not necessarily true for another person. These beliefs are a step above stage three because an individual admits that uncertainty may remain as part of the knowing process, and that right/wrong beliefs occur only occasionally rather than frequently.

Stage five is characterized by the understanding that objective knowledge does not exist and that reality can only be known through interpretation of data relative to a particular context or domain. A person's beliefs are justifiable only within a given context because different contexts have different rules of inquiry

and different perspectives. These beliefs extend beyond stage four because individuals only gain knowledge by making legitimate interpretations of data via evidence and rules of inquiry within a particular perspective.

Stage six is distinguished by the belief that since knowledge is based on subjective interpretations, absolute truth is not possible to attain. However, some personal certainty about beliefs can be achieved based on evaluation of evidence and the quality of arguments that have been applied to all perspectives. Individuals begin to perceive certain points of view that are more justifiable, better founded, more rational, and more reasonable than other points previously presented. This perception occurs whether it is within the same domain or across different domains due to access to rules of inquiry that apply across content. This constitutes an advancement from stage five because individuals now see relationships between subcategories in different domains.

In stage seven, which is the understanding that reality is never a “given”, an individual can believe with certainty that some knowledge claims are better or have greater truth value than others. Knowledge must be constructed via critical inquiry or through the synthesis of existing views and evidence, and a judgment can only be viewed as the most reasonable, current solution to a problem. Individuals at this stage display a complex comprehension of issues and an understanding that current knowledge, with the collection of additional data or reinterpretation of existing data, may need to be restructured in the future and may result in a new point of view.

As with Perry's (1970) model of Intellectual Development and Belenky et al.'s (1986) Women's Ways of Knowing model, educational exposure influences the qualitative and quantitative progress students make through the seven stages. King and Kitchener (1985) conducted numerous studies that showed that reflective judgment scores increase with the number of years of schooling from high school level to advanced doctoral level. They contended that formal academic work increases the ability to make knowledge claims based on the evaluation of data, evidence, and context.

Cognitive Development and Baccalaureate Education

Using Perry's cognitive development positions as a theoretical framework, many researchers have found that the majority of college students rank in positions two to four (Stephenson & Hunt, 1977; Stonewater & Daniels, 1983). Other research findings indicate that students move one third to one half a step between positions with each year of additional education (Frisch, 1987). In a study by Mines, King, Hood, and Wood (1990), cognitive development and critical thinking were investigated. The results showed that students at higher levels in their educational process reached a more advanced level of cognitive development and had better critical thinking skills than those who were at lower levels. A study conducted by Stonewater & Daniels (1983) indicated that intellectual maturity can be influenced when instructional strategies are designed to enhance cognitive development.

Cognitive Development and Nursing

Several researchers have focused their investigations on cognitive development and nursing (Frisch, 1987; Gambino, 1995; McGovern & Valiga, 1997). Frisch (1987) investigated the intellectual development of two separate groups of junior nursing students (N= 42). These students were evaluated at the beginning and end of an academic semester. During the semester, the students were exposed to both clinical and didactic learning experiences that could have an impact on cognitive development. An instrument was developed by the author to measure intellectual development and critical thinking in college students based on Perry's intellectual development positions. Students provided written responses to two questions about their feelings and actions in educational settings. Using defined criteria, two experienced raters analyzed the data, first independently, with interrater reliability of 86.5 percent, and then together, placing each participant into an intellectual development position. The findings of this study showed that a majority of the students in both groups were operating at Perry's multiplicity position. This position indicates that a student assumes that, at least temporarily, there is no right answer because the teacher lacked the knowledge and/or the answer has yet to be found. Frisch also noted that some students were thinking at the dualistic position, but only one of the participants from either group had reached a higher position. These findings were similar to those found by Stephenson & Hunt (1977) and Stonewater & Daniels (1983).

Gambino (1995) investigated the relationship between cognitive development and the ability to critically think in baccalaureate nursing students. This study will be discussed in greater detail in the section linking critical thinking and cognitive development ability later in this chapter. Her findings showed that 51.5% of the subjects were reasoning below Piaget's formal operational level.

McGovern and Valiga (1997) examined the cognitive development of baccalaureate nursing students at the beginning and end of the freshman year after exposure to planned developmental instruction. Participants (N= 196) in this study were enrolled in an introductory professional nursing course. This study was conducted using three different nursing groups. Each time one group receiving planned instruction and the other groups served as controls. The instrument used to measure intellectual development, as described by Perry, was The Learning Context Questionnaire (LCQ) (Kelton & Griffith, 1986). Participants were tested using the LCQ at the beginning of the first semester and again at the end of the first semester. Those subjects who chose to be in the study were placed in the experimental group and taught by the researchers using instructional strategies designed to facilitate cognitive development. Students in the control groups were taught by one other faculty member who used lecture-oriented teaching strategies traditionally practiced at the institution.

Results of the study did not demonstrate a statistically significant difference in Perry's position for either group. For all of the students, the mean level at the beginning of the course was early Multiplicity. At the end of the

semester, mean scores for both groups indicated that the participants remained at the Multiplicity level. The researchers felt that the combination of small sample size (N= 45), non-random group assignment, group homogeneity, and the curriculum design for the experimental group may have influenced the study's results. Additionally, none of the participants had prior exposure to the nursing curriculum; they had no clinical experience.

Theoretical and Empirical Justification for Proposed Variable Relationships

In structural equation modeling it is important to justify the relationships between the proposed variables. Evidence will be presented from a theoretical perspective or, when available, from an empirical body of knowledge to justify the proposed relationships in the hypothesized model.

Knowledge Base and Critical Thinking Skills

McPeck (1990) stipulated that thinking is thinking about something specific. To this end he believed that a specific knowledge base is essential for the utilization of critical thinking skills in a specific domain. Background knowledge of a subject is necessary for the reasonable application of a principle (Ennis, 1989).

The purpose of four years of education at a college or university is to achieve a liberal education and to receive the knowledge and training necessary to begin a career in a specific area of interest. The purpose of a liberal education is to enhance students' abilities to learn and to think for themselves. Facione (1984) believed that achieving a liberal education does not mean being

exposed to a variety of general courses that provide nothing more than fulfillment of unit requirements for graduation. Instead, it means being free to develop one's own thinking, to gain exposure to other cultural, artistic, philosophical and spiritual dimensions of life, and to grow from the interaction with cultures, ethnic groups, nationalities, and social classes other than one's own. "As the mind awakens and matures, and the proper nurturing and educational nourishment is provided, these and other parts of a liberal education develop as well. Critical thinking plays an essential role in achieving these purposes" (Facione, 1995, pp. 11-12).

Reasoning about any subject entails several forms of knowledge (Kurfiss, 1988). In professions with clinical practices, knowledge refers to information that is valuable in decreasing uncertainty and in answering clinical questions (Gambrill, 1990). One form of knowledge that is needed is propositional knowledge, which includes concepts, principles, and other forms of knowledge that are used to make inferences. Another form of knowledge, procedural knowledge, describes how a person can do something (e.g. drive a car). In nursing, both types of knowledge are needed and are derived, in part, from the content found in the nursing curriculum. In addition, knowledge based on courses in the humanities and sciences is necessary for nurses to make clinical decisions (Alfaro-LeFevre, 1995).

A study done by Frederickson and Mayer (1977) found that students who had higher grade point averages (GPAs) also had higher critical thinking scores on the Watson-Glaser Critical Thinking Appraisal instrument (WGCTA) than students with lower GPA's. Miller (1992) examined the impact of a baccalaureate registered nursing program on the critical thinking skills of students, also using the WGCTA. She reached two important conclusions from her research that indicate a relationship between knowledge base and critical thinking skills. First, her findings showed that there was a positive and significant correlation between critical thinking scores and grade point average in the nursing major. Second she found that enrollment in a baccalaureate nursing program had a positive impact on the overall critical thinking skills of students.

Pardue (1987) studied 121 registered nurses from four different educational programs (associate degree, diploma, baccalaureate, and masters). Her findings showed that nurses with baccalaureate and masters degrees had the highest WGCTA scores when compared to those from the other two programs.

In a meta-analysis study of domain-specific background knowledge and achievement in science, Pilburn (1994) showed that almost 35% of the variance in cognitive level appeared to result from background knowledge. Pilburn also found that procedural background knowledge contributed 22% of the variance in achievement.

Barnes (1991) examined the relationship between critical thinking skills and scholastic aptitude. Eighty-two undergraduates completed the Watson-Glaser Critical Thinking Appraisal and the Measure of Scholastic Aptitude Test. Research findings suggested that approximately 50% of the variance within scholastic aptitude could be accounted for by critical thinking ability. The critical thinking abilities most important in achieving high scholastic aptitude were inferences, interpretations, and deductions.

Several other studies added credence to the relationship between knowledge and critical thinking skills. Thiessen (1987) found that Scholastic Aptitude Test quantitative scores, total number of credit hours in the arts and humanities, and GPA contributed 24% of the variance in critical thinking ability. Lynch (1988) also found that SAT scores had a positive relationship to critical thinking ability. Kokinda (1989), in her study on critical thinking and academic achievement, found that as overall achievement improved, critical thinking abilities improved as well. Based on this review of the literature, a positive relationship is proposed between knowledge base and critical thinking skills. Figure 5 shows this proposed relationship.

Figure 5. Proposed relationship between knowledge base and critical thinking skills.

Cognitive and Intellectual Functioning and Critical Thinking Dispositions

Aspects of cognitive and intellectual functioning that contribute to critical thinking dispositions revolve around motivation, self-efficacy, independence, and the ability to function well in ambiguous situations (King, 1992).

Most of the reported research has focused on these attributes as independent factors in relation to a particular study. To date no reported research has investigated the relationship between cognitive and intellectual functioning and critical thinking dispositions. This is due to the fact that an instrument to measure critical thinking dispositions has just recently been developed.

In related research, Benware and Deci (1984) reported that college students who had more intrinsic motivation exhibited greater conceptual learning and better memory. Gendrop (1989) reported a significant positive correlation between the disposition of cognitive flexibility and critical thinking. Oxman-Michelli (1992) theorized that the curious, active learner who has a positive self concept and confidence in his or her abilities and potential has a good chance of developing as a critical thinker if critical thinking is encouraged in socially nurturing environments. Based on this review of the literature, a positive relationship is proposed between cognitive and intellectual functioning and critical thinking dispositions. Figure 6 depicts the proposed relationship between cognitive and intellectual functioning and critical thinking dispositions.

Figure 6. Proposed relationship between cognitive and intellectual functioning and critical thinking dispositions.

Critical Thinking Skills and Critical Thinking Dispositions

The relationship between critical thinking skills and dispositions has only been discussed in the literature from a theoretical perspective. To date there have been no published empirical reports investigating the relationship between critical thinking skills and critical thinking dispositions. Facione (1995) stated that the individual who has a critical spirit is one who possesses a “probing inquisitiveness, a keenness of mind, a zealous dedication to reason, and a hunger or eagerness for reliable information” (p 6). Oxman-Michelli (1992) contended that the development of dispositions for critical thinking and the development of critical thinking skills are independently valid, mutually dependent educational goals. Paul (1993) proposed that critical thinkers care about critical thinking and that they share a passion to engage in and utilize the skills needed for reasoned thinking. Bandura (1990) concurred with this assumption when he stated that “people who believe strongly in their problem-solving capabilities remain highly efficient in their analytic thinking in complex decision-making situations” (p. 321). Finally , Russo, Scheurman, Harred and

Luebke (1995) believed that the interrelationship of factors between the student's past experiences and values, current beliefs about oneself, and the subject matter itself, suggests that critical thinking cannot be effectively thought of as a set of isolated skills. Instead a holistic and developmental perspective needs to be employed in order to understand the constructs and the influences that effect an outcome.

Critical thinking dispositions and skills are cumulatively reinforcing. In a classroom, when students use critical thinking skills or display their critical thinking spirit and are rewarded for doing so, the likelihood increases that they will continue to use these skills (Lipman, 1988). A positive relationship between critical thinking dispositions and critical thinking skills is proposed based on theoretical propositions (See Figure 7).

Figure 7. Proposed relationship between critical thinking skills and critical thinking dispositions.

Critical Thinking Skills and Cognitive Development

Critical thinking is generally conceptualized as an intellectual ability that can be developed by those involved in higher education (Arons, 1985; Meyers, 1986). Brookfield (1987) noted that while the educational setting is crucial to the development of critical thinking, this process also takes place in the contexts of

adults' lives—in their relationships, at their place of work, and participating as a member of a democratic society. The readiness to question stereotypes and the refusal to accept moral codes and value systems simply because they presently exist or are practiced are examples of adult thinking. Brookfield (1987) noted that “critical thinking is like self-directedness in learning—both are capacities that are generally regarded as desirable, both are empirically observable, and both are seen as better open to development in adults than in children or adolescents” (p. 41).

In his research, Brabeck (1983) found that subjects who scored low on the Watson-Glaser Critical Thinking Appraisal Test scored no higher than level 4 on the reflective judgment interview, while those subjects who scored high in critical thinking skills reached stage five (Perry's relativism position). Implications of these findings are that critical thinking skills and cognitive development influence each other.

Cook (1995) conducted a qualitative study on ten senior nursing students with grade point averages of 3.0 or higher and ten registered nurses with three +years or less experience in acute care facilities. It was reported that practicing registered nurses used ten elements of critical thinking (seeks knowledge, seeks thought organization, sets priorities, questions self, identifies a need for action, networks with other nurses, correlates causality, draws conclusions, demonstrates maturity, demonstrates experience, and exhibits the ability to see the whole situation) when caring for patients. The student nurses used all of

these same elements of critical thinking, with the exception of networking, when providing patient care in the clinical setting. One interpretation of the results of this study is that senior nursing students and registered nurses possess similar critical thinking skills. This possibly is a reflection of the similar educational process to which nurses are exposed during the course of their nursing education. A weakness of the study is the small sample size of each group. A second problem with this study is that the quality of difference in using these skills was not addressed. Further investigation into differences between the use of critical thinking skills between senior nursing students and registered nurses with three years or less of experience in clinical situations is warranted.

Gambino (1995) studied the relationship between cognitive development of baccalaureate nursing students and ability to think critically. This was the first study found in the review of the literature that empirically tested this relationship. In this study she identified cognitive development as an antecedent to critical thinking. Participants (n= 140) were juniors and seniors from three generic baccalaureate nursing programs. The researcher used the Watson-Glaser Critical Thinking Appraisal Test to test for critical thinking and the Arlin Test of Formal Reasoning to test for cognitive development. Using Pearson correlation analysis, results showed a significant relationship between the stage of cognitive development and level of critical thinking. These findings suggest that the higher the stage of cognitive development, the greater the ability to think critically. This researcher has placed critical thinking skills and critical thinking dispositions as

variables that influence cognitive development. Since critical thinking is a process rather than an outcome, it seems logical that critical thinking leads to the development of something further. For this research, that “something” is a higher level of cognitive thinking.

Critical thinking experience, knowledge, and skills enhance cognitive development (Flavel, 1984). The ability to use critical thinking skills is both a product of development and a mechanism of subsequent development. The skills become the “what” of development; once developed, they also become part of the “how”. Charness and Bieman-Copland (1992) contended that cognitive development in adulthood likely represents an evolutionary change. This leads one to speculate that enhancing individuals’ critical thinking skills would influence their cognitive development. Thus, the enhancement of critical thinking skills is a process that encourages evolution of higher levels of cognitive development. Based on this review of the literature and argued assumptions, a positive relationship is proposed between critical thinking skills and cognitive development (Figure 8).

Critical Thinking Skills $\xrightarrow{+}$ **Cognitive Development**

Figure 8. Proposed relationship between critical thinking skills and cognitive development.

Critical Thinking Dispositions and Cognitive Development

As a result of the consensus definition that developed from the Delphi Project, The California Critical Thinking Disposition Inventory (CCTDI) was constructed. This instrument currently is the only critical thinking disposition measurement tool. To date few findings using the CCTDI have been published, although Facione (1997) has generated a first-round meta-analytic study from data obtained from researchers using this instrument. Presently, there are no empirical studies in the literature on critical thinking dispositions and cognitive development.

A theoretical relationship between critical thinking dispositions and cognitive development has been surmised in the literature. This relationship has been established due to the relationship between critical thinking skills and dispositions and the influence of critical thinking skills on cognitive development. Figure 9 shows the proposed relationship between critical thinking dispositions and cognitive development.

Figure 9. Proposed relationship between critical thinking dispositions and cognitive development.

This review of the literature supports relationships among the variables included in the model. Some relationships have been supported by empirical data while others only have been hypothesized to exist. Figure 10 represents the hypothesized model and the direction of the relationships.

Figure 10. The hypothesized model of cognitive development and the direction of the relationships.

The need to understand the concept of critical thinking as a process and the necessity to comprehend the concept of cognitive development as an outcome of critical thinking skills and dispositions are relevant in nursing today. A growing body of literature is available for theory testing. The major variables in cognitive development appear to have been identified. However, researchers have yet to examine these variables together in an attempt to clarify the

completeness of the causal network, the direction of causality among complex relationships, or the influence of critical thinking on cognitive development.

The call from the American Nurses' Association and the National League for Nursing, as well as from nursing administrators, nursing researchers, and nursing educators, is that nurses must be able to render well-reasoned clinical judgments and provide safe, progressive, high quality, competent nursing care for their patients. Nurses must take control of their practices, be self-directing, step forward, and guide nursing's destiny. This researcher believes that the path for doing this comes not just from knowing content, as this rapidly changes from one decade to the next, but from being able to make independent, competent decisions about health care practices. For the nursing profession to grow and survive, nurses need to possess a strong knowledge base, intellectual confidence, effective reasoning skills, the willingness to use these skills, and the ability to appreciate and listen to the opinions of others in order to take rational action. The obligation and the challenge to facilitate this development is directed to nursing's educational community. A thorough understanding of cognitive development and the variables that influence this process is vital to nursing's future.

CHAPTER 3

Methods

The purpose of this chapter is to describe the method that was used to collect and analyze the data for this study. The participants, procedures, and instruments are discussed. Techniques of data management are described as are statistical assumptions and analytic techniques.

Design and Rationale

A descriptive correlational survey design (Waltz, Strickland, & Lenz, 1991) was used to gather data . The fit of the model with the data was tested using structural equation modeling. The researcher examined the relationships between exogenous variables and endogenous variables in the model. Exogenous variables, through a directional association, influence one or more endogenous variables. In this study, knowledge base and cognitive and intellectual functioning were the exogenous variables. The endogenous variables are those variables that receive a directional influence from some other variable in the model or emit a directional influence to other variables in the model (Hoyle, 1995). In this study, the endogenous variables were cognitive development, critical thinking skills, and critical thinking dispositions. A

descriptive correlational design was chosen because the relationships among the endogenous variables had not been clarified in prior research.

Participants

The target population for this study consisted of registered nurses who completed their entire nursing education in one Southern California generic baccalaureate nursing program. A convenience sampling method via mail, email, and word of mouth was used to attain the needed sample size. A list of nursing graduates from this School of Nursing was obtained from information provided by the former students to the College of Health and Human Services at the University.

The minimum satisfactory sample size when conducting structural equation modeling has been debated by many researchers (Fassinger, 1987; Hoyle, 1995; Schumacker & Lomax, 1996). Although there is no clear consensus on the optimal size, it is recommended that a minimum sample size is 150 participants (Anderson & Gerbing, 1988).

Sample selection criteria included practicing registered nurses who (a) were at least two years post baccalaureate education, (b) had begun and completed their nursing education from one Southern California generic baccalaureate nursing school, (c) were presently working in a health care environment or pursuing post-graduate education, and (d) had worked in the same general practice setting (i.e. medical, surgical, pediatrics, public health,

administration, nursing research, etc.) for at least two years (at least 20 hours per week).

Benner's (1984) theory of nursing proficiency that reflected on the individual's transition from novice to expert nurse was used to guide sample selection. Her model elucidates the process by which an individual obtains skills and knowledge in nursing. This transitional growth reflects a nurse's progression away from reliance on principles, concrete experiences, and viewing individual parts of a situation to being involved in the experience and seeing the "whole picture". The growth of nursing knowledge and skills is reflected in the range of terms from novice to expert. A nursing student is a novice during his or her educational progression in an academic setting. After graduation from the educational program and for the next two years of clinical practice, a nurse is considered to be an advanced beginner where the ability to extract relevant data from complex situations is undeveloped. The competent nurse is one who has been in the same practice experience for two to three years and is beginning to separate relevant from irrelevant information and is able to see a broader picture of the complex situation compared to the advanced beginner nurse. Higher levels of expertise develop as clinical experiences enhance nurses' abilities to incorporate their knowledge background with past experiences to make accurate and relevant judgments based on the demands of the current clinical situation. Those individuals who have been working in the same or similar practice arenas

for three to five years are considered proficient, while those who have been in the same practice setting for more than five years are considered experts.

In previous studies on critical thinking, results ranged from no changes to significant changes in a student's ability to think critically after varying periods in the academic setting (Bauwens & Gerhard, 1987; Gross, Takazawa, & Rose, 1987; Lynch, 1988). The sample selection criteria listed above was used in order to find nurses who, according to Benner (1984), had reached a competent level of nursing knowledge and whose critical thinking skills theoretically should be more developed than individuals at the novice or advanced beginning level.

Sequence of Procedures

Administrative approval for conducting the study was sought from two institutions: (a) the school from which the doctoral degree will be granted and (b) the school from which the participants graduated. An expedited review for research approval from the Human Subjects Committee of each institution was granted since there was minimal risk to participants (See Appendices B and C).

Eligible participants were solicited by mail, phone, and electronic mail in local hospitals. Participants contacted by mail were sent a letter with a brief explanation as to the nature of the study and the selection criteria (see Appendix D). A return post card was included with the letter. The post card indicated whether the individual met the selection criteria and also if he or she was interested in participating in the study. Electronic mail information provided a phone number for prospective participants to leave messages for the

investigator to contact them about the study. Following participant agreement to participate in the study, a packet containing a consent form, a letter explaining the procedures for completing the packet material (see Appendix E), and questionnaires were mailed or delivered in person to each individual. A return self-addressed, stamped envelope was included in the packet for the return of the consent form and the measurement instruments. Individuals who had not returned their packets within three weeks were sent a reminder post card.

Protection of Human Subjects

The investigator informed all subjects in writing of the purpose, procedures, risks, and benefits of the study (see Appendix F). All subjects were told that their participation was entirely voluntary and that they had the right to withdraw at any time.

Anonymity of responses of the subjects could not be guaranteed due to the need of the researcher to review academic records and the necessary follow-up procedures if study packets were not returned. Confidentiality of responses was protected in the following ways: (a) subjects were not and will not be identifiable in public reports by name or any other defining characteristic, and (b) packets were returned in numerically coded envelopes, and codes were accessible only to the investigator. Each battery of instruments was numerically coded. Individuals assisting with data entry in a statistical data base had access only to coded questionnaires.

Instruments and Demographic Data

Cognitive and Intellectual Functioning

In this study a scale from the California Psychological Inventory (CPI) (Gough, 1987), entitled "The Measures of Cognitive and Intellectual Functioning", was used to gauge cognitive and intellectual functioning. The CPI is a multivariate tool designed to describe and predict socially relevant behavior patterns. The CPI has four standard scales with twenty subscales (see Appendix F for a list of the scales and subscales). The author (Gough, 1987) contended that the CPI instrument had two primary purposes: to forecast what people will say and do in defined, significant situations and to identify individuals who will be described by others in predictable and informative ways. The CPI, in its entirety or with individual scales or subscales, has been used by researchers to measure academic achievement in different settings (high school, college, medical school, dental school, and centers for higher education), in different subgroups (cultural groups, high-achievers, gifted), in special aspects of performance (independent vs. rule-following achievement patterns, cheating on examinations by college students), in different occupations (managers, teachers, police officers, nurses, engineers), and with respect to personal and social problems (criminal and delinquent behavior, drug abuse, alcoholism, coronary-prone personality, illness susceptibility) (Gough, 1987).

The Measures of Cognitive and Intellectual Functioning, one of four scales found in the CPI, was the only scale used in this study because a review

of the literature addressed the relationship between motivation, cognitive efficiency, and independence in thinking. The scale, Measures of Cognitive and Intellectual Functioning, has three subscales consisting of a) achievement via conformance (Ac), b) achievement via independence (Ai), and c) intellectual efficiency (Ie). There are 102 items in these three subscales.

The following is a description of the three subscales with descriptors of high and low score interpretation for each. The achievement via conformance subscale measures an individual's strong drive in structured settings versus difficulty with structured tasks. Individuals who score high are described as ambitious and capable, with the capacity to do well in clearly defined and controlled environments. Lower scores suggest distractibility, undependability, and resistance to rules or any kind of strict control.

The achievement via independence subscale measures a person's drive and initiative versus difficulty in vaguely defined tasks. Individuals who score high tend to be clear-thinking, intelligent, independent, and capable of functioning well in ambiguous, open, or only partially defined settings. Low scoring individuals tend to be narrow in interest, easily discouraged from doing their best, and poorly motivated in both educational and occupational matters.

The third subscale, (intellectual efficiency) measures a person's intellectual efficiency and motivation versus one who is a slow starter. High scorers tend to be described as capable, logical, and resourceful, and able to see projects through to completion. Low scorers tend to be seen as low in self-

esteem, below average in use of intellectual abilities or expressing their feeling or ideas, and poor in seeing projects through to completion (Gough, 1987).

The Measure of Cognitive and Intellectual Functioning of the CPI is a self-administered paper-and-pencil test with easy-to-follow instructions and no time requirement. The time required to complete the three subscales on the cognitive and intellectual function scale is estimated as approximately twenty minutes. The CPI requires a fourth-grade reading level and has been administered to individuals ranging from young teens to the elderly, although it is most appropriate for high school students, college students, and young adults (Domino, 1984). The instrument requires the participant to answer each statement with a true or false response. Standard scores (means for each scale are set at 50 and standard deviations at 10) are transformed from the raw scores and placed on an individual CPI profile sheet where the results can be computed using the manual. Scores that fall in the 30 to 40 range or in the 60 to 70 range carry moderate implications for interpreting the psychological meanings. Scores of 29 or below and 71 or above have stronger inferences as to the psychological meanings of the scale (Gough, 1987).

In a sample of 400 college students (200 males and 200 females) given the CPI, internal consistency for the three subscales (achievement via conformance, achievement via independence, and intellectual efficiency) to be used in this study were .72 for achievement via conformance, .70 for achievement via independence, and .72 for intellectual efficiency with a mean of

.71 for the overall scale. The entire instrument has a mean alpha coefficient of .69. High school students, who were fluent in both English and French (N=123), took an English version of the CPI followed one week later by the French version. Test score stability over one week ranged from .73 for achievement via conformance, .58 for achievement via independence, and .76 for intellectual efficiency. Test-retest correlations for 230 high school students tested in the eleventh grade and then a year later in the twelfth grade demonstrated stability of scores, .72 (achievement via conformance), .54 (achievement via independence), and .76 (intellectual efficiency) respectively. Domino (1984) contended that the pattern of results for reliability of the CPI scales and subscale, although somewhat low, were adequate given the complexities of the instrument.

The validity of the CPI scales was evaluated with ratings on Q-sort or adjective checklists completed by peers, spouses, or interviewers. Convergent validity and discriminant validity were certified to be high for the Q-sort and low for the adjective checklist; actual statistics were not furnished in the manual. Magargee (1972) proposed that the CPI was constructed for the purpose of predicting socially relevant behavior patterns; as a result predictive and concurrent validity were maintained at the expense of discriminant validity. The CPI has demonstrated long-range predictability, sometimes over a period of several years. In terms of concurrent validity, the CPI correlated highly with

behavior observations but not with other tests such as the Minnesota Multiphasic Personality Inventory (MMPI) (Gough, 1987).

In summary, the CPI ranks among the top psychological tests in use with normal clients and in its ability to predict behavior with specific populations. It has a substantial research base to support its usefulness as a measurement instrument (Domino, 1984).

Knowledge Base

Knowledge base is defined as the contents of long-term memory (Charness & Bieman-Copland, 1992). Three measures of knowledge base for each individual were used. The first measure was the grade point average achieved in the participant's nursing major. The second measure was the overall grade point average of courses taken during the college years, excluding grades achieved in courses in the participant's major. A third measure, the grade earned from a specific critical thinking course (a requirement of the university since 1982) had to be dropped during data analysis due to difficulties encountered in collecting this information. Students who had taken courses at a community college had transcripts that only reflected the number of units taken and the number of credits earned. Although many of the participants were given credit for taking a class equivalent to the required critical thinking course, there was no indicator as to the grade received. Therefore, the number of years that each participant had been in nursing replaced the critical thinking course grade as an indicator of knowledge base. Kataoka-Yahiro and Saylor (1994)

contended that inquiry and knowledge in a practice area, both from formalized education and experience, are important aspects of critical thinking.

A request for each participants' academic record was made to the University's Admission Office. The nursing grade point average and the overall grade point average (minus the nursing academic grades) were calculated from these records by the investigator.

The California Critical Thinking Disposition Inventory

In this study the California Critical Thinking Disposition Inventory (CCTDI) was used to measure CT dispositions. The CCTDI was the first and only instrument designed to measure dispositions toward critical thinking (Facione, Facione, & Sanchez, 1994). The intent of this tool was to assess the subjects' attitudes, opinions, and beliefs in relation to critical thinking. The CCTDI is based on the Delphi expert consensus of the conceptualization of critical thinking discussed in Chapter 2. The CCTDI contains 75 Likert-style items that have a six-point agree/disagree response on the answer sheet. Each statement prompts the subject to express familiar opinions, beliefs, expectations, and perceptions. The test yields an overall score of critical thinking dispositions and a score on each of the seven scales: truth-seeking, open-mindedness, analyticity, systematicity, self-confidence, inquisitiveness, and maturity. In this study only the seven scales were used to test the fit of the hypothesized model to the sample data.

The truth-seeking scale (TS) examines the disposition of being eager to seek the truth, courageous about asking questions, and honest and objective

argument is valid because the conclusion logically follows from the premises, even if the premise itself is not true.

There were two forms of the CCTST, both consisting of 34 multiple choice questions, that were conceptually and statistically equivalent. Form B was developed in the event that somehow the questions on Form A became compromised at a given test site. In this study, only Form A was administered to each participant. Each multiple choice item was scored dichotomously, with one correct answer and three or four distractors. Kuder-Richardson-20 reliability ranged from .70 to .71.

Face validity was taken from information gathered from college students exiting an administration of the CCTST and from faculty committee members who had recommended the use of the CCTST for use in their institutions. Construct validity came from the American Philosophical Association Delphi Report conceptualization of critical thinking. The CCTST also was validated in a quantitative study conducted at California State University, Fullerton in 1989-1990. Students ($n=1169$) were tested to determine if the CCTST was able to measure the growth in CT skills hypothesized to be achieved by college students completing approved CT courses, but not by students completing a control group course. Growth in CT skills was measured in the experimental group but not in the control group, indicating that the CCTST measures CT skills, the targeted phenomenon.

Concurrent validity, correlating the CCTST with other commercially available CT tests and with observed classroom performance, is still being

instances, judgments based on standards, contexts, or evidence must be made even if certainty is precluded.

The Self-Confidence scale (CF) measures the level of trust one places in one's own reasoning processes. This type of individual is self-confident and trusts in his or her ability to make good judgments and to bring reasonable closure to an issue or problem.

The Analyticity scale (AN) reflects the degree of awareness of potentially problematic situations, anticipating the possible consequences, and valuing reasoning and using evidence to support findings in challenging or difficult situations. High scorers recognize potential conceptual or behavioral difficulties, consistently seek proactive interventions, and use reasoned inquiry and fact-finding as effective ways to resolve matters. They are persistent in their inquiry even though difficulties are encountered.

The scale scorers on this instrument range up to 60. Persons who score below 40 on a scale are weak in that critical thinking disposition; persons who score above 50 on a scale have a strong dispositional attitude. In terms of the overall scale, a score of less than 280 indicates an individual with weak dispositions towards critical thinking; a score of 350 or more implies that an individual has strong dispositions towards critical thinking.

Alpha reliabilities for the seven individual subscales ranged from .71 to .80, with an alpha of .91 for the overall instrument. Construct validity for the CCTDI was supported when significant correlations were observed between

individual scales and established psychological scales. The overall relationship between the scores on the CCTDI and the California Critical Thinking Skills Test demonstrated a significant correlation ($p < .001$), supporting the overall construct validity of the CCTDI (Facione, Facione, & Sanchez, 1994). Convergent and divergent validity results were conducted. Each of the seven scales was composed of nine to twelve items interspersed throughout the instrument. The items were phrased in standard English and used no technical vocabulary or critical thinking jargon. It had been suggested by the authors to administer this test prior to the critical thinking skills test because giving a rigorous critical thinking ability test immediately prior to a dispositional measure could affect responses in unpredictable ways (Facione, Facione, & Sanchez, 1994). Test taking time was about thirty minutes.

The California Critical Thinking Skills Test

The California Critical Thinking Skills Test (CCTST) (Facione & Facione, 1994) was a standard 34-item, multiple choice test designed to measure critical thinking skills in relation to short problem statements and scenarios. This measurement tool yielded six scores: an overall score on critical thinking skills, and five sub-scales. The five subscales are analysis, evaluation, inference, inductive reasoning, and deductive reasoning. Only the five subscales were used for testing of the hypothesized model to minimize multicollinearity.

The Analysis (Anal) subscale examined two different skill capabilities. The first was the individual's ability to comprehend and express the meaning or

significance of a given situation, judgment, belief, rule, or procedure. This included the sub-skills of categorizing, decoding significance, and clarifying meaning. The second skill was the capacity to identify the proposed and actual inferential relationships among statements, questions, concepts, descriptions, or other forms of representation intended to express beliefs, judgments, experiences, reasons, information, or opinions. This skill explored the sub-skills of examining ideas, detecting arguments, and analyzing the different components of an issue.

The Evaluation (Eval) subscale also had two aspects. First, it measured the ability to assess the credibility of statements which were descriptions of a person's perception, experience, judgment, belief, or opinion; then it assessed the logical strength of the actual or intended inferential relationships among statements, descriptions, questions, or other forms of representation. This incorporated the sub-skills of assessing claims and assessing arguments. The second aspect of evaluation examined the results and justification of a person's reasoning based on the evidence, the criteria, the context, and the methodology. It also included the ability to present reasoning in the form of relevant arguments. The sub-skills of stating results, justifying procedures, and presenting arguments were measured on this scale.

The Inference (Infer) subscale addressed the ability to identify and secure elements needed to draw reasonable conclusions, to form hypotheses, to consider relevant information, and to elicit consequences arising from the data,

statements, evidence, judgments, opinions, beliefs, concepts, or other forms of representation. This scale included the sub-skills of querying evidence, conjecturing alternatives, and drawing conclusions.

The Inductive Reasoning (Induct) scale indicated an individual's ability to understand that an argument's conclusion is not certain, but probable, by the assumed truth of its premises. Finally, the Deductive Reasoning (Deduct) subscale of the CCTST measured the ability of an individual to indicate that an argument is valid because the conclusion logically follows from the premises, even if the premise itself is not true.

There were two forms of the CCTST, both consisting of 34 multiple choice questions, that were conceptually and statistically equivalent. Form B was developed in the event that somehow the questions on Form A became compromised at a given test site. In this study, only Form A was administered to each participant. Each multiple choice item was scored dichotomously, with one correct answer and three or four distractors. Kuder-Richardson-20 reliability ranged from .70 to .71.

Face validity was taken from information gathered from college students exiting an administration of the CCTST and from faculty committee members who had recommended the use of the CCTST for use in their institutions. Construct validity came from the American Philosophical Association Delphi Report conceptualization of critical thinking. The CCTST also was validated in a quantitative study conducted at California State University, Fullerton in 1989-

1990. Students ($n=1169$) were tested to determine if the CCTST was able to measure the growth in CT skills hypothesized to be achieved by college students completing approved CT courses, but not by students completing a control group course. Growth in CT skills was measured in the experimental group but not in the control group, indicating that the CCTST measures CT skills, the targeted phenomenon.

Concurrent validity, correlating the CCTST with other commercially available CT tests and with observed classroom performance, is still being tested. Studies have shown that the CCTST correlates with university grade point averages ($r = .20$) and SAT scores ($r = .44$ math, $.55$ verbal) (Facione & Facione, 1994).

Individual subscale scores were determined by the number of correct items on any given subscale. These scores were then compared to suggested percentile norms for each of the five sub-scales (see Appendix G). A time limit of 45 minutes was set by Facione and Facione (1994) in order compare results with a normative sample population.

The Scale of Intellectual Development

In this study, the Scale of Intellectual Development IV (SID-IV), developed by Erwin (1986) was used to measure Cognitive Development. The SID-IV is an objectively scored instrument based on William Perry's (1970) scheme of intellectual development for undergraduate students. It measures four

dimensions of cognitive development: dualism, relativism, commitment, and empathy.

Dualism measures the extent to which individuals tend to perceive issues in clear-cut, black-white, or wrong-right terms. Dualistic individuals have a tendency to look to authority to give them the one correct answer to their problems, because they do not believe that they have the ability to find solutions on their own.

Relativism measures the extent to which individuals have discovered that alternative perspectives and diversities exist. Persons exhibiting this type of perspective, though realizing they may possess the ability to work out their problems, do not trust it and remain reliant on authorities for solutions to their problems.

Commitment indicates the magnitude to which an individual has become committed to a personal viewpoint. Committed individuals realize that their personal ideas and way of thinking and processing information are valid. They embrace their own personal belief system while also recognizing and appreciating that others hold differing perspectives.

Empathy measures the extent to which an individual feels responsible to society for his or her actions and behaviors. Erwin (1986) considered this to be the highest level of cognitive development that an individual could achieve.

Most of the reliability and validity testing of the Scale of Intellectual Development was performed on the second version of this instrument.

Reliability estimates for the four dimensions, using alpha coefficients, were .81 (dualism), .70 (relativism), .76 (commitment), and .73 (empathy). The four factors were intercorrelated to verify the postulated hypothesis that a score on one scale would result in a low score on the other three. Erwin (1983) discovered a moderate, positive correlation between the Commitment scale and the Empathy scale when testing undergraduate freshman. He contended that this correlation occurred because individuals who have made major life commitments (values, beliefs, marriage, career) also appear sensitive to other people's needs. However, Erwin (1983) also suggested that the researcher use caution when interpreting the Empathy factor and its correlation to commitment due to the fact that too few freshman have reached this highest level of development. No test-retest information was given in the manual and a parallel form for the Sid-IV has not been developed.

Construct validity testing for the Scale of Intellectual Development had been conducted in various ways. The SID was compared with high school and college GPA's. Results showed that the higher the GPA, the higher the intellectual development score (Erwin, 1986). The SID also was compared with the Erwin Identity Scale (EIS). This instrument described how people felt about themselves and other people. The higher EIS score represented a higher level of identity. The SID and the EIS showed a moderate correlation between the two scales, indicating that a high level of personal identity was found in

individuals who had obtained higher levels of intellectual development (Erwin & Delworth, 1980).

The latest version of the Scale of Intellectual Development (SID-IV) was used for this study. Differences between the SID-IV and the SID-II consisted of the addition of fourteen statements for the respondent to answer. No mention of a SID-III was given in the manual or the literature. Several statements under each of the four dimensions were added. Additional reliability measurements for the fourth edition were not provided in the manual. Additional evidence for the validity of the SID-IV was presented by the instrument author using research results demonstrating a relationship between action-control and cognitive development. This study compared the Action Control Scale (ACS), which differentiated between action-oriented and state-oriented individuals. Negative correlations between items of performance, failure, and decision making on the ACS and the Dualism dimension of the SID-IV were reported as well as a negative correlation between Relativism and failure (Erwin & Marcus-Mendoza, 1988). Erwin (1986) contended that state-oriented people were more dualistic in their thinking while action-oriented individuals were more committed to a personal viewpoint but still could acknowledge diversity in other's thinking.

In addition to adding other items to the SID-IV, Erwin (1986) developed a fifth factor, referred to as "faking". This fifth scale was developed to determine whether or not individuals were deliberately intending to present themselves in a favorable or unfavorable manner by "faking" the responses on the instrument.

Five items comprise this fifth factor. Manual instructions directed the researcher to disregard all scores on the four dimensions if the Fake factor score was greater than nineteen.

The SID-IV had 115 items. For each item individuals were asked to respond on a four-point Likert-type scale (1=strongly disagree to 4=strongly agree). A higher score in one dimension reflected an individual's current level of cognitive development (see Appendix H). Test-taking was approximately forty-five minutes.

Demographic Data

All participants were given an investigator-designed demographic profile sheet to complete and return with the questionnaires. Information was elicited from each participant regarding age, gender, marital status, years licensed as an RN, hours worked per week, years of formal education, educational degrees in addition to BSN, certification, area of study for masters degree, practice area and number of years in this area, and professional activities (see Appendix G for a copy of the demographic profile form).

Data Analysis

Multivariate analysis with latent variables, or structural equation modeling (SEM) was used to analyze the model shown in Figure 11. Symbols in the model represent the following: (a) ovals indicate the latent variables, (b) squares indicate the indicators for the latent variables, and (c) circles reflect the measurement error for each indicator.

Figure 11. Hypothesized model of cognitive development with identified latent variables and indicators for the latent variables. Error measurement for each indicator is also shown in this figure.

Over the past decade, structural equation modeling has been recognized by researchers as an accepted tool to analyze research designs using non-experimental data (Buczynski, 1994), to substantiate theory, and to help examine the relationships between latent variables given a theoretical perspective (Schumacker & Lomax, 1996). Unlike regression analysis and path analysis, this statistical procedure allows for analysis of multiple variables simultaneously and examination of latent variables that are not directly measurable. In addition, SEM permits analysis of variables that may go in reciprocal directions (Glaser & Riegel, 1996). By using SEM, causal inferences can be made from non-experimental research though certainly not with the same degree of assurance as one gets from experimental research (Keith, 1993).

SEM is characterized by a five step process: (a) model development and specification, (b) identification, (c) estimation, (d) testing fit, and (e) respecification (Schumacker & Lomax, 1996). The first step in structural equation modeling was the development and specification of a causal model. The goal was for confirmation of causal relationships presumed on theoretical and empirical foundations. However, as there were limited empirical verification in the literature in some places, the researcher completed the model based on hypothesized relationships among the model variables (Glaser and Riegel, 1996).

Each model has two parts--a measurement model and a structural model. The measurement model is described as a submodel in structural equation modeling. This submodel specifies the indicators for each latent variable or construct and assesses the reliability of each construct for estimating the causal

relationships. This submodel process is equivalent to conducting confirmatory factor analysis, but with a major difference. In confirmatory factor analysis the researcher has no control over which variables describe each factor. In the measurement model, the researcher specifies which variables define each construct. Then estimates of the reliabilities are examined for each of the indicators.

The problem of multicollinearity among the latent independent variables needs to be examined. If these variables are interrelated, providing similar information in the model, then a problem in evaluating the model would result due to the confounding effects on the construct (Munro & Page, 1993).

Correlations among all the indicators were examined to determine if there was a problem with multicollinearity of variables in the hypothesized model.

The structural equation model is a statistical statement that describes the theoretical relationships among unobservable or latent variables. This is similar to a path analysis. The equations for both of the models resemble regression equations. Each equation specifies the sources of variation and contains an error component.

The second step, identification, is concerned with whether one unique value for each and every free parameter or path can be obtained from the observed data. Each potential parameter in a model is specified as either a free parameter, a fixed parameter, or a constrained parameter. A free parameter is unknown and one that needs to be estimated. A fixed parameter is one that is fixed to a specified value (often 0 or 1). A constrained parameter is unknown but

is constrained to equal one or more of the other parameters (Schumacker & Lomax, 1996). If this single value is obtained, the model is “just identified”. If a value for one or more parameters can be obtained in multiple ways, the model is overidentified. If a unique value cannot be found from the observed data for one of the parameters, the model is underidentified and cannot be estimated. In SEM it is necessary that the hypothesized model be either just identified or overidentified (Hoyle, 1995).

The third step in SEM involves obtaining estimates of the free parameters from a set of observed data by using the analytical method of maximum likelihood (Bentler & Chou , 1988). This process estimates all parameters simultaneously through the iterative process, converging to final estimates that should effect the best fit of the model to the sample data.

Step four involves testing the fit of the data through various analysis indices. These indices are used to determine if the parameters of the model are consistent with the data.

Structural equation modeling does not yield a single statistical test that best describes the fit of the model to the data. Instead, researchers use a variety of goodness-of-fit measures that, when used in combination, assess the results from three perspectives—overall fit, comparative fit to a base model, and model parsimony (Hoyle, 1995). The absolute fit indices determine the degree to which the overall model (structural and measurement) predicted the observed covariance matrix. The most common index of overall fit is the Chi-square goodness-of fit test (the difference between the observed covariance matrix and

the estimated covariance matrix). The Chi-square results should not be significant, since a non-significant finding indicates that there were no differences between actual and predicted data. If the model does not fit the data, the proposed model is rejected (Bentler, 1989; Hoyle, 1995). While the chi-square statistic is the norm in assessing the fit of the model to the data, it is not relied upon solely as an indicator of model adequacy because chi-square values are sensitive to large degrees of freedom and departures from multivariate normal distribution (Joreskog & Sorbom, 1993).

A variety of fit-indices have been developed to assess model fit (Bentler, 1989), with the Goodness-of-fit index (GFI) being reported most often as a measure of absolute fit. The GFI represents the overall degree of fit with no adjustment for the degrees of freedom. In addition to the overall fit, two other measurement perspectives should be reported—incremental fit measures (compares the proposed model to a model with all indicators that measure the construct exactly) and model parsimony (relates the goodness-of-fit index of the model to the number of degrees of freedom used to achieve this level of fit) (Raykov, Tomer, & Nesselroade, 1991; Schumacker & Lomax, 1996). The Tucker-Lewis Index (TLI) (also called the Nonnormed Fit Index [NNFI]), the Normed Fit Index, and the Comparative Fit Index (CFI) are reported in the literature. The recommended value for these three indices is .90 or greater (Hoyle, 1995).

Model parsimony is the third type of fit index used to evaluate the strength of the model. This index relates the goodness-of-fit index of the model to the

number of degrees of freedom used to achieve this level of fit. Model parsimony is defined as achieving higher degrees of fit per degree of freedom used per estimated coefficient (Schumacker & Lomax, 1996). The Parsimonious Normed Fit Index (PNFI) is reported as a measure of model parsimony. There is no recommended level of acceptable fit for this measure; however, higher values reflect greater model parsimony (Fassinger, 1987; Schumacker & Lomax, 1996).

The last step in SEM is respecification. This step is necessary if the model fit indices suggest a poor fit. The researcher can then choose to delete, add, or modify paths in the model, and then rerun the analysis (Schumacker & Lomax, 1996). However, much controversy exists surrounding the practice of model respecification. Proposed modifications in the model must first have theoretical justification before a respecified model can be tested. If the values of the modification indices, and not theory, lead the researcher to change the model, then the researcher would be capitalizing on the uniqueness of the particular data resulting in a model that has little general substance and limited use in testing causal relationships (Shumacker & Lomaz, 1996).

Statistical Assumptions

Multiple regression analysis is the basis for structural equation modeling (Hoyle, 1995). There are three assumptions underlying the use of structural equation modeling with latent variables. The first assumption is that no specification error will be committed by including irrelevant variables or excluding relevant variables in the model. The goal is to find the “best fitting” model that

includes parameters that have practical significance and that provide substantive meaning to the hypothesized model.

The second assumption is that the relationships between variables are linear. In SEM nonlinear relationships cannot be directly estimated. However, modified structural models can approximate nonlinear models.

Third, it is assumed that no measurement error has occurred. Measurement error is the degree to which the indicators do not perfectly describe the latent variables. Violations of these three assumptions were tested using the LISERAL 8.14 program.

Summary

In summary, the intent of this study was to test a theoretical model of critical thinking and intellectual development. The model was developed primarily from empirical data with the addition of hypothesized relationships drawn from the theoretical literature. Each participant was asked to fill out four questionnaires designed to measure cognitive and intellectual functioning, critical thinking dispositions, critical thinking skills, and intellectual development. A demographic profile questionnaire was included with the measurement tools. Participant confidentiality was maintained at all times. In addition, knowledge base indicators were obtained from University records with permission from the participants. The data were analyzed using multiple regression analytical techniques and structural equation modeling fit indices. Results of data analysis and a discussion of the implications of this analysis for nursing education, practice, and future research are reported in the following chapters.

CHAPTER 4

Results

The results of this study are presented in two sections in this chapter: (a) description of participant characteristics and (b) results of structural equation modeling testing.

Participant Characteristics

A total of 721 letters inviting participation in the study were sent to individuals who had completed their baccalaureate nursing education at one Southern California university between May 1981 and May 1995. Eighty-five letters were returned to the sender due to either an incorrect or undeliverable address. Two hundred seventy (270) individuals returned the enclosed post card indicating a willingness to participate in the study. In addition, 111 individuals returned post cards stating that they did not qualify to be in the study (63 people did not meet the criteria for the study and 48 individuals were not working as registered nurses in any capacity). The remaining 255 letters fell into a "no response" category. It is not known whether these individuals received letters and failed to respond or whether the letters were lost in the mail. The number of post cards returned, either with a positive or negative response, resulted in a response rate of 52.8% (N = 381). Waltz, Strickland and Lenz (1991) maintained that it is not unusual to have a response rate as low as 30% on mailed

questionnaires. Twenty additional participants were entered into the study in one of the following three ways: (a) responding to requests via hospital email systems, (b) word of mouth from study participants, and (c) in-person requests from the investigator.

Of the 290 graduates who agreed to participate, 233 returned completed questionnaires. This was a 32.3% return rate from the original sample. The average age of the participants was 34.8 years (± 6.5), with ages ranging from 24 to 55 years. Most subjects (66.1%, $n=154$) were married (see Table 5), female (91.8%, $n=214$), and worked an average of 36.5 hours per week (± 10.3). The average number of years of education was 16.82 (± 1.35) and ranged from 16 to 23 years. In addition to the baccalaureate degree received by all participants, 13 participants had an associate degree (5.6 %), 17 had a second bachelor of arts or science degree (7.3%), and 33 held a masters degree (14.2 %)(see Table 6). Five of 13 participants who held associate degrees had received their degree in nursing.

Grade point averages for nursing courses and other academic courses, excluding nursing, were calculated for each participant from transcripts provided by the University Admissions and Records Office. The mean nursing grade point average was 3.07 ($\pm .42$), with scores ranging from 2.10 to 4.00. The mean grade point average for other course work, excluding nursing, was 3.18 ($\pm .433$) with scores ranging from 2.14 to 4.00.

Table 5

Marital Status (n=233)

Marital Status	Frequency	Percent
Single	61	26.2%
Married	154	66.1%
Divorced/Separated	17	7.6%
Widowed	1	0.4%

Table 6

Masters Area of Concentration (n=33)

Masters area of study	Frequency	Percent	Masters area of study	Frequency	Percent
Family Nurse Practitioner	9	27.2%	Maternal-infant	1	3.0%
Community Health Nursing	6	18.1%	Cardiovascular	1	3.0%
Nurse Anesthetist	3	9.0%	Critical Care	1	3.0%
Gerontological Nurse Practitioner	3	9.0%	Pediatric Nurse Practitioner	1	3.0%
Nursing Education	2	6.0%	Women Health Nurse Practitioner	1	3.0%
Midwifery	1	3.0%	School Health	1	3.0%
Family Health	1	3.0%	Public Health	1	3.0%
Child Health	1	3.0%			

A majority of the subjects (52.4%, n=122) had earned certification in a specialty area of nursing (see Table 7). Of the 233 participants, 93% (n=209) worked in a clinical practice setting (see Table 8) in a variety of specialty areas. Fifteen participants (6.7%) listed the clinical practice area as not applicable. These individuals were involved in administrative duties, education or research, or attended graduate school full time.

Table 7

Nursing Certification Beyond the Baccalaureate Degree (n=124)

Certification	Frequency	Percent	Certification	Frequency	Percent
Critical Care	29	23.4%	Audiologist	3	2.4%
Nurse Practitioner	14	11.3%	Home Health	3	2.4%
Certified Emergency Nurse	14	11.3%	Neonatal critical care	3	2.4%
Neonatal or Pediatric Life Support	8	6.5%	Nurse Anesthetist	3	2.4%
Operating Room	6	4.8%	Certified Psychiatric Nurse	3	2.4%
Medical/Surgical Nursing	6	4.8%	Certified Enterostomal Therapy	2	1.6%
Certified Pediatric Nurse	6	4.8%	Clinical Nurse Specialist	1	0.8%
Chemotherapy	5	4.0%	Certified Lactation Educator	1	0.8%
Oncology (Pediatric and Adult)	4	3.2%	Midwifery	1	0.8%
ACLS Instructor	4	3.2%	Rehabilitation	1	0.8%
Childbirth Educator	3	2.4%	Teaching	1	0.8%
High Risk Perinatal Nurse	3	2.4%			

Table 8

Clinical Practice Areas of Participants (n=209)

Clinical Practice Area	Frequency	Percent	Clinical Practice Area	Frequency	Percent
Critical Care	61	29.2%	Enterostomal Therapist	3	1.4%
Labor & Delivery, Nursery, Postpartum	25	12.0%	Clinical Specialist	3	1.4%
Medical Surgical or Acute Care Units	22	10.5%	Anesthesia	3	1.4%
Ambulatory Care	18	8.6%	Post Anesthesia Care	2	0.9%
Emergency Room	15	7.2%	Rehabilitation	2	0.9%
Community or Home Health	14	6.7%	Psychiatric	1	0.5%
Pediatrics	12	5.7%	Occupational	1	0.5%
Operating Room	10	4.8%	Discharge Planner	1	0.5%
School Nurse	10	4.8%	Flight Nurse	1	0.5%
Geriatrics	5	2.4%			

Thirty-one (0.4%) of the participants listed administration as either their main area of responsibility or one that was included in their clinical practice. Administrative positions included: (a) supervisor (n=11), (b) head nurse (n=15), and (c) case manager (n=4). One participant stated that she was president of her own health care company.

Two additional practice settings listed included education and research. Eighteen nurses practiced in an educational setting. These areas included:

(a) client educator (n=7), (b) associate degree educator (n=5), (c) unit educator (n=3), (d) baccalaureate degree educator (n=2), (e) continuing education program coordinator (n=1), and (f) instructional nursing program educator (n=1). Research as a practice area was listed by seven participants.

The mean number of years in the clinical, administrative, educational, or research practice setting was 5.1 (± 3.24) and ranged from 1 to 30. The five participants who held associate degrees in nursing prior to entering the undergraduate nursing program have been in nursing for the greatest number of years. Their years in nursing practice ranged from 17.5 to 30 years. Those participants who were in a practice area for less than two years qualified for the study due to enrollment in graduate education.

Structural Equation Model Testing

A two-step approach to testing the goodness of fit of the hypothesized model to the data has been recommended by Anderson and Gerbing (1988). The first step involves testing the measurement model by confirmatory factor analysis to determine the relationship between the measured indicators and their respective latent variables. The second step involves testing the structural model by examining the relationships among the latent variables. One advantage of using the two-step approach is that it allows identification of measurement problems, which may arise from inadequately designed psychometric instruments, separately and independent of the identification of the

structural problems, which may occur due to problems with the hypothesized theory (Fassinger, 1987).

Descriptive statistics (mean, standard deviation, variance, and range) for the variables are listed in table format. The statistics for the Knowledge Base variables are given in Table 9. The statistics and normative sample scores for registered nurses for the California Psychological Inventory variables are listed in Table 10. Descriptive statistics for the California Critical Thinking Skills Test overall score and the sub-scales are summarized in Table 11. In addition, the means and standard deviations for senior nursing students from an aggregate data analysis are listed in the table. In Table 12 the descriptive statistics for the overall total score and the sub-scales for the California Critical Thinking Disposition Inventory are presented along with the means and standard deviations of senior nursing students from an aggregate data analysis. Finally, descriptive statistics for the Scale of Intellectual Development are given in Table 13. Comparison scores for the normative sample are also provided in this table.

Table 9

Descriptive Statistics for the Knowledge Base Variables

Variable	Mean	Standard Deviation	Variance	Range
<u>Knowledge Base</u>				
Years in Nursing	7.66	4.09	16.70	31.00
Nursing Grade Point Average	3.07	.42	.17	1.90
Overall Grade Point Average	3.18	.43	.19	1.86

Table 10

Descriptive Statistics for the California Psychological Inventory (CPI) and
Comparison Scores for Normative Sample

Variable	Sample Mean	Standard Deviation	Variance	Range	Normative sample mean for registered nurses*
<u>CPI</u>					
Achievement via conformance	30.61	3.84	14.71	25.00	29.94
Standardized**	55.93				54.71
Achievement via Independence	27.29	3.74	14.02	27.00	24.46
Standardized**	58.62				54.02
Intellectual Efficiency	31.18	3.86	14.86	21.00	31.84
Standardized**	52.30				53.41

* Gough, H. (1987)

** Scores converted to the scale of the original instrument (mean = 50, standard deviation = 10)

Table 11

Descriptive Statistics for the Overall Score and Sub-Scales for the California
Critical Thinking Skills Test (CCTST) and Aggregate Data Analysis Results From
Senior Nursing Students.

Variable	Mean	Standard Deviation	Variance	Range	Senior Nursing Students CCTST Scores* means (m) standard deviations(sd)
<u>CCTST sub- scales</u>					
Analysis	4.92	1.38	1.89	7	m = 4.59 sd = ± 1.32
Evaluation	5.77	2.70	7.27	12	m = 5.72 sd = ± 1.87
Inference	6.53	1.74	3.04	8.00	m = 5.71 sd = ± 1.67
Inductive Reasoning	6.85	2.70	7.29	13	m = 6.93 sd = ± 1.99
Deductive Reasoning	8.52	2.42	5.87	12.00	m = 7.25 sd = ± 2.12
CCTST overall score	17.22	4.31	18.60	22	m = 16.4 sd = ± 3.55

* Facione (1997)

Table 12

Descriptive Statistics for the Overall Score and Sub-Scales of the California
Critical Thinking Disposition Inventory (CCTDI) and Aggregate Data Analysis
Results from Senior Nursing Students.

Variable	Sample Mean	Standard Deviation	Variance	Range	Senior Nursing Students CCTDI Scores* m = means sd = standard deviation
<u>CCTDI sub-scales</u>					
Truth-seeking	40.62	6.50	42.22	38.00	m = 38.70 sd = ± 4.78
Open-mindedness	43.86	5.90	34.82	41.00	m = 45.11 sd = ± 7.67
Inquisitiveness	48.48	6.97	48.61	43.00	m = 48.80 sd = ± 4.89
Systematicity	45.48	7.27	52.90	43.00	m = 43.78 sd = ± 5.20
Maturity	46.28	7.45	55.44	46.00	m = 46.09 sd = ± 4.83
Confidence	44.86	6.95	48.35	38.00	m = 44.59 sd = ± 5.47
Analyticity	43.85	5.96	35.54	36.00	m = 44.03 sd = ± 4.42
CCTDI overall score	313.52	34.69	1203.59	240	m = 311.40 sd = ± 23.71

* Facione (1997)

Table 13

Descriptive Statistics for the Scale of Intellectual Development (SID) and the Comparison Scores for the Normative Sample.

Variable	Sample Mean	Standard Deviation	Variance	Range	Normative sample mean/ standard deviation (college students)
<u>SID</u>					
Dualism	72.78	14.07	198.20	82.00	73/±16
Standardized*	49.89	8.80	57.56	51.25	
Relativism	58.94	8.72	76.05	48.00	63/±11
Standardized*	46.78	7.59	57.56	41.76	
Commitment	134.10	10.90	118.90	57.00	106/±10
Standardized*	76.74	10.47	109.58	54.72	
Empathy	85.44	8.99	80.83	49.00	79/±9
Standardized*	56.45	9.17	84.10	49.98	

* Scores converted to the scale of the original instrument (mean = 50, standard deviation = 10)

The numbers for the mean score for the study sample and the normative sample on the commitment scale were different, indicating that the individuals in this study had possibly reached a higher developmental level.

Testing of Assumptions

Statistical analyses were conducted in order to assess for violations of both the univariate and multivariate assumptions, since problems in estimation can occur when the distribution of the indicators departs from multivariate

normality (skewness, kurtosis, and skewness and kurtosis together), the chi-square was significant for the combination of skewness and kurtosis for fourteen of the indicators of three constructs: (a) critical thinking dispositions (truth-seeking, open-mindedness, inquisitiveness, systematicity, maturity, confidence, and analyticity), (b) cognitive development (dualism, relativism, commitment, and empathy), and (c) knowledge base (years in nursing, overall grade point average, and nursing grade point average). Substantial deviation from univariate normality from any of the observed variables indicates that the multivariate distribution is not multinormal. Therefore, transformation of the nonnormal variables is indicated (West, Finch & Curran, 1995). With the exception of years in nursing, where the logarithmic computation brought it closer to a normally distributed variable, the nonnormal variables were transformed using a square root computation. However, only seven of the fourteen transformed indicators achieved a nonsignificant chi-square for the combination of univariate skewness and kurtosis. When assessing the structural model, no difference in goodness of fit was noted with either the non-transformed or the transformed data.

In assessing for multivariate normality for continuous variables, the skewness ($z = 43.111$, $p = .000$), kurtosis ($z = 9.898$, $p = .000$), and skewness and kurtosis combined ($X^2 = 1956.56$, $p = .000$) were all significant. While a reduction was noted in both the z -values (skewness = 34.37 , kurtosis = 4.80) and the chi-square values (skewness and kurtosis combined = 1204.18) for the transformed

indicators, the results remained significant. One assumption of maximum likelihood is that there is a multivariate normal distribution of the data. This parameter estimation method, however, can handle slight to moderate departures from normality (Joreskog & Sorbom, 1993). Since use of the transformed data did not substantively change the structural model, the untransformed data were used in order to maintain the metric of the scale.

The Measurement Model

Since the focus of structural equation modeling is on the pattern of relationships across respondents, the covariance matrix from the final sample of 233 (Table 14) was the unit of analysis for this study. One indicator on each latent variable was set to a value of 1.0 to establish a common metric. The indicator that represents the best relationship with the construct is usually chosen to set the metric of the scale (Ecob & Cuttance, 1987). In this study, nursing grade point average, intellectual efficiency, systematicity, evaluation, and commitment were selected as the indicators that represented the best relationship with their latent constructs.

Table 14

Covariance Matrix

Variables	yrn	anal	eval	infer	deduct	induct	ts	om	inq	sys	cm	cf	an	du	re	co	em	ai	ac	ie	gpan	gpao
years in nursing (yrn)	16.70																					
analysis (anal)	0.14	1.89																				
evaluation (eval)	-0.53	0.57	7.27																			
inference (infer)	-0.06	0.60	2.03	3.04																		
deductive reasoning (deduct)	-0.63	0.34	3.38	3.25	5.87																	
inductive reasoning (induct)	0.02	0.70	6.28	2.19	1.73	7.29																
truth-seeking (ts)	-5.76	0.51	3.33	3.12	3.55	3.12	59.77															
open-mindedness (om)	-2.09	-0.48	1.57	1.85	2.07	1.66	25.99	50.28														
inquisitiveness (inq)	-0.47	-0.59	1.04	1.88	1.80	1.31	23.94	26.14	48.61													
systematicity (sys)	-2.17	0.09	2.11	2.08	1.76	2.71	35.58	20.07	33.18	63.75												
maturity (cm)	-2.66	1.61	2.68	2.71	3.37	3.03	38.90	19.55	23.65	31.08	55.44											
confidence (cf)	0.91	-0.31	2.00	0.49	-0.33	2.83	13.87	17.73	28.11	25.20	12.44	38.87										
analyticity (an)	-0.64	0.22	1.02	1.42	1.19	1.72	14.59	12.36	26.88	28.58	17.69	25.28	42.81									
dualism (du)	-0.08	-0.32	-10.96	-5.71	-8.83	-8.89	-38.80	-35.85	-20.92	-17.18	-25.21	-15.01	-1.82	198.20								
relativism (re)	0.09	-0.73	-2.18	-0.01	-0.79	-1.48	-20.33	1.92	-6.59	-21.65	-18.60	-5.73	-6.79	29.39	76.05							
commitment (co)	2.89	-0.54	4.30	2.45	2.11	4.02	19.36	14.59	28.17	41.50	12.42	33.38	28.96	-42.41	-36.60	118.90						
empathy (em)	2.78	0.02	-2.63	-0.50	-2.05	-1.63	-1.59	7.75	12.38	9.12	0.47	21.82	15.40	16.59	1.31	36.77	80.83					
achievement via independence (ai)	0.47	-0.07	2.39	2.09	2.36	2.18	9.95	9.24	6.76	9.39	7.55	3.09	2.56	-21.73	-4.26	9.40	-1.65	14.02				
achievement via conformance (ac)	0.24	0.11	1.13	1.05	0.87	1.25	7.44	0.02	7.50	15.81	5.60	6.38	9.08	-3.01	-12.70	15.14	3.32	4.52	14.71			
intellectual efficiency (ie)	-0.53	0.63	3.26	2.35	2.43	3.53	11.36	6.52	7.19	10.83	9.32	4.56	3.61	-24.48	-9.69	12.97	-3.53	8.40	7.37	14.86		
nursing grade point average (ngpa)	-0.04	0.02	0.05	0.01	0.02	0.09	0.46	0.49	0.37	0.45	0.32	0.28	0.28	-0.61	0.06	0.33	-0.03	0.99	0.00	-0.02	0.17	
overall grade point average (ogpa)	0.08	-0.03	0.01	-0.01	-0.02	0.02	0.13	0.30	-0.02	-0.04	-0.15	0.01	0.15	-0.56	0.25	0.06	0.21	0.04	-0.04	0.01	0.12	0.19

The overall model in Figure 12 did not fit the data well ($X^2 = 1250.97$, $df = 200$, $p < .001$). The significant chi-square value indicated a difference between the actual and predicted matrices. The goodness-of-fit index was .71, the normed-fit index (NFI) and the nonnormed-fit index (NNFI) were .56 and .53 respectively. All three fit indices were well below the accepted .9 level. The CFI (.59) score indicated an ill-fitting model when compared to the data, and the score on the PNFI (.48) indicated that the parsimony of the model was low. These results indicate an identification problem with the proposed model. Poor fit can occur if variables were hypothesized to be indicators for two or more constructs, if missing paths were identified, if large standard errors were present for more than one coefficient, or if there were deviations of the variables from normal distribution (Cuttance, 1987; Hoyle, 1995). Standard errors are given inside the circles in Figure 12.

The hypothesized measurement model, therefore, was tested within a confirmatory factor analysis to explore the pattern of interrelationships among the indicators and to establish construct validity. Table 15 shows the correlation matrix for each of the indicators. Potential multicollinearity problems may exist due to the high intercorrelation among some of the variables. Many researchers believe that correlations greater than .80 would be problematic, others contend that correlations greater than .60 could cause problems (Grimm & Yarnold, 1995; Munro & Page, 1993). In this study, only the correlation between inductive reasoning and evaluation was greater than .80 ($r = .86$). However, the variance inflation factors for all the correlations were not high enough to show evidence of multicollinearity among the variables.

Figure 12. Critical thinking and cognitive development model with parameter estimates and measurement errors data.

Table 15

Correlation Matrix

Variable	ac	ai	an	anal	cf	cm	co	deduct	du	em	eval	ie	induct	infer	inq	ngpa	ogpa	om	re	sys	ts
Achievement via independence (ai)	0.32																				
Analyticity (an)	0.36	0.09																			
Analysis (anal)	0.02	-0.02	0.03																		
Confidence (cf)	0.27	0.13	0.62	-0.04																	
Maturity (cm)	0.20	0.29	0.36	0.16	0.27																
Commitment (co)	0.36	0.27	0.41	-0.04	0.49	0.15															
Deductive reasoning (deduct)	0.09	0.25	0.08	0.40	-0.02	0.19	0.08														
Dualism (du)	-0.06	-0.49	-0.02	-0.07	-0.17	-0.24	-0.28	-0.26													
Empathy (em)	0.20	-0.08	0.26	0.00	0.39	0.01	0.38	-0.09	0.13												
Evaluation (eval)	0.11	0.27	0.06	0.15	0.12	0.13	0.15	0.52	-0.29	-0.11											
Intellectual efficiency (ie)	0.50	0.63	0.14	0.12	0.19	0.33	0.31	0.26	-0.45	-0.10	0.31										
Inductive reasoning (induct)	0.12	0.25	0.20	0.19	0.17	0.15	0.14	0.26	-0.23	-0.07	0.86	0.34									
Inference (infer)	0.16	0.32	0.12	0.25	0.05	0.21	0.13	0.77	-0.23	-0.03	0.43	0.35	0.47								
Inquisitiveness (inq)	0.28	0.25	0.59	-0.06	0.65	0.46	0.37	0.11	-0.21	0.20	0.06	0.27	0.07	0.16							
nursing grade point average (ngpa)	0.00	0.05	0.10	0.04	0.11	0.10	0.07	0.02	-0.10	-0.01	0.05	-0.01	0.08	0.02	0.13						
overall grade point average (ogpa)	-0.02	0.02	0.05	-0.05	0.01	-0.05	0.01	-0.02	-0.09	0.05	0.01	0.00	0.02	-0.01	-0.01	0.66					
open-mindedness (om)	0.00	0.37	0.27	-0.05	0.40	0.37	0.19	0.12	-0.36	0.12	0.08	0.24	0.09	0.15	0.53	0.17	0.10				
relativism (re)	-0.38	-0.15	-0.1	-0.12	-0.11	-0.29	-0.39	-0.04	0.24	0.02	-0.09	-0.3	-0.11	0.00	-0.11	0.02	0.07	0.03			
systematicity (sys)	0.52	0.34	0.55	0.55	0.51	0.52	0.47	0.09	-0.15	0.13	0.10	0.35	0.60	0.15	0.56	0.13	-0.01	0.35	-0.31		
truth-seeking (ts)	0.25	0.38	0.29	0.29	0.29	0.68	0.23	0.19	-0.36	-0.02	0.16	0.38	0.44	0.23	0.44	0.14	0.04	0.47	-0.30	0.58	
years in nursing (yrn)	0.00	-0.01	-0.03	-0.03	0.02	-0.11	0.05	-0.06	0.02	0.05	-0.07	-0.1	-0.02	-0.04	-0.02	-0.06	0.02	-0.09	0.04	-0.07	0.21

Two of the indicators from the knowledge base construct had significant and moderate correlations between overall grade point average and nursing grade point average; the number of years in nursing was not significantly correlated with either indicator. The cognitive and intellectual functioning construct had significant but weak correlations among the three indicators.

Examination of the critical thinking disposition construct showed that inquisitiveness and systematicity were each significantly and moderately correlated with five of the other seven indicators. Inquisitiveness also had a weak correlation with commitment, while systematicity was weakly correlated with commitment but moderately correlated with achievement via conformance. Each of the other five indicators had significant but weak to moderate correlation with at least three other indicators for this construct.

Four of the five indicators for the critical thinking skills construct, deductive reasoning, inductive reasoning, evaluation, and inference, all had significant and moderate correlations with two other indicators from this construct. The analysis indicator was weakly correlated only with deductive reasoning. The fifth construct, cognitive development, had only two indicators, dualism and commitment, which showed correlations above the 0.4 level. Synthesizing the data on construct validity shows that the indicators are not strong measures of the constructs they are supposed to measure.

A second factor to consider when seeing how well the model fits the data is to evaluate the squared multiple correlation for an observed variable. Low squared multiple correlations indicate that the indicator is a weak or invalid

measure of the construct (Cuttance, 1987). In this study, years in nursing ($R^2 = .00$), analysis ($R^2 = .034$), dualism ($R^2 = .13$), and empathy ($R^2 = .12$) were low. Therefore, little of the variance for the construct cognitive development is accounted for by two of the four indicators. Indicators that appear to be valid for their constructs are as follows: a) grade point average in nursing for knowledge base, b) evaluation and inductive reasoning for the construct of critical thinking skills, c) inquisitiveness and systematicity for the construct of critical thinking dispositions, d) commitment for cognitive development, and e) intellectual efficiency for cognitive and intellectual functioning.

Table 16 shows the measurement model parameters which consist of factor loadings and measurement error variances. The critical thinking dispositions factor loadings and the cognitive and intellectual functioning factor loadings are uniformly high, indicating that these factors are well-identified. Three of the factors, critical thinking skills, cognitive development, and knowledge base, have variable factor loadings. The factors associated with the critical thinking skills construct range from .097 (analysis) to 1.00 for the fixed parameter evaluation. The cognitive development factor loadings also are variable, ranging from -.41 (relativism) to 1.00 for the fixed parameter commitment with high error measurements. The final factor loadings, those corresponding to knowledge base, range from -.24 (years in nursing) to 1.00 for the fixed parameter GPA-nursing. These indicators are not as highly intercorrelated among themselves because they are not subscales of an instrument but are individual indicators hypothesized to relate to the construct of knowledge base.

The error variances associated with most of the measurement model were routinely high, indicating that the indicators were measuring something other than what the latent variables were hypothesized to measure. The error evident in the measurement model may explain one reason why the fit of the model was poor.

Table 16

Measurement Model Parameters

<u>Construct Name with Indicator Names</u>	<u>Factor Loadings</u>	<u>Error Variances</u>
Knowledge Base		
Years in Nursing (YRN)	-.24	16.70*
Overall GPA (OGPA)	.68*	.10
Nursing GPA (NGPA)	1.00+	.01*
Cognitive and Intellectual Functioning		
Achievement via Conformance (AC)	.67*	9.80*
Achievement via Independence (AI)	.74*	7.99*
Intellectual Efficiency (IE)	1.00+	3.81*
Critical Thinking Dispositions		
Truth-Seeking (TS)	.78*	35.43*
Open-mindedness (OM)	.63*	34.63*
Inquisitiveness (INQ)	.89*	17.30*
Systematicity (SYS)	1.00+	26.58*
Maturity (CM)	.72*	34.69*
Confidence (CF)	.69*	19.89*
Analyticity (AN)	.71*	23.10*

Table 16 (con't)

Measurement Model Parameters

Critical Thinking Skills		
Analysis (ANAL)	.097*	1.83*
Evaluation (EVAL)	1.00+	.41
Inference (INFER)	.32*	2.34*
Inductive Reasoning (INDUCT)	.91*	1.61*
Deductive Reasoning (DEDUCT)	.47*	4.33*
Cognitive Development		
Dualism (DU)	-.54	172.80*
Relativism (RE)	-.41	60.91*
Commitment (CO)	1.00+	30.41*
Empathy (EM)	.33	71.37*

+ Fixed parameter; * Parameter significant, $p < .05$ (parameter estimate exceeds standard error by a ratio of ≥ 1.96).

To further investigate problems that occurred with the indicators, factor analysis with varimax rotation was performed on all the indicators in the model. The results did not confirm that the indicators, as presented in the measurement model, loaded on their respective constructs. Table 17 shows that there were seven components identified by the analysis, two more than shown in the hypothesized model. Factor one accounted for 25.12% of the total variance while all seven components accounted for 70.77% of the total variance. It appears from this analysis that the variance accounted for by the indicators is moderately high; however, the indicators load on factors other than what they were constructed to measure.

Table 17

Principal component matrix

Indicators	Construct	1	2	3	4	5	6	7
Confidence	CCTDI	.846						
Analyticity	CCTDI	.770						
Inquisitiveness	CCTDI	.755						
Empathy	SID	.610						
Systematicity	CCTDI	.594						
Commitment	SID	.566						
Achievement	C & I F		.793					
via Independence								
Dualism	SID		-.771					
Intellectual Efficiency	C & IF		.626					
Open-Mindedness	CCTDI		.564					
Relativism	SID			-.758				
Achievement	C & IF			.752				
via Conformance								
Inductive Reasoning	CCTST				.902			
Evaluation	CCTST				.982			
Deductive Reasoning	CCTST					.813		
Analysis	CCTST					.758		
Inference	CCTST					.696		
Truth-seeking	CCTDI						.652	
Maturity	CCTDI						.639	
Years in Nursing	KB						-.630	
Overall GPA	KB							.911
Nursing GPA	KB							.903

KB= Knowledge Base, C&IF= Cognitive and Intellectual Functioning, CCTST= California Critical Thinking Skills Test, CCTDI = California Critical Thinking Disposition Inventory, SID = Scale of Intellectual Development

One method to help strengthen the measurement model is to eliminate poor indicators (Fassinger, 1987; Hoyle, 1995; Schumacker & Lomax, 1996). The knowledge base construct was eliminated from the structural model based on low factor loadings for one indicator, years in nursing, thus leaving only two

indicators to measure the construct. Since the remaining two indicators (overall grade point average and nursing grade point average) had intercorrelations that were moderately high (.66), it is highly probable that they were measuring much of the same variance. Thus, using these two as indicators for knowledge base would not provide valid information for the construct. A second factor that supports the elimination of the knowledge base construct is that it is recommended that a minimum of three and preferably four indicators be used for each construct (Bentler & Chou, 1988; Fassinger, 1987; Schumacker & Lomax, 1996). Testing this modified model, the results indicated that the model did not fit the sample data as the chi-square value remained significant and the GFI was .72.

Inductive reasoning and deductive reasoning were removed from the original model on the basis that the scores obtained for these two indicators were derived from answers given on the analysis, evaluation, and inference indicators. Inductive reasoning and evaluation were highly correlated (.862), which indicates that they may measure the same phenomenon. The residual for the inductive reasoning and deductive reasoning subscales (-11.14) was the largest negative standardized residual, and the residual for deductive reasoning and inference subscales (11.24) was the largest positive residual. Large standard residuals indicate that a particular covariance is not well explained by the model (Schumacker & Lomax, 1996). However, little change occurred in the structural model (GFI = .74) by eliminating the deductive and inductive reasoning indicators.

The Structural Model

When the measurement model cannot be justified as representing the sample data, there is little to be gleaned from assessing the structural model as the model parameters are invalid (Hoyle, 1995). Therefore, the structural model was not tested.

CHAPTER 5

Discussion

This study began as an investigation of critical thinking and cognitive development using structural equation modeling. The researcher was guided by Perry's (1970) theory of adult cognitive development and Kataoka-Yahiro and Saylor's (1994) Critical Thinking Model for Nursing Judgment. The review of the literature uncovered a dissonant collection of theories about critical thinking and cognitive development. No widely accepted theory or model of the concepts of critical thinking and cognitive development has been advocated by nursing leaders in the field.

The goal set forth was the development of a theoretically justified model of critical thinking and cognitive development. The results obtained in this study showed that the indicators of the latent variables in the measurement model were not sufficient to measure the constructs. This conclusion was identified when examination of the measurement model indicated weak relationships between the constructs and their indicators. Low correlations among indicators of a construct imply that there is little shared variance among them. Instrument construct validity is called into question. A model with weak relationships among constructs and their indicators makes little substantive or

methodological sense; inadequately designed measurement tools cannot yield a substantively valid model (Fornell & Larcker, 1981). Therefore, the hypothesis that the model of critical thinking and cognitive development would fit the sample data was could not be tested.

The subscales for the constructs of critical thinking dispositions and cognitive and intellectual functioning were the strongest indicators of these constructs. Indicator support for the constructs of knowledge base, critical thinking skills, and cognitive development was variable. Error variances were high for all the indicators, with the exception of those for critical thinking skills and the two indicators of knowledge base (overall grade point average and nursing grade point average), which showed that the indicators were measuring something else in addition to the construct they were designed to measure. A second gauge that the indicators were weak or invalid measures of their construct was the low squared multiple correlations for the indicators of dualism, empathy (two of the four indicators for the construct of cognitive development), years in nursing (an indicator of knowledge base), and analysis(an indicator of critical thinking skills).

A second problem identified in the evaluation of the measurement model for goodness-of-fit concerned the large measurement errors found during model analysis. Measurement errors occur most often when the concepts are measured by relatively more abstract or theoretical indicators. A statistical assumption in structural equation modeling is that any errors of measurement noted in the observed variables are both random measurement error and

variance unique to each indicator and uncorrelated with the constructs underlying those variables. This implies that the response tendencies of participants on one questionnaire do not influence the other observed measures in a similar way (e.g. tendency to respond to the center of the scale, defensiveness, or tendency to deny all psychological difficulties). However, psychometric data obtained from self-report questionnaires are often distorted by generalized response biases (Holm & Llewellyn, 1986). In this study three of the four measurement tools were psychological tests which may account for the large measurement error findings.

Error variances affect both the reliability and validity of measures (Waltz, Strickland, & Lenz, 1991). Random error affecting reliability may be due to such factors as scoring methods for the instrument, characteristics of the subject (attention span, anxiety), or characteristics of the measuring device (types of items). Systematic errors affecting validity may be due to characteristics of the respondent (attitude towards taking the test, test taking skills, illness) or characteristics of the measurement tool (items on the questionnaire that were irrelevant to the concept being measured). The presence of a large random error compromises the ability of the indicator to represent the concept that it is supposed to measure.

A third problem identified from this research is the possibility that several of the concepts measured similar things. Four of the indicators of critical thinking dispositions (confidence, analyticity, inquisitiveness, and systematicity) loaded on the same factor component as two of the indicators of cognitive development

(commitment and empathy). A second factor loading showed that achievement via independence and intellectual efficiency, from the concept of cognitive and intellectual functioning, measured some of the same traits as did the dualism indicator of cognitive development and the maturity indicator of critical thinking dispositions. In a similar manner, the indicator of relativism from the concept of cognitive development loaded with the indicator of achievement via conformance from the cognitive and intellectual functioning construct. Two indicators of critical thinking dispositions (truth-seeking and maturity) loaded with years in nursing. The construct of critical thinking skills, which had low error variances, loaded as two separate but distinct factors, with inductive reasoning and evaluation loading as one factor, and deductive reasoning, analysis, and inference loading as the second factor. Again this indicates that the same indicators were measuring two different variables.

Examination of the reliability estimates of the instruments is necessary when problems develop in testing the measurement model. An instrument that has been tested and modified should demonstrate reliability at or above a .80 level (Hinshaw & Atwood, 1982). The sub-scales of cognitive and intellectual functioning of the California Psychological Inventory had an alpha coefficients of .72 for achievement via conformance, .70 for achievement via independence, and .72 for intellectual efficiency. Domino (1984), in an evaluation of the California Psychological Inventory, believed that, they were adequate given the complexities of the instruments, even though the scores were low. The results of this study do not support that evaluation.

The alpha reliabilities for the seven individual subscales for the California Critical Thinking Dispositions Inventory ranged from .71 to .80. Truth-seeking, Open-Mindedness, Analyticity, Systematicity, and Maturity all had reliability at or below .75. The alpha coefficient for inquisitiveness was .80, and for confidence it was .78. However, an alpha of .91 was reported for the overall instrument. Using the total score on the CCTDI might have proven to be a better indicator of critical thinking dispositions rather than the instrument's sub-scales.

Kuder-Richardson-20 reliability for the overall California Critical Thinking Skills Test was .70. Facione and Facione (1994) argued that a dichotomously scored test often results in low reliability results. One explanation may be that the instrument is designed to measure a variety of cognitive skills and not just a single, homogeneous factor. Therefore, reliability ratings of .65 to .75 are considered sufficient (Norris & Ennis, 1989).

The alpha coefficients for the Scale of Intellectual Development were reported in the instructional manual provided by the author as .81 for dualism, .70 for relativism, .76 for commitment, and .73 for empathy (Erwin, 1983). As stated earlier, for a mature instrument these are considered low reliabilities. Additionally both dualism and empathy had low squared multiple correlations. Again, the need for valid instruments is evident to evaluate and develop the model in this study.

Problems with the measurement instruments may have occurred because of several factors. First, many of the respondents indicated their dislike for the critical thinking skills test. Some of the participants included notes in the packet

commenting on the CCTST. Some of the statements were: “this was the hardest test of the packet”, “I hate having to return this to you, I hope I don’t mess up your findings, as I just did not like the CCTST”, and “I hope I never have to take the CCTST again; I feel stupid”. These attitudes could have influenced their responses. Second, even though the participants were told that they did not have to complete the tests in one sitting, it is unknown if many actually filled out all the questionnaires at one time. If this did occur, fatigue could certainly be a factor. Third, the respondents were given instructions to answer the questionnaires in the order that they were placed in the packet. Instructions for the California Critical Thinking Dispositions Inventory indicate that this test needs to come before the California Critical Thinking Skills Test so as not to be influenced by the latter. Since no monitoring of the procedure was possible, it is unknown whether this instruction was followed by the participants. Finally, the California Critical Thinking Skills Test is a timed test. It was up to the participant to follow the instruction to complete the test within 45 minutes. Again, since no observer was present while taking the tests, it is unknown whether this instruction was followed by the participants. If any of these conditions was present in the testing procedure, the reliability and validity of the measurement model may have been compromised for this sample.

The California Critical Thinking Skills Test, the California Critical Thinking Disposition Inventory, and the Cognitive Development Instrument all have normative samples which come from undergraduate college students. Since the sample population for this study was from those who had graduated from college

at least two years prior to the study, these tools may not be a valid measure of critical thinking skills, dispositions, or cognitive development for this sample population.

Many authors (Leppa, 1997; McMillan, 1987; Norris & Ennis, 1989) also have questioned the use of standardized tests when measuring critical thinking. There are several problems with such an approach that have been identified in the literature. One is the multiple-choice format itself. This style of testing forces the subject to select only from the options available. Individual life experiences and/or knowledge base may have subjects identifying alternatives other than those available to them. Second, the subject matter the individuals were reading may not have been of interest to them or they may have possessed little knowledge in the area. Third, the breadth of the critical thinking tests may have been too narrow and not considered to be a comprehensive test of overall critical thinking abilities. Finally, testing a general critical thinking ability may not be reflective of individuals' capabilities in a domain-specific area where knowledge base and experience might have an impact on the scoring results (Norris & Ennis, 1989).

Testing the assumptions for multivariate normality showed that many of the variables departed from normality. This departure often is cited as a concern when conducting structural equation modeling (Fassinger, 1987; Hoyle, 1995; Schumacker & Lomax, 1996). Cuttance (1987) found that the model will be rejected when the skewness of any of the variables is greater than 2.0 or when kurtosis is greater than 2.0. In this study, years in nursing, open-mindedness,

inquisitiveness, maturity, and achievement via conformance were the indicators that showed nonnormal distribution and may have contributed to the measurement model having such a poor overall fit to the data.

In addition, the sample population tested could have caused problems. Since a non-random sample was used and because they all graduated from the same school of nursing, the sample population may have been too homogenous.

In summary, inadequate measurement structure of the instruments may have been a significant factor that led to model problems. Therefore, this model remains untested.

Limitations

Threats to Validity

The major limitation to this descriptive correlational design is that cause and effect relationships cannot be identified with confidence.

Internal Validity

One threat to internal validity in this study may have been a time longevity factor or history. Many participants took over three months to complete the questionnaires, with an increased chance of personal or work-related events possibly affecting responses during this time and therefore affecting the major variables as well. These influences, however, most likely occurred randomly throughout the sample, thereby minimizing this threat.

Selection is a threat to internal validity where randomization is not used in the selection of the participants for the study. Certainly, people self-select when they are asked to participate in a study and are willing to complete a battery of

time consuming tests. The results of this study only can be generalized to a similar subset of baccalaureate prepared nurses.

Another threat to internal validity may have occurred because of maturation. In this study some of the participants were enrolled in graduate studies. It is conceivable that their collective educational process could have influenced the responses on the questionnaires.

Construct validity

One of the most important aspects when investigating limitations of a study is the construct validity of the instruments used to measure the different concepts. Specific instruments were carefully chosen not only for reliability and validity, but as measures of the variables defined from the conceptual framework and theory.

However, the choice of instruments proved to be a significant problem in this study as well as a major limitation in interpreting the results. None of the study's measurements functioned well; evidence that these instruments did not work as expected included the large standard errors associated with the subscales on the critical thinking dispositions inventory, the cognitive and intellectual functioning test, and the cognitive development measurement. Items on these subscales apparently failed to measure the aspects of the construct they were intended to measure. The indicators for the critical thinking skills construct and the cognitive development construct were inadequately intercorrelated among themselves, revealing that they did not represent the construct.

Apprehension when evaluating and responding to the questionnaires also may have created a problem with construct validity. All of the participants knew the researcher and were aware that the results would be carefully examined. Evaluation apprehension hopefully was minimized by explaining to the participants the need to answer the questions honestly and assuring them of the confidentiality of their responses by having the completed questionnaires returned in envelopes that contained an identification number known only to the researcher.

External validity

Generalizing the results of the data to other populations is limited by the lack of random sample selection. The results only can be generalized to nurses comparable to the subjects studied and from the same school where the subjects received their baccalaureate education.

Implications for Practice

The concept of critical thinking has been emphasized in nursing literature and by the National League for Nursing as important for nursing education and for practicing registered nurses. Presently there is no clear definition or general consensus about what the construct actually represents in nursing. However, educational strategies have been developed to infuse critical thinking into the nursing curriculum, and nursing schools are required to demonstrate that graduating nursing students can think critically. More employers are seeking nurses who can think critically; many performance evaluations now require that nurses demonstrate this ability.

This study showed that the concepts of critical thinking and cognitive development were not well measured by the California Critical Thinking Skills Test, the California Critical Thinking Dispositions Inventory, or the Scale of Intellectual Development. To date, most of the nursing studies have used the Watson-Glaser Critical Thinking Appraisal Instrument to measure critical thinking. As stated in the literature review section, mixed results have been reported when using this instrument (Brigham, 1989; Matthews & Gaul, 1979; Saarmann, Freitas, Rapps, & Riegel, 1992). The findings from this study suggest that nursing educators and practicing nurses must be cautious in reporting or evaluating the critical thinking abilities of students or nurses until better instruments are developed to test these constructs.

Implications for Future Research

As an outcome of this study, four major areas of research need to be explored. First, qualitative research on the concepts of critical thinking and cognitive development would be extremely helpful. Further understanding of these two constructs would allow distinction among factors important to nursing and validate these concepts as appropriate in nursing.

Second, a strong effort should be made to develop better measures of both critical thinking and cognitive development for both nursing students and practicing nurses. Due to the discipline specific nature of nursing, it is important to develop instruments that reflect the concepts as they apply to the nursing profession. Measurement tools that reflect the general ability to think critically appear unable to show how a specific nursing curriculum, teaching strategy,

nursing practice area, or years of experience influence critical thinking in nursing students or practicing nurses. In addition, developing an instrument that reflects the novice to expert continuum would be a valuable tool to use as a way to measure cognitive development in nursing.

Third, when valid measures of critical thinking and cognitive development have been developed for nursing education and clinical practice, this research should be replicated in a sample population that encompasses the continuum of novice to expert. Study samples also should include nursing students and nurses from different and varied educational programs.

Finally, once valid measures and exploratory models have been developed and tested, intervention studies should be designed to investigate educational approaches that promote critical thinking and cognitive development. From these studies teaching strategies can be developed and expanded to foster these conditions in nursing students and practicing nurses to promote high quality, cost-effective nursing care in a variety of health care settings.

Summary

While this study did not validate or refute a model of critical thinking and cognitive development, it did highlight the need for instruments that can measure these constructs in a reliable and valid manner. The problems identified in the measurement model due to inadequately designed psychometric instruments prohibited the structural model from being evaluated. As a result, a model of critical thinking and cognitive development has yet to be adequately tested.

The diversity and complexity of professional practice in today's health care arena demand that nurses be able to think critically and utilize their nursing education and experience in planning, problem-solving, and managing the health care needs of their clients. The goal of nursing education is to educate individuals in such a way that they become self-determining, independent thinkers who are prepared to keep pace with the rapidly changing demands of today's health care system. It is important to know whether nurses utilize critical thought and reasoned action as a basis for clinical practice. A clear understanding of the concepts of critical thinking and cognitive development is needed by nursing educators and practitioners in order to implement educational programs that promote this type of thinking. Further research in this area would be of significant value to hopefully strengthen nursing in both educational and clinical arenas as well as to enhance and benefit patient care.

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Appendix A

Comparison of Perry's Cognitive Development Positions
with Belenky's et al. Development Positions

Cognitive Development Position	Perry's Positions	Belenky, Clinchy, Goldberger, & Tarule's Perspective
0		Silence
1	Dualism	Received Knowledge
2	Multiplicity	Subjective Knowledge
3	Relativism	Procedural Knowledge
4	Commitment	Constructed Knowledge

Appendix D

Sample Letter to Participants

August 1997

Dear Janet,

Hi, this is Jane Rapps, a voice from the past. Remember me? I was one of your nursing instructors at San Diego State University. I taught the "Stress and the Health Continuum" course which since has been changed to Nursing Practice II. I still have the pleasure of teaching this course. I am presently completing my doctoral dissertation and I need your help. I am looking for volunteers who would be willing to participate in my research study. My research interest is in the area of critical thinking and knowledge development. As a participant in this study you would need to meet the following criteria:

1. began and completed your nursing undergraduate education at SDSU between May, 1981 and May 1995.
2. presently working in health care environment or pursuing post-graduate education.
3. have worked in the same general practice setting (i.e. medical, surgical, labor & delivery, orthopedics, administration, etc.) for at least two years (at 20 hours per week).

As a participant in this study, you will be asked to complete four questionnaires and one demographic profile. This should take you approximately two and one half hours to complete. I know this seems like a considerable amount of time, but the questionnaires do not have to be completed in one sitting. However, you do have to fill them out according to the order they are numbered in your packet and follow any special directions noted on the questionnaire. For example, one of the questionnaires has a time limit of 45 minutes.

Confidentiality of responses to the questionnaires and data profile will be protected in the following ways: (a) you will not be identified in public reports by

name or any other defining characteristics, (b) packets will be returned in coded envelopes, and these codes will be accessible only to me.

Additional data that I must gather will require your permission for me to access your college records. I will be gathering your GPA both in the nursing major and overall. Once I have verified your return envelope and have gathered the information from your records, I will place your name and code number in separate places and will not link the ID number with your name again. The information from the questionnaires will only be entered by coded number after the school data has been placed in the computer.

Please fill out the enclosed postcard and return it ASAP. If you agree to participate in this study and meet the criteria requirements, I will send you a packet in the mail within one week of receiving your postcard. The consent for participation in this study will be enclosed in that packet.

I realize that I am asking you to take time out of your already busy schedule to help me with my research. I am committed to finding ways to improve teaching and to helping nursing students and practicing nurses strengthen their decision-making abilities. I need your help to begin this work. Thank you so much

Jane Rapps, RN, DNSc (C), CS

Appendix E

Instruction Letter to Participants

Dear Janet,

Thank you so much for consenting to participate in my research study. There are a few items that may need further explanation before you begin to fill out the questionnaires.

1. Please sign the consent-to-participate form and place it in the envelope provided before you begin to complete any of the questionnaires. **Please fill out your Social Security number on the front of the envelope.**
2. Please fill out the questionnaires in the order they are placed in this packet. If individual instructions are needed, they will be found paper-clipped to each questionnaire. You need to use a #2 pencil on the scantrons.
3. The tools for this study should take approximately 2.5 hours to complete. You do not have to do them at one sitting. There is only one instrument that has a time limit to it. All others can be taken at your own pace. I would appreciate your trying to return the packet within **fourteen** (14) days. If I have not heard from you within two weeks I will send you a reminder.
4. Please place the consent form and all the questionnaires in the return manila envelope that is self-addressed and stamped.
5. I again want to thank you so much for giving of your time. Your input will help with the evolution of a model of critical thinking and knowledge development.
6. In the future, if you need any assistance with research studies or with educational opportunities, please don't hesitate to reach me by mail or phone. If you have any questions regarding this study, please call me at (619) 594-1314. If I am not available please leave a message on my answering machine and I will return your call as soon as possible.

7. If you know the whereabouts of any of your classmates I would greatly appreciate your including their names and addresses in this envelope so I can contact them. The mailing list I have received from the college is out-of-date and I am getting many returned letters back due to incorrect addresses.

Again, thanks so much for helping me with this study.

Warmest regards,

Appendix F
Demographics Questionnaire

In this questionnaire you are asked to provide information about yourself. **Please be sure to complete all the questions.**

Place your answer in the shaded box.

General Demographic Profile

1. What is your age?

2. What is your gender?

3. What is your marital status?

Personal Education and Practice Area Profile

4. How many years have you been licensed as an RN?

5. How many hours per week do you work?

6. Total number of years of formal education completed: (Graduation from SDSU's undergraduate college program = 16. Add one year for each year of post-baccalaureate education).

7. What educational degree besides your BSN have you been awarded?

8. Have you received a certification for knowledge and experience in a specialty area?

Yes

No

If yes, what is the name of your certificate and which specialty area is it in?

9. If you have received a Master's in what area of study did you receive it?

Community Health Nursing	Adult Health Practitioner
Medical/Surgical Nursing	Family Nurse Practitioner
Child Health Nursing	Primary Care Nurse
Maternal-infant Nursing	Gerontological Nurse Practitioner
Adult Health Nursing	Women's Health Nurse Practitioner
Geriatric/Gerontological Nursing	International/Cross-Cultural Nursing
Psychiatric/Mental Health Nursing	Renal Nursing
Cardiovascular Nursing	Diabetes Nursing
Rehabilitation Nursing	High-risk Perinatal Nursing
Critical Care Nursing	Correctional Nursing
Occupational Health Nursing	Neurological Nursing
Oncology Nursing	Rural Health Nursing
Nursing Administration	Burn/Emergency/Trauma Nursing
Nurse Anesthesia	School Nurse Practitioner
Nurse Midwifery	School Health Nursing
Advanced Practice Nurse	Other
Pediatric Nurse Practitioner	

10. What is your current primary nursing role or practice area?

Practice Areas:	Quality Control Department
Ambulatory care setting	Recovery room
Cardiac or Coronary care units	Rehabilitation nursing
Client Advocate	School nurse
Clinical specialist (any specialty)	Thanatology nurse specialist
Community health nurse	Other:
Critical Care or intensive care	Administration:
Dialysis units	Director of Nursing
Discharge Planner	Supervisor of Nursing
Emergency /Trauma Department	Head nurse/charge nurse
Enterostomal therapist	Assistant Head nurse
Geriatrics	Other
Home health nurse	Education:
Infection control (nurse epidemiologist)	Director of continuing education
Labor and delivery	Continuing education instructor
Postpartum	Client education instructor
Nursery	Nursing Instructor in a BSN program
Medical and/or surgical nursing	Nursing Instructor in an ADN program
Nurse anesthetist	Nursing Instructor at Instructional Program
Occupational health	Other
Operating room	
Orthopedic nursing	Research:
Pediatric nursing	Nurse Researcher
Psychiatric nursing	Other

11. How many years have you been in the above practice setting?

Professional Activities

12. Number of professional organizations that you belong to:

13. Number of professional nursing journals you subscribe to:

14. On the average, how many articles do you read per month.

15. Which of the following activities have you participated in within the past twelve months?

Individual research effort
Presenter, professional meeting/conference
Presenter, hospital based presentation
Mentor preceptor for new graduate
Mentor preceptor for new staff RN
Master's courses
Master's thesis
Doctoral courses
Doctoral dissertation
Advisor-advisee relationship
Research assistantship
Preparation of journal manuscript
Member of research team

Critical Thinking Abilities.

Using the following scale: 1=no confidence
2 = very little confidence
3 = some confidence
4 = fairly confident
5 = quite a lot of confidence
6 = totally confident

16. How confident are you in your critical thinking skills when working with patients?

17. How confident are you in your critical thinking abilities when working with physicians?

18. How confident are you in your critical thinking abilities when working with other nurses?

Background questions from the California Critical Thinking Skills Test

19. Out of the 34 items on the California Critical Thinking Skills Test I am confident that I answered _____ of them correctly. (Record the number you wrote down on the instruction sheet for questionnaire #3 in the shaded area below.

20. In terms of deciding what to believe or what to do, critical thinking and being logical are:

- A. a waste of time
- B. helpful, but not nearly as important as lots of other things
- C. more important than most other things
- D. extremely important

Appendix G

Suggested Percentiles for the California Critical Thinking Skills Test

Score	Analysis	Evaluation	Inference	Deduction	Induction
0	1	1	1		1
1	4	5	2	1	2
2	10	11	3	2	7
3	26	23	11	6	13
4	49	37	21	12	22
5	75	52	37	22	34
6	92	70	55	33	48
7	98	81	73	47	65
8	99	89	88	62	79
9	99	94	97	74	88
10		98	99	85	94
11		99	99	92	98
12		99		97	99
13-14				99	99
15-16				99	

(Facione & Facione, 1994)

Appendix H

Raw Score Deciles, Means, and Standard Deviations for the

Scale of Intellectual Development

Raw Score	Dualism	Relativism	Commitment	Empathy
Decile	Mean = 73	Mean = 63	Mean = 106	Mean = 79
	SD = 16	SD = 11	SD = 10	SD = 9
90%	93	79	120	97
80%	88	73	114	89
70%	81	70	109	86
60%	76	66	105	81
50%	71	63	100	79
40%	68	60	95	77
30%	64	57	89	73
20%	59	53	72	68
10%	55	48	60	61

(Erwin, 1983)