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Investigation into the relationship between critical thinking skills and clinical judgment in the nurse practitioner student

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UNIVERSITY OF NORTHERN COLORADO

Greeley, Colorado

The Graduate School

AN INVESTIGATION INTO THE RELATIONSHIP BETWEEN
CRITICAL THINKING SKILLS AND CLINICAL JUDGMENT
IN THE NURSE PRACTITIONER STUDENT

A Dissertation Submitted in Partial Fulfillment
of the Requirement for the Degree of
Doctor of Philosophy

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College of Natural and Health Sciences
School of Nursing
Program of Nursing Education

December, 2010

This Dissertation by: Karen L. Gorton

Entitled: *An Investigation into the Relationship Between Critical Thinking Skills and Clinical Judgment in the Nurse Practitioner Student*

Has been approved as meeting the requirement for the degree of Doctor of Philosophy in the College of Natural and Health Sciences in the School of Nursing, Program of Nursing Education

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ABSTRACT

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The purpose of this study was to determine if there was a relationship between critical thinking (CT) skills and clinical judgment in nurse practitioner (NP) students enrolled in an advanced practice educational program. To assess this relationship, the following four research hypotheses were developed:

- Nurse Practitioner students who demonstrate higher scores on the California Critical Thinking Skills Test (CCTST) will also demonstrate more accuracy in the formulation of differential diagnoses as determined by their results on the exam style questions.
- Nurse Practitioner students who demonstrate higher scores on the (CCTST) will also demonstrate higher scores on the evaluation and reevaluation of consequences subscale of the Clinical Decision-Making in Nursing Scale (CDMNS).
- Nurse Practitioner students who demonstrate higher scores on the (CCTST) will also demonstrate more accuracy in the formulation of differential diagnosis as determined by the preceptor clinical evaluation tool.

- Professional work experience of the NP student as a registered nurse will have some relationship to the NP students' scores and sub-scores on the California Critical Thinking Skills Test.

This descriptive correlational study using a convenience, nonprobability sampling technique engaged participants from across the United States. All participants were enrolled in a family nurse practitioner educational program at the master's level. Participants were within one year of graduation and providing care for patients under the supervision of a clinical preceptor. There were 50 participants who completed all the study tools.

Correlational analysis demonstrated no statistically significant relationship between critical thinking skills and exam style questions; critical thinking skills and scores on the evaluation and reevaluation of consequences subscale of the CDMNS tool; critical thinking skills and the preceptor evaluation tool; and critical thinking skills and years of professional nursing experience. Further statistical evaluation using one way Analysis of Variance (ANOVA) and Kruskal-Wallis analysis demonstrated no statistically significant relationship between critical thinking skills and professional work experience or years of professional work experience.

Based on this small study, no statistically significant relationship was found between critical thinking skills and clinical judgment. However, those nurses who had critical care nursing experience demonstrated higher scores on all of the CCTST scales. To further investigate the potential relationship between professional nursing experience and critical thinking skills, further research should be considered.

Educators and practitioners could consider further research in these areas to gain insight into how clinical judgment is and could be measured; to gain insight into the critical thinking skills of NP students; and to gain insight into the development and measurement of critical thinking skills in advanced practice educational programs.

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CHAPTER I

INTRODUCTION

Increasingly, the Nurse Practitioner (NP) is being called upon to meet the health care needs of more and more individuals in the United States. Currently Nurse Practitioners provide health care for more than 600 million patients each year (American Academy of Nurse Practitioners, 2007). The American Association of Medical Colleges indicates that there will be a shortage of primary care physicians in the coming years (Salsberg & Grover, 2006). With a predicted decrease in the number of physicians providing primary health care to our nation, increasing the number of qualified Nurse Practitioners who provide primary care is one way to meet this health care provider shortage.

The ability of the nurse to think critically about the condition of a patient has been identified as one of the key components within the scope of nursing practice (American Nurses Association, 2004). Critical thinking skills are important for the NP as each is required to carefully evaluate and prioritize data presented to them by the patient. Once the patient-provided information is evaluated and prioritized, the NP has to carefully evaluate that information and formulate an appropriate differential diagnosis that will dictate and direct patient care and treatment. This key outcome is referred to as clinical judgment, which requires clinical decision-making as the NP assesses the data using critical thinking skills to identify the patient's problem and provide an appropriate

treatment plan. Critical thinking is an abstract process which results in a concrete clinical judgment outcome evidenced by the formulation of a differential diagnosis.

As nursing higher education strives to increase the number of qualified Nurse Practitioners (NP), it becomes ever more important that the educational experience helps to develop and enhance the ability to think critically. These skills are central to clinical judgment (Coles, 2002; Tanner, 2006). Therefore an advanced practice educational program must demonstrate the ability to enhance the NP student's capacity to think critically, make correct clinical decisions, and prepare the student to meet the required competencies for certification and practice.

This project explores the relationship between the process of critical thinking and the outcome of that process as demonstrated by the ability to make appropriate data based clinical decisions. The appropriate clinical decision is recorded as an accurate differential diagnosis.

Background of the Problem

Decision-making is such an integral part of daily life; many complex decisions are made with little conscious effort. Every decision involves a series of preliminary decisions that provide input into the primary outcome. What to wear, how fast to drive, and what to eat are all examples of daily decisions that appear simple, yet require complex thinking. The choice to stop or go when faced with a yellow light is an exemplar of the complexity of a seemingly simple choice. The choice is complex and requires knowledge of (a) how long the light has been yellow, (b) how fast the vehicle is moving, (c) how far away the vehicle is from the intersection, (d) how close the vehicles are behind the one that the decision maker is in, (e) the condition of the brakes of the vehicle,

(f) the situation in which the driver finds him/herself, and (g) if there is cross traffic that will enter into the intersection shortly. Stop or go? The example makes it easy to understand the difficulty of teaching students and faculty to understand and measure decision-making as it relates to critical thinking. To facilitate the decision-making process, an external decision-making framework may be used. A framework can assist the decision-making by creating a matrix of smaller, sub-problems that are not as complex as the overall problem. With each decision made at the smaller, sub-problem level, outcomes are generated and will contribute to the decision-making process of the more complex problem.

Decision-making in the patient care environment is also complex and, at times, seemingly insurmountable. Good decisions have the potential to impact the patient in a positive manner; likewise, poor decisions have the potential to harm the patient. In nursing, the ability to think analytically, or critically, about the condition of a patient and make appropriate judgments about their care has been identified as one of the key components within the scope of nursing practice (Brooks & Shepherd, 1990; del Bueno, 1994, 2005; Ford & Profetto-McGrath, 1994; Paul & Heaslip, 1995).

Decision-Making Framework

When evaluating frameworks for decision-making, consideration was given to utilitarianism where decisions are made with the idea of doing the greatest good for the greatest number of individuals. Within healthcare, this may be an appropriate approach to public health issues, but it is not a practical approach to use for one patient. Using this framework, decisions could be made that would not benefit the patient, but that would

benefit the general population. Patient care is individualized and requires a unique solution that fits each patient.

Another decision-making framework is that of the moral perspective. This framework focuses the use of personal values to determine what is right or wrong, good or bad, and positive or negative actions (Bishop, 2005). While this may be a good framework for individual decision-making, it may cause conflict when making decisions related to patient care that are not in keeping with the values of the patient. It is not up to the practitioner to determine what is good or bad from the perspective of the patient. Rather it is up to the practitioner to consider the values of the patient as decisions related to patient care are made.

The use of specified steps to make a decision can also be useful in solving problems. One method requires the individual to perform the following steps as they seek to make a decision, define the problem, analyze the problem, make a decision, reconciliation of potential threats, and execution of the decision. Another decision-making framework is similar but asks the participant to not only identify the problem but to carefully consider the pros and cons of the possible choices and to identify alternatives. Criteria for the evaluation of the decision and alternatives need consideration as well.

Although these decision-making frameworks can be used, the use of a more formalized framework may provide the user with a structure for decision-making that has the capacity to not only solve small problems, but has the functionality to address larger and more complex problems. One such framework for decision-making that may be used in the advanced practice nursing environment is that of the analytic hierarchy process (Saaty, 2008).

The analytic hierarchy process or AHP (Saaty, 1994) relies on taking a large, complex problem and breaking it down into smaller problems. The smaller problems can then be addressed and the best solution for each smaller problem determined. As the smaller problems are solved, the larger problem is addressed via the solutions already presented. The key steps to the decision-making process are as follows:

Focusing on the goal of solving the problem; knowing enough about a problem to develop a complete structure or relations and influences; having enough knowledge and experience and access to the knowledge and experience of others to assess the priority of influence and dominance (importance, preference, or likelihood to the goal as appropriate) among the relations in the structure; allowing for differences in opinion with an ability to develop a best compromise. (Saaty, 1994, pp. 21-22)

For the Nurse Practitioner (NP) and NP student, the decision-making process involves these steps to formulate a differential diagnosis for the patient. Each aspect of the assessment (physical, history, laboratory work) must be considered as part of a problem that can be influenced in a positive or negative manner. Some findings will cause the NP student to decide that some differential diagnoses are not related to the assessment; other findings will cause the NP student to continue to focus on potential differential diagnoses. With each small decision that the NP student makes, he/she begins to think critically within the decision-making process, determining what information is most important to focus on as he/she works toward making a clinical decision using clinical judgment from which he/she can then formulate a differential diagnosis.

Critical Thinking

Critical thinking within nursing has been called “a process and clinical judgment is the result of the process” (Alfaro-LeFevre, 2008, p. 6). Paul (2007) further supports the idea of critical thinking being a process when he defines critical thinking as “not one

isolated skill. It is not even a random set of skills. It's an orchestrated way of thinking that enables you to decompose your thinking at any moment. It encompasses basic structures integrated together into a whole" (p. 27). Using this framework for critical thinking, the outcome of the critical thinking process is demonstrated by the ability of the individual to make sound judgments. As decisions are being made, the nurse continues to evaluate and reevaluate the patient, the patient's responses and the change in the condition of the patient relative to the decisions made. A correct decision facilitates patient recovery; a wrong decision may cause harm to the patient (Bolton, Donaldson, Rutledge, Bennett, & Brown, 2007; Clarke & Aiken, 2003; Erlen, 2007).

Therefore, the nurse's ability to think or reason critically about the patient's condition is a key skill that should be used daily by the registered nurse as he/she seeks to provide appropriate care for each patient. When the registered nurse begins further schooling for qualification as an advanced practice nurse, the skill of critical thinking or reasoning becomes even more important.

The education of the NP student at the graduate level builds upon the educational process that occurs at the baccalaureate level. Before returning to school for an advanced practice degree, nurses are required to have earned the minimum of a baccalaureate degree in nursing. It also presumes that by virtue of the baccalaureate preparation, the nurse has some ability to think critically upon their entrance to the advanced practice education program. This key assumption occurs within the graduate education of NP students; the student is expected to advance their critical thinking skills while in the program.

The American Association of Colleges of Nursing (AACN) and the National League for Nursing (NLN) place emphasis on critical thinking, either directly in their statements about what nursing requires or indirectly as they call for the incorporation of professional standards in the educational process. The AACN and NLN set the standards by which baccalaureate nursing programs are evaluated. The American Nurses Association (ANA) further supports critical thinking as an important component of nursing practice. The ANA states “nurses employ critical thinking to integrate objective data with knowledge gained from an assessment of the subjective experiences of patients and groups” (American Nurses Association, 2004, p. 10).

The advanced practice nursing educational program has been charged to further develop the critical thinking skills of the entering student. According to the American Association of Colleges of Nursing (AACN; 1996), “each graduate of a master’s nursing education must possess strong critical thinking and decision-making skills” (p. 6). This statement about critical thinking and decision-making is one of the many aspects of the graduate educational program that must be met for schools to hold accreditation. This emphasis on critical thinking is continued from the baccalaureate level to the graduate level by the AACN.

The need for the development of appropriate critical thinking skills in the NP student is also supported by the standards of practice for Nurse Practitioners as determined by the American Academy of Nurse Practitioners. These standards state that the Nurse Practitioner uses “critical thinking as they synthesize and analyze collected data to formulate a differential diagnosis that is based upon all aspects of the patient’s exam” (American Academy of Nurse Practitioners, 2007, p. 2). As NP students progress

through the academic program, their critical thinking skills should continue to develop. In each course, the NP student is challenged to master new material and use this information to guide clinical decisions in case studies and while providing direct and individualized patient care. Each semester of course work builds upon earlier knowledge. It is the assimilation of all the knowledge and experiences that allows the NP student to provide care for each patient that is appropriate for the symptoms and diagnosis presented. The care to be provided requires the NP to think critically about each patient and the patient presentation as they develop a differential diagnosis.

In the clinical setting, the NP student provides patient care under the supervision of a practicing NP and oversight of a faculty member. The NP student is accountable for the formulation of appropriate differential diagnoses that will guide treatment plans for a variety of patients. The ability of the student to carefully evaluate the patient, perform appropriate physical assessment, and think critically about the findings to make judgments as the differential diagnosis is formulated will be important as this will direct the course of treatment for each patient. It is this ability to think critically and make appropriate clinical decisions that demonstrate the competency of the NP student. Inability to do so may result in remedial work or course failure. During the course of the educational process, the student will have to use critical thinking skills as they answer test questions, formulate differential diagnoses for patients, develop treatment plans for patients, and research patient problems.

The assessment of critical thinking skills related to clinical judgment and the formulation of differential diagnoses for patients within the NP student population has not been reported in the literature. A significant amount of literature examines the process

of critical thinking among baccalaureate nursing students (Alfaro-LeFevre, 2008; Brunt, 2005; Dickerson, 2005; Girot, 2000; Niedringhaus, 2001; Paul & Heaslip, 1995; Riddell, 2007; Suliman, 2006; Turner, 2005). However, current literature provides limited research in the area of critical thinking among graduate nursing students or the outcomes of the critical thinking process. This lack of information related to critical thinking skills in NP students is problematic, especially when looking at graduate education standards as well as the responsibilities of the NP in the care and treatment of patients.

Clinical Judgment

Nurse Practitioners (NP) provide comprehensive care for each patient based upon their unique needs. The critical thinking process is complex and involves the integration of experience, reflection, and theoretical and practical knowledge as the practitioner seeks to make a clinical judgment and provide appropriate care for the patient (Coles, 2002). Patient histories are gathered, symptoms are noted, and physical examination of the patient occurs. Appropriate treatment for each patient is dependent upon correct evaluation and analysis of all findings, allowing for clinical judgment to be used as a clinical decision is made and a differential diagnosis is formulated for each patient based upon their examination. The differential diagnosis involves putting all the facets of the examination process together by the NP.

To arrive at a differential diagnosis for the patient, the NP must carefully evaluate and reevaluate the possibilities and consequences of each component of the final decision. There must be careful consideration of the symptoms presented; a variety of potential diagnoses must be ruled out due to the absence or presence of specific indicators, and further critical thinking about all the information gathered in the clinical

setting can result in a sound decision. The critical thinking process involved cannot be seen; however, the clinical judgment process which results in the formulation of a differential diagnosis requires the use of critical thinking by the nurse, NP, or physician when caring for patients (Levin, Lunney, & Krainovich-Miller, 2004; Van Puymbroeck et al., 2003; Windish, Price, Clever, Maganzier, & Thomas, 2005).

The differential diagnosis can be considered the outcome of the clinical judgment process that the NP uses in the clinical setting. The diagnosis provides direction for patient management and treatment according to appropriate evidence based protocols. If the differential diagnosis is not correct, the treatment pathway will follow an incorrect protocol for the patient, resulting in a treatment plan that is not appropriate for the condition of the patient. The implication of an incorrect diagnosis is significant: (a) care may be directed to treatment that does not address the health concern, (b) treatment may make the problem worse, and (c) inappropriate treatment may add to the overall cost of care. With only these few examples, it becomes increasingly important for the NP to have and develop the ability to use critical thinking and clinical judgment as a clinical decision is made and an appropriate differential diagnosis is formulated for each patient.

If critical thinking is an important component in the development of differential diagnoses by the NP student, improved understanding of the relationship between critical thinking skills and the ability to use clinical judgment to formulate a differential diagnosis will be beneficial. If a positive relationship is present, those NP students who demonstrate stronger critical thinking skills should demonstrate a greater ability to formulate differential diagnoses for patients suggest an appropriate treatment plan and evaluate the consequences of the clinical decision.

If the relationship between critical thinking skills and clinical judgment is positive, then assessment of critical thinking skills in the NP student could become a more important component of the educational process. If the relationship is positive, the identification of strengths and/or weaknesses in the area of critical thinking skills in a NP student could allow for an educational process that is more tailored to the needs of each student. There may also be the opportunity for faculty to further incorporate educational experiences that foster and further develop critical thinking skills.

Statement of the Problem

The American Academy of Nurse Practitioners has emphasized the need for the NP to think critically in relationship to patient care. Therefore, educational programs should make some attempt to assess critical thinking skills in the NP student and to determine what outcomes might be related to possessing such skills. If the charge to NP educational programs is to prepare nurse practitioners to provide appropriate patient care and treatment and to think critically, then there needs to be some method to assess critical thinking. Critical thinking skills should be used by the NP student in all aspects of the educational process. Failure to explore the potential relationship between critical thinking skills and the ability to formulate a clinical judgment in NP students would ignore both educational and professional standards. Determining if there is a relationship between critical thinking skills and clinical judgment in the NP student becomes increasingly important.

The problem statement is as follows: Is there a relationship between critical thinking skills and clinical judgment in Nurse Practitioner students? To measure critical thinking skills in this population, the California Critical Thinking Skills Test (CCTST)

was used. This tool was developed from the work of the American Philosophical Association think tank on critical thinking. This group developed a consensus statement about critical thinking and the characteristics of the ideal critical thinker. Their definition is as follows:

The ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fairminded 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. Thus, educating good critical thinkers means working toward this ideal. (Facione, 1990, p. 2)

This definition requires that the critical thinker engage and participate actively in thinking as they seek knowledge. In practice, Nurse Practitioners are required to evaluate, organize, and prioritize patient information as they seek to determine not only a diagnosis, but also the appropriate treatment for their patients. This requires them to possess the skills, as noted by Facione (1990), and to utilize them effectively as they provide health care.

Clinical judgment is a vital part of the role of the NP. The ability to perform appropriate clinical assessment, identify the patients' problems, and to develop an appropriate course of treatment require the use of clinical judgment have been identified as key components of nursing care (Tanner, Padrick, Westfall, & Putzier, 1987). The nurse has been charged to "exercise judgment" as they provide patient care (American Nurses Association, 2004, p. 5). Within the clinical setting, judgment is a key component of patient care. Clinical judgment requires the integration of both theoretical and practical knowledge as the NP seeks to provide care for each patient based upon the specific needs and concerns of that patient. To measure clinical judgment skills in this population, three

tools were used: The Clinical Decision-Making in Nursing evaluation and reevaluation subscale, exam style questions, and preceptor feedback.

The Clinical Decision-Making in Nursing Scale was used to assess the NP students' decision-making skills relative to their current practice. This tool provided information related to how nurses make decisions with attention to the following areas: evaluation and reevaluation of consequences, search for alternatives and options, canvassing of objectives and values, search for information, and unbiased assimilation of new information. This study focused on using the evaluation and reevaluation of consequences subscale. Exam style questions required the student to formulate a correct differential diagnosis, based upon the data presented, to correctly answer the question. Feedback from the preceptor was also sought to provide additional insights into the clinical judgment abilities of the NP student.

The purpose of this study was to determine if there is a relationship between critical thinking skills and clinical judgment in NP students. Knowledge gained from this study has the potential to impact the curriculum and education process of NP students. This led to the following research question and four research hypotheses.

Research Question and Research Hypotheses

Q1 Is there a relationship between critical thinking skills and clinical judgment in Nurse Practitioner students?

In line with the research question, the following research hypotheses were proposed:

H1 NP students who demonstrate higher scores on the California Critical Thinking Skills Test will also demonstrate more accuracy in the formulation of differential diagnoses as determined by their results on the exam style questions.

- H2 NP students who demonstrate higher scores on the California Critical Thinking Skills Test will also demonstrate higher scores on the evaluation and reevaluation of consequences subscale of the Clinical Decision-Making in Nursing Scale.
- H3 NP students who demonstrate higher scores on the California Critical Thinking Skills Test will also demonstrate more accuracy in the formulation of differential diagnosis as determined by the preceptor clinical evaluation tool.
- H4 Professional work experience of the NP student as a registered nurse will have some relationship to the NP students' scores and sub-scores on the California Critical Thinking Skills Test.

Importance of the Study

As nursing education strives to prepare NP students for entry into practice, the need for expert clinical judgment is essential. Clinical judgment can be evidenced by the formulation of an appropriate differential diagnosis for each patient. As NP students begin to assume the responsibility for managing the primary health care needs of patients, the need for correct diagnosis is paramount. As educational programs seek to further develop critical thinking skills and clinical judgment as evidenced by correct differential diagnosis formulation, the need for additional information about the students' base line critical thinking abilities becomes more important. If strengths are identified, faculty will have the opportunity to provide those students with experiences that have the potential to challenge them to further develop their critical thinking skills. If areas of concern are identified, faculty will also have opportunities to work with these students to improve their critical thinking skills by providing experiences in clinical settings that will challenge them to grow and develop these skills, yet be safe as they provide patient care.

Critical thinking has been identified as an important skill set required by advanced practice nurses; however, consensus on identifying the skill is lacking. Additionally, if

critical thinking is an abstract a process, educators should develop a better understanding of potential outcomes that may be anticipated. The lack of published information about NP student critical thinking skills related to the ability to formulate differential diagnoses demonstrates the need for further research in this area. If a relationship is found between critical thinking skills and clinical judgment and the formulation of a differential diagnosis in the NP student, a potential for further research is present. If there is a positive and significant relationship, educational programs could have the opportunity to develop critical thinking skills with a variety of tools. While these tools are unknown at present, the development of such could have an impact upon the development of critical thinking skills of the NP student. The present lack of knowledge and published research demands exploration in this area.

While this study sought to examine the relationship between critical thinking skills and clinical judgment in the NP student population, many extraneous variables could influence NP students' critical thinking abilities. Those variables might include, but were not limited to, years of experience as a registered nurse (RN), types of work experience as a RN, life experience prior to entry into the program, educational pathway prior to entering into the NP program, and clinical experiences within the NP program. There might or might not be some relationship between clinical experience in an acute care setting and the ability to formulate a differential diagnosis as measured by the exam style questions. There might be a relationship between educational pathway and critical thinking skills as those with a longer educational timeline may have developed their critical thinking skills to a different level than those with a shorter educational timeline. Information gained from the study might provide information concerning what

extraneous variables may be beneficial for the NP student to have experienced; or it might demonstrate that extraneous variables had no influence on the NP students' critical thinking ability or their ability to formulate differential diagnoses. This study was designed to manage these variables and assess the impact they had on the constructs of the study.

Limitations of the Study

A limitation of the study was the sampling method selected. This study used a convenience sample from nursing education programs located primarily in the mid-western and western United States. Findings from this study might not be representative of other advanced practice nursing education programs within the United States. In addition, the minimum sample size of 50 for this study might be a limitation. With this small size, the ability to use multiple regression analysis that would yield reliable information was questionable.

Definitions

California Critical Thinking Skills Test (CCTST). The test developed to provide measures of critical thinking (CT) skills based upon the definition of CT developed by the Delphi Expert Consensus group in the late 1980s (Facione, 1990). This assessment yields six scores for each individual: overall score, analysis, evaluation, inference, inductive reasoning, and deductive reasoning (Insight Assessment, 2009).

Clinical Decision-Making in Nursing Scale (CDMNS). A tool developed to evaluate and assess clinical decision-making, as perceived by the individual, in nursing (Jenkins, 1985). The tool contains 40 unique items that the individual responds to on a 5-point Likert-type scale with ranges from *always* (5) to *never* (1). The total scores can

range from 40 to 200 with higher scores indicating stronger clinical decision-making skills. The evaluation and reevaluation of consequences subscale was used for this study. This subscale contains 10 unique items and the score can range from 10 to 50.

Critical thinking skills. The overall critical thinking skills score as measured by the California Critical Thinking Skills Test. These would be unique for each individual.

Clinical judgment. The process of evaluation of patient data by the Nurse Practitioner, using clinical decision-making skills, critical thinking skills, knowledge and prior experiences in the identification of the patient's problem and in the formulation of an appropriate differential diagnosis.

Nursing faculty. An individual associated with the academic nursing education program where NP students are enrolled. This person may provide instruction, oversight, and guidance to the NP student throughout the course of the academic program. This person visited the NP student and observed at least two patient visits conducted by the student.

Nurse practitioner student(s). Any individual(s) currently enrolled in an accredited, advanced practice educational program. Operationally, this refers to students in the clinical phase of the Family Nurse Practitioner educational program. In this setting, students are seeing and assessing patients under the supervision of an experienced Nurse Practitioner.

Nurse practitioner. An individual who has successfully completed advanced practice training and is engaged in providing patient care. In this study, it referred to an experienced advanced practice nurse who provided supervision for the Nurse Practitioner student enrolled in an academic nursing program.

Research Design

This study used a descriptive correlational design. This study attempted to determine if there was any relationship between critical thinking skills of the Nurse Practitioner (NP) student and the ability to make a clinical judgment and formulate a differential diagnosis. This study also sought to evaluate the relationship between demographic characteristics of the NP student and critical thinking skills. Results from this study will add to the body of knowledge related to critical thinking in the NP student population by testing the hypothesis that there is a relationship between critical thinking skills and clinical judgment. This type of research--theory-generating--seeks to “clarify and describe relationships” (Chinn & Kramer, 2004, p. 130) and will further contribute to the body of knowledge related to advanced practice nursing education.

Summary

As advanced practice nursing education programs seek to provide educational experiences that will allow for the development of critical thinking skills in their students, basic knowledge and understanding in this area must be gained. This study sought to identify if there was a relationship between critical thinking skills and the NP student’s clinical judgment. Findings from this study might assist graduate nursing education programs evaluate how they are educating NP students in the areas of critical thinking and in differential diagnosis formulation. The following chapter reviews relevant literature related to this study.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

This chapter acquaints the reader with a discussion of literature relevant to this study. A review of the literature related to decision making processes and decision making processes of the NP or NP student in the clinical environment is also reviewed. The theoretical framework of analytical hierarchy processing is described and presented as a model for the decision making process the Nurse Practitioner (NP) or NP student uses when formulating a differential diagnosis for a patient.

Careful evaluation of the literature demonstrated limited research related to the relationship between critical thinking skills and the formulation of differential diagnoses in the Nurse Practitioner (NP) student population. Formulation of a differential diagnosis is the outcome of the clinical decision making process the NP and NP student internalize as they evaluate facts presented to them by the patient. The purpose of this study was to determine if a relationship existed between critical thinking skills and differential diagnosis formulation in the NP student. Concepts related to decision making, critical thinking, differential diagnosis formulation, and problem based learning were reviewed. Few studies examined the relationship of critical thinking and the ability to generate a differential diagnosis. Additionally, research related to the characteristics of critical thinking and its development in the educational process was reviewed.

Decision-Making in Practice

Decision making is a process nurses and Nurse Practitioners (NP) engage in on a daily basis. It may be in a complex situation that requires careful evaluation or one that involves little conscious effort. In nursing, clinical decision making has been an essential skill within nursing since the time of Florence Nightingale. Nightingale (1860) supported the role of the nurse in the gathering of data and making observations. Careful evaluation and interpretation of the data was important for the nurse. While not identified formally as decision making, the use of the outcomes from the evaluation and interpretation of data gathered to guide and direct further patient care can be considered as decision making. Since the time of Nightingale, decision making continues as a key component of nursing practice for the registered nurse and advanced practice nurse (Benner, Hughes, & Sutphen, 2008; dela Cruz, 1994; Harper, 1985; Ingersoll, McIntosh, & Williams, 2000; Royle et al., 2000; Wood, 1972). The ability to perform accurate clinical assessment, identify patients' problems, and develop an appropriate course of treatment for the patient have been identified as key components of nursing care (Tanner, Padrick, Westfall, & Putzier, 1987). In a comprehensive review of the literature, Tanner (2006) found that the terms problem solving, clinical judgment, and decision making have been used interchangeably. The lack of one common term relating to clinical judgment has fostered a lack of clarity in the area of clinical decision making research in nursing.

Within the scope and practice of nursing, the nurse is responsible "to exercise judgment based on education and experience in determining what is appropriate or possible for a patient or particular situation" (American Nurses Association, 2004, p. 5). The nurse is expected to make decisions in the clinical setting for each patient. Decision

making by the nurse in the clinical environment is a complex process, requiring knowledge, the ability to carefully evaluate not only the patient but also the situation, and to then determine a course of action that will benefit the patient (Burman, Stepan, Jansa, & Steiner, 2002; O'Neill, Dluhy, & Chin, 2005).

While focusing on clinical decision making, Murphy (2004) identifies clinical reasoning as the “ability to assess patient problems or needs and analyze data to accurately identify and frame problems within the context of the individual patient’s environment” (p. 227). This definition implies that the nurse has the ability to not only think critically about the data but to determine what data are appropriate to use and what data are not relative to the current problem. The study undertaken by Murphy focused on the evaluation of the impact of focused reflection and articulation on the development of clinical reasoning in first semester nursing students. The study involved 33 community college first semester nursing students and four unique instructors who were divided into two cohorts. One group received the intervention training related to focused reflection and articulation and the other group did not. The researcher-developed tool was used to evaluate student performance on patient assessments. Knowledge of nursing diagnoses and assessments were evaluated via specific exam questions. Students also provided a self report on their perceived effectiveness of the focused reflection intervention. Results of the study demonstrated no significant differences between the groups related to clinical reasoning composite scores. Although there was a lack of demonstrated gains in the area of clinical reasoning related to a specific intervention, Murphy (2004) did not attempt to evaluate the relationship between critical thinking and clinical reasoning, or clinical judgment, in this population.

In a study examining the relationship between critical thinking skills and clinical judgment skills in the undergraduate nursing population, Bowles (2000) discovered that there is a significant positive relationship between critical thinking skills and clinical judgment. The study was designed to evaluate this relationship in undergraduate nursing students at the end of their educational process. The correlational study engaged 65 nursing students in their last semester of baccalaureate nursing programs. The students were from two unique institutions. Demographic data, results from the California Critical Thinking Skills Test (CCTST), and the Clinical Decision Making in Nursing Scale (CDMNS) were used for data collection. Regression analysis using Pearson Product Moment Correlation on the CCTST and CDMNS scores demonstrated that there was a significantly positive relationship between the two ($r = 0.21, p < 0.05$) (Bowles, p. 375). Analysis of the CCTST sub scores and scores on the CDMNS found that within this population, inductive reasoning ($r = 0.27, p < 0.05$) and inference ($r = 0.23, p < 0.05$) were significant predictors of clinical judgment.

While this study enrolled a relatively small number of undergraduate nursing students, the researcher found a significant relationship between critical thinking skills and clinical judgment in the undergraduate nursing student. The research in this study sought to build upon these findings to determine if the relationship between critical thinking skills and the evaluation and reevaluation of consequences subscale on the CDMNS tool could also be found in the NP student.

When examining the decision making process of the registered nurse, some studies have found that contextual factors can have an impact upon the process. Hoffman, Donoghue, and Duffield (2004) found that area of clinical practice had a significant

correlation with perceived decision making in nursing, i.e., nurses in a medical setting were found to have a higher frequency of decision making than nurses in a surgical setting. This study engaged practicing Australian nurses to evaluate the relationships between educational level, area of practice, experience, occupational orientation, age and clinical decision making. The study was designed as a prospective, correlational survey of registered nurses to evaluate their perception of participation in clinical decision making and their role orientation. The participants averaged 33.5 years old and had an average of 11 years of nursing experience with a majority of the participants having earned a university degree. Ninety-six Australian nurses participated in the study. It found no significant relationship between perceived decision making and educational level of the nurses; nor was there any relationship between experience and decision making. Weak significant positive relationships were found between professional orientation and perceived decisions ($r = 0.332, p \leq 0.05$) and between level of appointment and perceived decisions ($r = 0.338, p \leq 0.05$). While this was a small study with positive, yet weak correlational results, it raised the following question: Is there any relationship between the workplace environment of a registered nurse and the clinical judgment skills of the Nurse Practitioner student?

Ferrario (2003) found that experienced nurses integrated prior knowledge into patient care more frequently than did less experienced nurses. The study engaged a random sample of 219 Emergency Nurses who were members of the Emergency Nurses Association. The participants completed demographic data forms and a survey tool--16 items were related to clinical decision making. Data analysis was completed with Mann-

Whitney U to evaluate age, gender, years of education, and years of emergency nursing experience by comparing more experienced and less experienced nurses.

Differentiation in use of the four types of heuristics (modal frequency, essential similarity, subset variability and causal systems) and level of experiences were evaluated with the Kruskal-Wallis rank sum test. The results found that the more experienced nurses used the causal system of heuristic reasoning--problems are viewed as a composite or a network of cause and effect relationships between factors and categories--significantly more than the less experienced nurses (). These results indicate that more experienced nurses see problems in context of the whole situation.

The study undertaken by Cioffi (1998) found that emergency triage nurses with greater experience were more likely to identify more serious conditions correctly than those with less experience. This was a descriptive study using 20 nurses from a variety of emergency settings. Six triage assessment situations were developed from actual patient records and nurses completed all six triage scenarios. Nurses were expected to evaluate the situation and assign an appropriate triage category for the patient in the scenario. This required the nurse to carefully evaluate the patient presentation, ask questions to gather further information, and then come to a decision as to what triage category was appropriate for the situation. The researchers found that the more experienced nurses were more likely to use past information and knowledge to a greater degree than the less experienced nurses as they worked through the triage scenarios.

The works of Ferrario (2003) and Cioffi (1998) found that nurses with more experience utilized their experiences in decision making. While these studies examined

the impact of nursing experience on clinical decision making in the registered nurse population, they did not look at the relationship between clinical decision making and critical thinking skills.

Aitken's (2003) descriptive study of decision making in critical care nurses found that critical care nurses formulate hypotheses and think out-loud as they work through complex patient problems. The eight critical care nurses participating had more than five years critical care experience and were working at least two days per week when the study was conducted. These nurses were found to be continuously evaluating and reevaluating the effectiveness of their working hypothesis as they assessed the effectiveness of their interventions on the patient's status. This study found expert nurses used more than one decision making strategy in their clinical decision making process. It was interesting to note that more experienced nurses engaged in more than one strategy as they engaged in clinical decision making. For the NP, the decision making process is complex and requires attention to all aspects of the patient assessment to guide the process. The outcome of the clinical judgment/decision making process for the NP is the formulation of a differential diagnosis that will guide patient care and treatment.

Within the practice of medicine, Groves, O'Rourke and Alexander (2003) found that clinical decision making is a complex process influenced by years of general practitioner experience. Their study engaged 21 experienced general practitioners in the completion of the Diagnostic Thinking Inventory and a set of 10 clinical reasoning problems to evaluate their clinical reasoning abilities. The practitioners were divided into two groups based upon the number of correct diagnoses with two or more identification errors. The authors found that experienced general practitioners were able to reach a

correct diagnosis with less clinical information than less experienced general practitioners. The authors also addressed the issue of misdiagnosis. They found that even with the presence of correct data, the lack of integrating key clinical information led to misdiagnosis (Groves et al.). While this study was undertaken with experienced physicians, it brought to light the possibility that with more experience, the less likely the Nurse Practitioner will formulate incorrect diagnoses for their patients.

When attempting to carefully evaluate the clinical decision making skills of NP students, Stroud, Smith, Edlund, and Erkel (1999) found the use of faculty and preceptor assessment had the potential for bias. The authors described the development rationale and process of a standardized patient scenario used within a controlled environment to assess the ability of the NP student to use appropriate clinical decision making skills. This tool was developed in response to a student challenge of a course failure. The student questioned the midterm and final evaluation based upon the: availability of appropriate patients in the clinical setting, potential bias of the evaluator, and inadequacy in the clinical environment. The tool development was undertaken to eliminate subjectivity from student assessment; it was not developed to evaluate the relationship between clinical decision making and critical thinking in the NP student. However, it reinforced the use of an objective tool to assess NP student skills in the formulation of differential diagnoses, one outcome of clinical decision making.

In evaluating the ability of undergraduate students to formulate a diagnosis, it was found that the process of backward reasoning yielded significantly more correct diagnoses than did forward reasoning (Norman, Brooks, Colle, & Hatala, 2000). The study assessed the impact of an instructional manipulation to bias students. Sixteen

students were divided into two groups. Each group was provided with instruction that had a bias towards a problem solving method. One method asked the participants to gather data systematically before beginning to think of diagnoses, which is considered to be forward reasoning. The other method encouraged the participants to generate hypotheses before data collection, which is considered to be backward reasoning. Results demonstrated that members of the group who were instructed in backward reasoning had an accuracy of 61.3% versus 41.9% for those who were instructed in forward reasoning. Analysis of variance found significant differences in the number of irrelevant data points identified, $F(1,14) = 17.57$, $MSE = 11.96$, $p < 0.001$.

Backward reasoning has been described as working backward from the unknown to the known to solve problems. In his analysis of the literature, Gilhooly (1990) found that backward reasoning is a skill set more prevalent in novices than in experts. These findings suggest that prior data or learning experiences related to the patient could influence the practitioner in the formulation of a differential diagnosis. This could be both harmful and beneficial for the patient and the NP: harmful if the NP begins the evaluation with an idea of what the diagnosis could be; beneficial because the patient history was carefully evaluated by the NP prior to assessing the patient that focused upon the current problem.

In the field of physical therapy, clinical reasoning or clinical decision making improves with experience (Noll, Key, & Jensen, 2001). This qualitative case study aimed to evaluate how frequently physical therapists rely on past experience throughout a patient evaluation. The researchers observed the interactions between an expert physical therapist and patient. The interaction was later deconstructed to evaluate the decision

making process. Each unique patient encounter demonstrated the use of clinical experience and forward reasoning to develop a working hypothesis. While the study was a case study, it demonstrated that the expert physical therapy practitioner used forward reasoning and clinical experience to assist in the formulation of a diagnosis.

Clinical reasoning in physical therapy has been found to vary widely from practitioner to practitioner (Edwards, Jones, Carr, Braunack-Mayer, & Jensen, 2004). The qualitative case study, using ground method theory, evaluated the clinical reasoning of six expert physical therapists in three distinct fields. They found that the expert physical therapists incorporated a variety of clinical reasoning processes into every aspect of clinical practice. This suggested that while experience was important, the experiences of the practitioner also impacted the decision making process. For the NP, the outcome of the decision making process is seen in the determination of clinical judgment and formulation of a differential diagnosis.

For the NP, the decision making process within advanced practice builds upon the decision making process experienced when they were practicing as a registered nurse. This arena provided basic experience in decision making utilized by the NP. In advanced practice, the decisions are typically complex, requiring vigilant thought and analysis; the outcome of the decision making process completed by the NP is directly related to the patient and their new symptoms or complaints. The NP must evaluate all information presented, formulate a differential diagnosis, and order appropriate external tests to confirm or deny the diagnosis (American Nurses Association, 1999). As noted in the literature, as the level of experience grew, so did the decision making process engaged in to formulate differential diagnoses and determine appropriate treatment.

When the patient presents for routine follow-up, a new differential diagnosis may not be formulated; rather, existing ones may be modified. This too requires careful analysis and evaluation of the information presented. While it is understood that clinical decisions are being made by the NP, the framework for the decision making process is somewhat vague. To provide insight into the complexity of the decision making process, a theoretical decision making framework is presented. While this process is not exclusive to nursing, it can provide insight into the complex process involved with making decisions.

Analytic Hierarchy Process

Analytic Hierarchy Process (AHP) is a model for problem solving and decision making that requires the use of critical thinking. AHP can also be seen as an umbrella for solving problems--both complex and relatively straight forward, requiring the decision maker to use critical thinking as they engage in the decision making process. For the NP student, the outcome of the decision making process is clinical judgment. Both critical thinking and clinical decision making processes are abstract and difficult to assess. The model below demonstrates the conceptual framework of AHP, critical thinking skills, clinical judgment, and clinical decision making that guided this study.

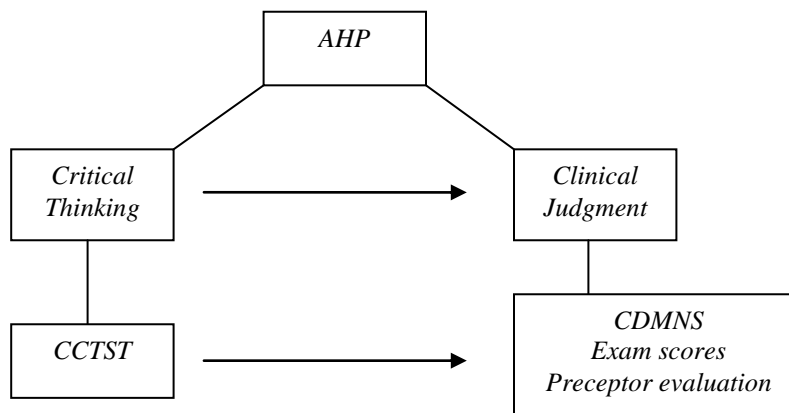


Figure 1. Analytic hierarchy process.

To facilitate the complex decision making process, application of the analytic hierarchy process can provide a framework to evaluate the situation. The use of a framework to facilitate the evaluation of difficult situations has been reported in the nursing literature since the 1970s. Within nursing, critical thinking is an integral part of the decision making process (Bauwens & Gerhard, 1987; Brooks & Shepherd, 1990; Harbison, 1991; Valiga, 1983).

The NP is faced with many complex decisions each day. Some of these decisions are made without conscious effort; others require great effort to sort through the pertinent information to make the best decision. With complex decisions, the use of a decision making framework can assist the NP in breaking the problem into less complex, smaller pieces to allow for decision making. The analytic hierarchy process (AHP) is a decision making model that takes complex problems, breaks them into smaller units, and allows for the evaluation of each unit in the decision making process (Saaty, 2006).

AHP is “a framework of logic and problem-solving that spans consciousness by organizing perceptions, feelings, judgments and memories into a hierarchy of forces the

influence decision results” (Saaty, 2006, p. 5). This process is simple, yet complex, in how it breaks the decision into simple components. According to Saaty (2008), each decision must be broken down into four steps:

1. Define the problem and determine what knowledge will be needed.
2. Create a decision hierarchy, starting at the top with the goal, using broad perspective objectives for the subsequent levels as the hierarchy is mapped out to the starting point.
3. Construct pairwise comparison matrices where each element is compared to all others at the same level. In this step, each object is ranked from 1 to 9 relative to the intensity of importance--1 being lowest or equal importance and 9 being of extreme importance. Each object is compared to all others in the level and a numeric value is determined.
4. Develop a weighing process that sums the weighted values and obtains an overall priority for the object. This process allows decisions to be made with a structure that (a) assumes a depth of knowledge about the problem that allows for the creation of a hierarchical structure, (b) assumes there is enough knowledge to prioritize relationships within the structure, and (c) allows for the development of compromise if needed (Saaty, 2006).

This AHP decision making process has been used successfully for the (a) routing of tanker ships (Celik, Cebi, Kahraman, & Er, 2009), (b) selection of the best underground mining method for a bauxite mine (Naghadehi, Mikaeil, & Ataei, 2009), (c) evaluation of alternative energy source models for Germany (Karger & Hennings, 2009), (d) assessment of urban renewal proposals (Lee & Chan, 2008), and (d) creation and

evaluation of high-tech industry in Taiwan (Chuang, 2005). While these examples come from industry, the AHP evaluation has also been used within healthcare around the world. It is interesting to note that all of these examples demonstrate a specific outcome of the process of the AHP. For the NP, or NP student, this outcome is seen in the clinical judgment that occurs when a differential diagnosis is formulated.

In Korea, the AHP was used to (a) evaluate national immunization policies (Schin et al., 2008), (b) determine the best management for adults who have pharyngitis (Singh, Dolan, & Centor, 2006), and (c) determine if a new treatment for patients with cervical vertebra dysfunction would be effective (Marjan Hummel, Snoek, van Til, van Rossum, & IJzerman, 2005). It has also been used to facilitate shared decision-making with physicians and patients in preventative health screening (Dolan, 2000), to determine appropriate antibiotic treatment for kidney infections (Dolan, 1989), in the decision making process for prostate cancer screening (Liberatore et al., 2003), and in the development of treatment protocols.

For the Nurse Practitioner (NP) or NP student, the ability to use a decision making framework to guide clinical judgment to assist in the formulation of a differential diagnosis can be helpful. One example where a framework has been effectively used is in the treatment of hypertension. The treatment protocol developed by the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (U.S. Department of Health and Human Services, National Institutes of Health, National Heart, Lung, and Blood Institute, 2003) is indicative of the best current evidence for treatment of hypertension. The Nurse Practitioner is provided with a treatment algorithm for treatment of hypertension that can be tailored to each patient.

The treatment protocol has been constructed using the AHP method in assessing risks, indications, and contraindications of treatment. This treatment protocol requires that the NP or NP student perform a comprehensive, focused assessment of the patient with the identification of risk factors, comorbid factors, other possible causes of the hypertension, and requires some external testing. With the assessment complete, the appropriate diagnosis related to hypertension is formulated and the course treatment is determined following the guidelines. Use of a treatment protocol does not mean that the NP or NP student are not making decisions; rather, it means they are using resources that have carefully evaluated the problem and determined appropriate courses of treatment of the diagnosis.

In this situation, the NP or NP student did not follow the four steps outlined by Saaty (2008) but used a treatment protocol developed with this process in mind. The NP or NP student acknowledged that they had a knowledge base in the area of concern that was not as comprehensive as those who developed the treatment guidelines. The decision to use the guidelines was the outcome of the AHP. The practitioner recognized that (a) the treatment goal was to control the patient's hypertension, (b) the assessment provided data related to factors influencing the hypertension, and (c) the treatment was identified per the guidelines. The practitioner did not construct the pairwise comparison matrices but identified comorbid risk factors and then used the treatment protocol to determine the differential diagnosis level of hypertension present and the treatment.

To facilitate the complex decision making process, application of the analytic hierarchy process can provide a framework or treatment protocol to evaluate, diagnose, and treat the current patient situation. Use of treatment protocols developed with AHP in

mind has been effective for decision making in complex situations such as the treatment of hypertension and by health care providers who do not have all the resources to carefully identify all factors that impact a disease process or illness. While the guidelines assist the NP or NP student in the formulation of a diagnosis and treatment for the problem, its use does not require the NP or NP student to think less about the patient. Rather, critical thinking remains as an integral part of the decision making process.

In the AHP framework, the decision making steps are outlined to facilitate the identification of all the components of the issue at hand. The AHP framework does not solve the problem; rather, it lays the problem out and asks the problem solver to identify and think critically about each component of the process. With each decision that is made at each level, outcomes are noted; however, the choices of outcomes are left to the problem solver. Thus, the individual solving the problem must look carefully at the outcomes presented and think critically to determine the best outcome for each level. With the determination of level outcomes, the next levels are addressed and the impact of prior decisions must be evaluated by the problem solver on the subsequent levels. This is not a passive process but an active one requiring the problem solver to think critically about each solution and the impact on the overall problem.

For the NP or NP student, careful decision making is required to guide the assessment of the patient based upon the patient complaint, the personal knowledge held by the NP or NP student, and the knowledge of potential problems. Completion of the assessment then requires the NP and NP student to use clinical judgment in the analysis and evaluation of all components of the examination as they seek to formulate a differential diagnosis. To do this, the NP and NP student must be able to think critically

about each situation as they provide patient care that does not harm the patient but provides beneficial treatment.

Historical Background of Critical Thinking

The concept of critical thinking has been found in the literature for many years. As early as Socrates, individuals were encouraged to respond to questions in order to deconstruct the original question. Hopefully, this would cause the individual to think deeply about the initial question and why it may or may not be true (Maxwell, n.d.). In current educational practices, the Socratic method is used in a constructivist manner, requesting of individuals answers to questions that cause them to think deeply, reflect, and draw upon their current knowledge as they reach a conclusion.

The depth of understanding required of deep thinking is seen in the autobiography of John Stuart Mill. Although the term critical thinking was not used, Mill (1924) reported that he did not just memorize facts; rather, he had to demonstrate understanding of and mastery of the material. This method of instruction allowed Mill to develop his thinking skills in such a manner that he became “the most influential English-speaking philosopher of the nineteenth century” (Wilson, 2007, para. 1). John Stuart Mill was taught in the methods of Socrates; he thought deeply about things and he strove to provoke thought and change in others.

The trend toward deep thinking and mastery of content was continued in the 1930s when Dewey addressed the need for open-minded, intellectually responsible, and whole-hearted reflective thinking (Archambault, 1964). Dewey’s work in education created learning environments that would not only teach people to learn more knowledge but “educate people for a way of life” (Berger, 1966, p. 189). While Dewey was seen as

controversial in his time, the important aspects of learning and thinking are very similar to traits of a critical thinker developed in the late 1980s by the workgroup (the Delphi group) formed by the American Philosophical Association to identify traits of critical thinking (Facione, 1990).

The Delphi group collaborated throughout the 1980s to develop a consensus description of critical thinking. They spent over 20 months developing a definition of critical thinking and describing habits of the ideal critical thinker (Facione, 1990). While this was not the first attempt at defining critical thinking, it became the foundation for research in the area of critical thinking.

Critical Thinking Defined

Much of the literature addressing the development of critical thinking (CT) in nursing students was focused on the undergraduate student. Limited information related to CT and the advance practice nurse was found. This area of the literature review drew upon aspects of CT related to nursing. When evaluating the literature, it was very difficult to find a consensus on what CT is and how it is measured. Several authors sought unsuccessfully to determine a consensus definition of CT (Brunt, 2005; Suliman, 2006; Turner, 2005).

Lack of consensus on a common definition has created confusion for not only researchers but for nursing educators. There has been no common ground for communication, research, or development of curricular tools to facilitate growth in the area of CT. In an attempt to determine a consensus definition of critical thinking within nursing, Scheffer and Rubenfeld (2000) used a Delphi process to identify an international panel of nurse experts to develop a definition of critical thinking within nursing. This

group worked together over three years to define critical thinking in nursing.

Interestingly, the nursing content experts determined that the habits of critical thinkers were similar to those developed via the Delphi process undertaken by the American Philosophical Association (APA) in 1990 (Facione, 1990). However, nurse experts determined that creativity and intuition were two components present in nursing but not accounted for in the APA definition (Scheffer & Rubenfeld). The consensus definition of critical thinking in nursing is as follows:

Critical thinking in nursing is an essential component of professional accountability and quality nursing care. Critical thinkers in nursing exhibit these habits of the mind: confidence, contextual perspective, creativity, flexibility, inquisitiveness, intellectual integrity, intuition, open-mindedness, perseverance, and reflection. Critical thinkers in nursing practice the cognitive skills of analyzing, applying standards, discriminating, information seeking, logical reasoning, predicting and transforming knowledge. (Scheffer & Rubenfeld, p. 357)

This definition is nursing specific. It has been developed by nursing experts worldwide but does not present the individual with any tool for assessing or measuring critical thinking in nursing.

Lack of a tool for assessment of critical thinking skills using the nursing consensus definition leads one to look carefully at the definition of critical thinking developed by the American Philosophical Association as it is similar to the consensus definition developed by nursing (Scheffer & Rubenfeld, 2000). According to Facione (1990), the definition of a critical thinker is

The ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fairminded 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. Thus, educating good critical thinkers means working toward this ideal. (Facione, p. 2)

Not only is the definition similar to that of Scheffer and Rubinfeld, there is a well developed and researched tool for assessing critical thinking skills. Both definitions state that critical thinkers are (a) inquisitive in their search for knowledge and understanding; (b) open-minded to reconsider and seek other opinions that may differ from theirs; (c) flexible as they change and adapt to each situation; (d) possess knowledge that will assist them in decision making; (e) persistent in the quest for answers or solutions to problems; and (f) confident in their thinking skills which allow them to consider all the aspects of the situation (Facione; Scheffer & Rubinfeld). Throughout this study, the definition developed by the American Philosophical Association (APA) is used as the framework that defines critical thinking. Skills and characteristics of critical thinkers as identified by the APA and Facione are used.

Critical Thinking Characteristics

Some authors believe that critical thinking (CT) is an abstract process that can be further developed in an environment that supports and encourages cognitive development using reflection (Alfaro-LeFevre 2008; Kuiper, 2000; Mezirow, 1990; Scheffer & Rubinfeld, 2000; Youngblood & Beitz, 2001). Reflection as a part of thinking and learning is a key component to the process of learning (Bruner, 1996). Reflection can be considered the act of thinking critically about the information, processing it, and integrating it into a personal knowledge base. The acts of reflection and integration contribute to the knowledge development of the individual--the nurse in this case--and the profession (Chinn & Kramer, 2004).

This reflective attitude of thinking fits into a generalized change in education at the secondary level. Lipman (1993) carried the ideas of Dewey further when he called for

students to practice thinking in a manner that became self-corrective and inquisitive. Self-correction requires the learner to be honest in the evaluation of their thoughts and the actions evidenced as the outcome of the thinking process. All individuals possess the ability to think; however, it is thinking with purpose that presents the individual with solutions to potential problems (Paul & Elder, 2006). In nursing, this difference can be seen in the nurse who thinks about the orders for a specific patient. One nurse may just follow the orders to check the blood sugar and notify the care provider because that is what was written. Another nurse may follow the orders in the same manner but then think about potential complications and prepare for them. Both nurses followed the orders but the second nurse demonstrated purposeful thought in preparing for potential complications related to the blood sugar finding. Some may say that the second nurse engaged in purposeful and reflective thinking, drawing on her personal knowledge and experience to provide appropriate care for the patient.

While not specific to nursing, Paul (1993) and Ennis (1985) both spoke of reflection as an important part of the critical thinking process. Reflection is not a casual part of the thinking process but an active and intentional component of the process. The descriptive research by Boyd and Fales (1983) with professional counselors in the area of reflection found that when the counselors were made aware of the process of reflection, they realized an active component was utilized in their problem solving processes. While only nine individuals were selected with purposeful sampling, the study demonstrated that if knowledge about reflection is incorporated into the education process, individuals become more aware of it and use it as they seek to develop differential diagnoses for their patients. For the Nurse Practitioner student, the practice of reflection may have an impact

upon their problem solving abilities. It is important to note that reflection has been found to be important in patient care.

In summary, reflection is an important component of critical thinking. While reflection is not specifically mentioned in the definition presented by Facione (1990), it can be implied to be a component of self-regulation, inquisition, and honesty when evaluating the situation relative to personal biases. In the Nurse Practitioner student, reflection can allow the individual time to carefully evaluate and consider all aspects of the patient problem. They can then carefully consider possible causes for the problem and determine appropriate differential diagnoses and treatments. While the time allowed for reflection may not be long, it is an important component of the critical thinking process.

Two other characteristics of critical thinkers are inquisitiveness and open-mindedness. This implies that the individual continues to seek knowledge with recognition of the biases in their personal knowledge base (Facione, 1990; Scheffer & Rubenfeld, 2000). The individual is not limited by their own learning and beliefs; they seek new knowledge to complement their current knowledge. For the Nurse Practitioner (NP), this means seeking answers to questions in a variety of ways. The educator is challenged to create an environment that allows for questioning and learning while incorporating new knowledge into the discussion (Emerson & Records, 2008). In this type of environment, the Socratic method of teaching works to engage students via probing questions by challenging what is known to encourage discussion (Gose, 2009).

As the inquisitive learner seeks to gain new knowledge and understanding, they challenge their own knowledge by growing and learning to critically evaluate all that they are exposed to. Within nursing, Underwood (2006) was able to demonstrate that using

student guided inquiry to direct learning related to diversity, culture, and health was able to focus the lecture to meet the needs of the student. Student feedback related to this educational intervention demonstrated that students gained knowledge and sensitivity in the areas of diversity and culture. While this intervention occurred with baccalaureate nursing students, it has the potential to serve as an example for both undergraduate and graduate nursing classrooms that facilitate inquisitive environments.

Engagement of the learner has become a key area in higher education. According to the Carnegie report, higher education needs to embrace the pedagogy of engagement and inquiry (Sullivan & Rosin, 2008). By encouraging faculty to create an environment of inquiry, benefits are experienced by more than the student (The Carnegie Foundation for the Advancement of Teaching, 2008). Students will have role models asking questions, clarifying what is known, seeking new information relative to the question at hand, and being supported in their questioning. Faculty will also learn to question their own knowledge and accept questioning as a valid teaching and learning strategy. They will move them from the position of transmitter of knowledge to the guide who creates a learning environment full of discussion, active participation, and thinking (King, 1993).

As education adopts the pedagogy of engagement, student learning outcomes have changed for the better. Using a variety of strategies such as think-pair-share, just-in-time-teaching, problem based learning, guided questioning, and collaborative learning exercises, improvements in student learning outcomes have been noted (Barron, Lambert, Conlon, & Harrington, 2008; Crawley, Curry, Dumois-Sands, Tanner, & Wyker, 2008; Slunt & Ginacarlo, 2004; Umbach & Wawrzynski, 2005). Barron et al. describe the development of scenarios used to stimulate discussions in a problem-based learning

environment. The student groups who participated in the process found that they became more interested in the content area and spent time independently searching for more knowledge in the content area. While not a comparative study, these results of the work with problem based learning methods demonstrated that students became more engaged in the learning process.

Crawley et al. (2008) describe a teaching pedagogy that focuses on using questions during lecture to stimulate discussion and learning. Specific examples of types of questioning styles and the potential outcomes are discussed from the perspective of the author and supported by the literature. While not a quantitative research study, the teaching methods described and used by the primary author have received positive feedback. This feedback ranges from 5.0 out of 5.0 on overall instructor rating on student evaluations, to student reports of how the course changed their perspective, to being the recipient of the outstanding undergraduate teaching award for the university.

The comparative study by Slunt and Giancarlo (2004) demonstrated that the use of student centered activities in the classroom increases student achievement. While statistical analysis was not undertaken due to the small sample size, the average class GPA for those students in the sections using student centered activities (just in time learning and concept checks) was higher than those using no student centered learning activities. Students in the general chemistry course who did not have the student centered learning activities had an average GPA of 2.1, while those who participated in sections with the student centered learning had an average GPA of 2.3. For the students in organic chemistry, the sections without student centered learning activities averaged 2.2 for the GPA and those who had the activities had an average GPA of 2.6. Without statistical

analysis, the ability to determine if the differences presented were statistically significant was limited; however, student feedback related to the learning experiences with the student centered activities was positive and indicated that students became more engaged in the learning process.

Umbach and Wawrzynski (2005) engaged in an exploratory research process to evaluate the relationship between faculty teaching practices and student engagement. Faculty teaching practices that were assessed included faculty expectations of student engagement, classroom structure, out of class work, academic challenge, active and collaborative learning, and student-faculty interaction. The study utilized two national data sets and 137 schools from the National Survey of Student Engagement database, representing over 20,000 senior level college students and over 22,000 first year college students. The second data set came from a study that examined behaviors and attitudes of faculty at these 137 institutions. Hierarchical liner modeling was used to analyze the data. The findings demonstrated that in the environments where there was a higher frequency of interaction between the faculty and student in courses, the students were more engaged in active learning activities. While there were no data related to standardized student outcomes such as GPA, the student reports of increased engagement appeared to support the idea that increased student engagement in the classroom leads to increased student learning.

Although these research studies addressed the apparent importance of student engagement in the classroom and the creation of a culture of engagement in higher education, they did not specifically address how engagement improved critical thinking or standardized outcomes. No data were found that indicated the impact of such a

learning environment could change a student's overall grade point average, scores on entrance exams for graduate schools, and critical thinking skills. While these authors spoke to improved student learning outcomes, there was no measurement of critical thinking gains due to the pedagogy of engagement.

Lack of research in this area is of concern since nursing education outcomes indicate that critical thinking is an important aspect of the educational process at both the baccalaureate and graduate levels (American Association of Colleges of Nursing, 1996; National League for Nursing Accrediting Commission, Inc., 2008). This further supported the current study of measuring critical thinking and examining its relationship to the clinical decision making process of differential diagnosis generation.

In addition to reflection, inquisitiveness, and open-mindedness, the critical thinker must consider other ideas, be clear about the situation at hand, and diligent in seeking answers (Facione, 1990). The potential for these characteristics to be developed via reflective practice and the pedagogy of engagement is one avenue that may need further research.

Teaching Critical Thinking

When teaching CT to students, Dickerson (2005) described a strategy of active participation of both the instructor and learner in an environment that was beyond the formal educational environment. In the professional work setting, she described how the instructor should work to create a learning environment that facilitated student engagement and learning. The use of active participation and continued individual engagement could provide the learner with an environment that allowed for the transformation of the information into personal knowledge. This transformation could

occur when there is time for reflection coupled with the opportunity to apply the material to a meaningful experience. The combination of engagement and reflection allows for the creation of new personal knowledge that can be used in daily nursing practice.

Active participation was not the only method described in the literature as useful for the development of critical thinking in nursing students. Recently, it has been discovered that service learning, when closely aligned to course objectives, can be a useful tool to facilitate growth and development of critical thinking skills (Goldberg, Richburg, & Wood, 2006; Joseph, Stone, Grantham, Harmancioglu, & Ibrahim, 2007; Sedlak, Doheny, Panthofer, & Anaya, 2003). In creating this type of learning situation for the student, it is important to clearly define the goals of the service learning experience and how they fit the course outcomes. The description of a service learning experience and the impact of these experiences provided by Goldberg et al. (2006) demonstrate how the incorporation of service learning into a theory course can impact student outcomes. A pre-test/post-test design was used and it was found that a statistically significant difference in the level of student competency after the service learning experience existed. There was no comparison group to determine if the level of change demonstrated was related specifically to the service learning experience. Student feedback related to the experience was positive. While not a strong study supporting the benefits of service learning, it is a start of the investigative process into the impact of this unique pedagogy on student learning.

Joseph et al. (2007) took the research process further with their exploratory study on service learning and its impact upon community service involvement and critical thinking. The researchers developed a survey tool in which questions from the National

Survey of Student Engagement (NSSE) were adapted to the study. Critical thinking questions were also developed from the NSSE tool. With correlation analysis, the findings demonstrated a significant relationship existed between community service learning project participation and synthesis of information ($r = 0.172$, with significance at the 0.05 level). The tool for the assessment of critical thinking was not one of the more typical tools but it provided an interesting concept that could be further investigated.

The descriptive study by Sedlak, Doheny, Panthofer and Anaya (2003) used service learning experiences in the first semester nursing courses to assess the development of a critical thinking perspective in the students. Students were provided with guidelines for the experience and knew what work would be completed by the end of the semester. Using the critical thinking framework of Paul (1993) to evaluate the reflective written work of the student, the researchers found that students developed critical thinking skills through their participation in this specific service learning experience.

These reported increases in critical thinking and student learning from the service learning process can serve as an example for higher education. Nursing education has been charged with the task of teaching students to think critically. This is an important aspect of the professional role--the ability of the nurse to think critically about the patient and the situation can have a positive or negative impact upon patient outcome. If one outcome goal is to increase CT skills, service learning is one potential tool for doing this.

In a study in the United Kingdom, Bell and Procter (1998) found a link between critical thinking and practice development of nurses engaged in research projects. Their qualitative study used semi-structured interviews of 15 nurses working on a nursing

development unit in the United Kingdom. The data analysis demonstrated that there were two unique groups of nurses in the study--those who were actively engaged in research and those who were engaged in data collection for research. Findings from this three-year study were not anticipated by the authors. They found that for those nurses actively engaged in the research process, the research undertakings were meaningful to their professional practice. In this study, the importance of engagement in thinking and reflecting related to new knowledge was found to be beneficial to the critical thinking skills of nurses. These findings provided support for the concept that participant engagement in the research process can facilitate the development of cognitive skills. In this study, the rich qualitative results demonstrated that outcomes related to personal gains in the areas of professional practice, thinking, and self-motivation were experienced by the participants.

Much of the literature about teaching critical thinking focused on reflection, reflective practice, and engagement. Some focused on reporting results from quantitative studies; others focused on qualitative reports of learners that their critical thinking skills were improved. Other literature reported what was being done to promote critical thinking within education but did not demonstrate gains resulting from the educational process. Overall, literature related to the measurement of critical thinking and critical thinking skills in higher education was limited. Nursing education literature was also limited in the measurement of critical thinking gains by students. Need for more research in this area is threefold: (a) there is a need for a consistent definition of critical thinking; (b) there is a need for a reliable and valid tool for the measurement of critical thinking skills; and (c) students need to be tested upon entry to and exit from nursing programs to

measure gains or losses in critical thinking skills if it is an important outcome of the educational process.

Concepts Related to Critical Thinking in the Nurse Practitioner Student

While much of the literature related to critical thinking and higher education focused on the undergraduate level, a few studies evaluated critical thinking at the graduate level for nursing. In one article on critical thinking in the nurse practitioner (NP) student, Rash (2008) presented problem-based learning teaching methods to facilitate critical thinking in NP students. The results related to increased student and faculty satisfaction were from a formative class survey that was not statistically evaluated. There was no discussion of a statistical design as to the impact of problem-based learning on student outcomes such as grade in the course or overall success in the educational program. Although the author stated that facilitating nurse practitioner student critical thinking was a desired outcome, the document did not address specific gains in the area of critical thinking in the NP student population. While information was presented related to the impact of problem-based learning on critical thinking in other disciplines, there was no measurement of critical thinking in the NP student or how the use of problem-based learning facilitated critical thinking in this population.

Weber (2005) discussed a variety of interventions the educator can use to encourage the student to further develop and use critical thinking skills. His work was not based upon research but on providing the reader with helpful information as they sought to increase critical thinking behaviors in the nurse practitioner student. While this could assist educators, it is not known if these interventions affected students' critical thinking skills. Although not used as an intervention, Cole and Ramirez (2000) described the use

of case scenarios as part of the interview process to screen applicants for the Emergency Nurse Practitioner program. Although a unique manner for assessing critical thinking skills of the potential student was presented, there was no other assessment of those skills. The authors did not describe any follow-up assessment or long-term success of students except that the students were successful in the role transition from registered nurse to nurse practitioner student. There was no indication of how this success was measured; rather, it was a blanket statement provided by the authors. Again the use of tools to assess critical thinking in students was presented; however, no assessment of their skills in this area, i.e., a standardized test, was used to support the use of a case example as a valid assessment of critical thinking skills.

Use of a teaching intervention to facilitate growth and development of nurse practitioner skills was reported as being effective in promoting active critical thinking (Zunkel, Cesarotti, Rosdahl, & McGrath, 2004). Again, a tool aimed at assisting the development of critical thinking skills in the NP student was presented. No data were found related to student learning outcomes to demonstrate benefits or disadvantages related to the use of the framework. It was interesting to note that the tool provided to the NP student was a framework from which they were able to guide their questioning and learning. The NP students were expected to use this tool as they began data collection. The authors stated that the tool guided and directed the students thinking skills as they worked towards diagnostic hypotheses for a variety of cases.

Presenting the nurse practitioner student with a framework to guide them as they grow and develop their skills in the area of diagnosis generation fits with the model of novice to expert presented by Benner (2001). Benner states that as new practitioners enter

into the field as novices, decisions and actions are guided by rules that must be followed. As the experiences and knowledge of the novice practitioner grow, movement into the advanced beginner and competent stages occurs. The nurse begins to integrate past experiences into the provision of care. Rules serve as guides but not as absolutes in these stages. With continued growth and development, the competent nurse moves from this stage to proficient and finally to the expert. It is at the expert level that the nurse will no longer rely on rules to direct actions. Experience, knowledge, and the use of intuition will guide practice. As practitioners enter a new field, they bring knowledge with them but lack experience in the new environment. By presenting practitioners with a framework or set of rules, they begin to understand the expectations of the new environment. They can use the framework to guide their growth from novice to advanced beginner.

Youngblood and Beitz (2001) described a change in advanced practice nursing curriculum where specific critical thinking exercises were integrated throughout the courses. The authors described why specific experiences were selected and what these experiences involved. At no time did the authors measure critical thinking skills of the students in these courses. Assessment was noted in the improvement of student satisfaction with the learning interventions. However, the present research did not relate changes in critical thinking skills of the nurse practitioner student resulting from the interventions.

When reviewing the impact of problem-based learning upon education, Cote (2007) discussed how this teaching method encouraged the student to solve problems independently while drawing upon prior learning and knowledge. There was no assessment of how the teaching method described impacted student learning outcomes.

Other authors have supported the use of case studies throughout the curriculum as a way to encourage students to seek out new information related to the case at hand.

Mandin, Jones, Woloschuk, and Harasym (1997) reviewed the literature relative to problem-solving strategies in the clinical arena and concluded that accuracy in diagnosis is dependent upon having mastery of knowledge and problem solving strategies. Additionally, they concluded that the assumption that there is a universal and generic method for solving problems was not a valid assumption. Students must be exposed to a variety of problems that requires the learning of more than one method to evaluate and solve problems. They presented a seven step method for teaching clinical problem solving but had not assessed the impact of this teaching approach on student learning outcomes.

Thomas, O'Connor, Albert, Boutain, and Brandt (2001) discussed the benefits of using case studies to assist advanced practice nursing students in gaining new knowledge and improving clinical reasoning. They provided support from the literature as to expected benefits of case study learning modules and presented three examples of case study learning experiences requiring students to participate at the moderate, high, or very high level to complete the case study. There was no presentation of measureable student learning outcomes, just a report of what type of student learning was expected with the examples provided.

When case studies were integrated into the curriculum and used effectively, there were significant gains in critical thinking dispositions of undergraduate nursing students who participated in the problem based-learning courses compared to those in traditional lectures (Tiwari, Lai, So, & Yuen, 2006). This randomized controlled trial of 79 nursing

students compared the effects of problem based learning or standard lecture teaching with the students' critical thinking indicator scores. The researchers found that the overall California Critical Thinking Disposition Indicator scores showed significantly greater improvement in the students who were in the problem based-learning group as compared to those in the lecture group ($p = 0.0048$) even after Bonferroni adjustment.

This was one of the few studies that provided data related to gains in critical thinking as the result of an intervention. Although this study was in an undergraduate setting, it has the potential to be replicated at the graduate level to determine the effect of integrating case study learning on the critical thinking skills of the nurse practitioner student. While not directly related to critical thinking and its relationship to clinical judgment and the formulation of differential diagnosis, the authors demonstrated that gains in critical thinking increased when students are engaged in case study or problem-based learning experiences. It should be noted that students in the non-intervention group also experienced gains in critical thinking as measured by the California Critical Thinking Disposition Indicator scores.

In summary, much of the literature related to increasing critical thinking in nursing and nurse practitioner education was primarily anecdotal in nature. Few studies demonstrated actual gains or losses in critical thinking skills of students. Much of the literature reported interventions and stated that they made a difference without any supporting data of students' critical thinking skills before or after the intervention occurred. This lack of evidence drives one to carefully assess and measure critical thinking skills of not only exiting nurse practitioner students but those entering the

program. Measurement would allow the educational program to concretely demonstrate that the educational process impacted the critical thinking abilities of students.

Concepts Related to Differential Diagnosis Generation

A differential diagnosis is the endpoint in the clinical decision making process as well as the starting point for interventions. Nurse Practitioners (NP) are expected to demonstrate expertise in their clinical decision making skills as they determine a differential diagnosis for the patient. Decision making is a complex process involving a systematic, organized approach to the situation (Hemaida & Kalb, 2001; Millet, 1998; Saaty, 2008). To facilitate the process, we must gather information, understand why a decision is needed, know the criteria for the decision, and understand the impact of the decision on all involved (Saaty). In the case of the NP, needed information comes not only from the patient and physical assessment but from their own knowledge base. The NP brings experience and theoretical knowledge from their clinical nursing to the decision making process. The NP must decide what areas will be of primary focus for the assessment and which areas will have decreased attention. Each step of the way, the NP must make decisions based upon sound knowledge. Initially, the NP will begin the assessment with a patient history related to the current complaint. This initial information provides the starting point for the rest of the decision making process.

As the process continues, the NP should have an organized framework for the assessment (Bickley & Szilagyi, 2004; D'Amico & Barbarito, 2007; Jarvis, 2007). The framework may range from a systems approach where each system is independently assessed to a problem-based approach where multiple systems are evaluated in an integrated manner. Once the assessment is completed, the NP must interpret the findings

appropriately to determine the course of treatment. This involves considering which findings are relevant to the patient complaint, which findings are irrelevant, and which findings are suggestive of another unrelated problem the patient is experiencing.

The NP makes many decisions in reaching a differential diagnosis for each patient. They decide which assessments to perform; which lab tests to order; what information is relative to the current complaint; what impact the other health problems are having on the new problem; if an emergency, can care be delayed without harm to the patient; what is the most likely explanation for the current symptoms; and what diagnoses will have no relationship to current symptoms of the patient. To generate a differential diagnosis, the NP must effectively gather information from the patient in the form of history, physical assessment, and results of laboratory tests.

With the differential diagnosis determined, the course of treatment will be guided and directed by the diagnosis the NP has formulated. Determining a differential diagnosis is not a simple task for the healthcare provider (Papa, Oglesby, Aldrich, Schaller, & Cipher, 2007). To make this an easier challenge, several authors evaluated tools to facilitate students in the development of differential diagnoses. One method for improving the ability of the NP student in the generation of differential diagnoses was in the oral presentation of a patient case. Brown (2006) described the use of oral case presentation of the case by the NP or NP student. The framework for data presentation could serve as a guide to assist the individual in organizing the data gathered.

Initially, a framework for researching a topic area can be provided to the student in one of the core courses. Introduction of a framework provides the student with some experience in the analysis of a basic physical and physiologic process that can be built

upon in later course work. Bedi and Rutt (2006) described the use of a tool that could assist the student as they structure, prioritize, and formulate a diagnosis for a clinical scenario. While it was used in a specific setting, there have been no data related to the impact of this tool on student outcomes in the area of structuring, prioritizing, and formulation of a diagnosis.

Coralli (2006) discussed the importance of effective case presentations and provided the reader with examples of a framework that might be used. Again, no measurement related to the impact of the tool on student learning outcomes was noted. Rather, descriptive information was provided to demonstrate how the tool could be used in NP student education.

Fisher and Riley (2005) presented the use of specific assignments that require the students to present a case in class and respond to peer questions. Prior to presenting patient cases in the educational setting, the student must have mastered basic knowledge related to anatomy, physiology, and health assessment. Over time, the student continues to gain knowledge related to abnormal anatomy, physiology, and health assessment in more advanced courses. Learning tools that prompt the student to ask key questions and demonstrate knowledge of abnormal presentations have proved beneficial. In the study by Jamison (2006), the use of a structured study guide, classroom simulation experiences, a traditional textbook, an online learning platform, and student self-assessment were examined related to the ability of students to generate differential diagnosis. Evaluation of the formative and summative assessment of student learning found that students demonstrated the ability to generate differential diagnoses with fewer face-to-face lecture hours. While the author stated that it appeared that students could be taught to generate

differential diagnosis with fewer lecture hours, there was no comparison of this group, which utilized a varied approach, to a control group where traditional lecture was the mode of instruction.

While the use of frameworks and tools to assist the student in the formulation of differential diagnoses has been reported in the literature, the effectiveness of these tools has not been assessed. The generation of a differential diagnosis is complex and takes time. Using a framework to provide structure as the problem is evaluated can be helpful and assist in the learning process. However, there was a lack of supportive data to demonstrate that any of the interventions described above had an impact upon the ability of the student to generate a differential diagnosis.

Conclusion

The lack of a consistent definition and measurement of CT within the literature points out the need for a clear definition and a reliable and valid method for evaluating CT within nursing. Much of the literature reported gains in critical thinking without any type of formal assessment. To improve critical thinking skills in the NP student, pre- and post- intervention scores of CT should be noted. This study used one well defined and accepted definition of critical thinking to study the relationship between critical thinking and clinical judgment resulting in differential diagnosis formulation in NP students. While this study had no pre- or post-test by design, it was an investigative study to determine if a relationship existed between critical thinking skills and the generation of differential diagnoses in NP students.

CHAPTER III

METHODS AND PROCEDURES

Purpose

The purpose of this study was to add to the body of knowledge related to critical thinking in Nurse Practitioner (NP) students. Current literature provided limited information in the area of critical thinking and clinical judgment in NP students. This chapter provides a description of the study to determine if there is a relationship between critical thinking and clinical judgment in NP students. Clinical judgment is assessed via the ability of the NP student to correctly formulate a differential diagnosis and provide the correct answer to an exam style question, by the report of the ability of the NP student to formulate differential diagnosis, by the clinical preceptor, and by the score on the evaluation and reevaluation sub-scale of the version of the Clinical Decision Making in Nursing Scale tool. Information related to the setting, design, population, sample, and protection of human subjects is presented.

Research Design

The research is a descriptive correlational design study. This study type is used to look at relationships between variables (Gall, Gall, & Borg, 2007; Houser, 2008). A correlational study does not determine causality between two variables but describes the strength and extent of a relationship between two variables (Polit & Beck, 2008). Since little information has been found in the literature related to critical thinking skills and

clinical judgment in the nurse practitioner student, this design was selected to investigate the potential relationship between these variables. This study involves the testing of hypotheses; the results can be used to formulate further research in the areas of critical thinking and clinical judgment in the NP student.

Setting

This study used schools of nursing across the United States. The participants attended schools where both undergraduate and graduate nursing programs were offered. The advanced practice nursing degree at these institutions remains at the master's level. Yearly, an average of 15 and 35 students are admitted to each of these advanced practice nursing programs. Some programs had over 100 eligible participants, while other programs had less than 10 eligible participants.

Within the Master of Science curriculum, the students progress through a program that includes core courses in the areas of pharmacology, theory, advanced pathophysiology, research, advanced physical assessment, professional role, leadership, and nursing issues. The clinical experiences cover three or four semesters and are concurrent with theory courses related to the provision of care by the Nurse Practitioner (NP). In the practicum experiences, the student must have a minimum of 500 hours providing direct patient care under the supervision of an experienced advanced practice nurse (American Association of Colleges of Nursing [AACN], 1996). During the clinical experiences, the NP preceptor provides direct supervision, feedback, and evaluation of the student. A faculty member from the program also visits the NP student in the clinical setting. While there, the faculty member observes patient visits with the NP student, provides feedback to the NP student, and completes a formal evaluation of the

observation session. Currently, the programs are using a variety of evaluation tools to report on the ability of the NP student to formulate a differential diagnosis.

The first institutions were selected for the study because of their accessibility and convenience to the researcher. However, with a lack of adequate participants, the researcher continued to query schools to seek other participants. Overall, over 80 programs were contacted; 70 of those agreed to expose their students to this research project. A return rate of less than 1% was obtained in the study. The decision making skills of the students were assessed via Survey Monkey using the evaluation and reevaluation scale of the Clinical Decision Making in Nursing Scale tool and exam style questions that require the student to correctly formulate a differential diagnosis before selecting the correct answer to the question. These tools are discussed in greater detail under the Instruments section. Additionally, the preceptor evaluation data were gathered via Survey Monkey. Permission to conduct the study at the institutions was requested from the directors of the educational programs as well as the appropriate Institutional Review Boards as needed. The University of Northern Colorado Institutional Review Board (IRB) also provided the appropriate permission for the study. The IRB information can be found in Appendix A.

Population

This study used Nurse Practitioner students currently enrolled in the last year of an advance practice nursing education program. Students were providing patient care under the supervision of qualified Nurse Practitioner preceptors. With the small number of students enrolled in the Nurse Practitioner educational programs, all were eligible for

participation. Participation was voluntary; students who did not wish to participate were excluded from this study.

Sampling Procedure

A convenience, nonprobability sampling technique was used for this study. Schools of Nursing that offered a Family Nurse Practitioner educational program at the master's level were solicited. Information related to the study was provided to deans, program directors, and faculty who then passed the information onto students. This type of study has been noted to be purposeful as there is a specific plan presented for sampling (Trochim, 2006). This sampling technique was correct for this type of study; however, because of the lack of random sampling, the findings of the study might not be generalizable to the population of nurse practitioner students in the United States. Inclusion criteria were (a) nurse practitioner students enrolled in accredited Family Nurse Practitioner educational programs, (b) NP students who were within one year of graduation, (c) NP students currently providing patient care under the supervision of licensed Nurse Practitioners, and (d) NP students who were willing to participate in the research. The sample size was a minimum of 50 students. This sample size provided a power analysis of 0.71 for the correlation analysis. Power analysis was calculated by the program G*Power 3.1.0 using a moderate effect size ($r = 0.30$) and significance level = 0.05 for correlation analysis. Participants were sought from specified institutions until the required sample size was met. Participants were actively recruited from at least 70 schools that have accredited Family Nurse Practitioner programs until a minimum of 50 participants had completed the assessments.

Instruments

California Critical Thinking Skills Test

The California Critical Thinking Skills Test (CCST) was used to assess the critical thinking skills of the participants. This tool was developed from the work of the Delphi panel's definition of critical thinking and the skills inherent in that process. Since 1990 when it was first used, the CCTST has undergone several "forms," the most recent version being Form 2000. The tool was developed to also measure gains in Critical Thinking (CT) related to specific courses within the California State University (CSU) system; thus, some of the additional sub-scores (deductive reasoning and inductive reasoning) which were meaningful to that system are reported.

This tool has 34 multiple choice questions and allows individuals 45 minutes to complete the tool. Three sub-scores arose from the work of the Delphi group: Analysis, Evaluation, and Inference. Analysis refers to the ability to "comprehend and express the meaning of significance of a wide variety of experiences, situations, data, events, judgments, conventions, beliefs or criteria" (Facione, Facione, Blohm, & Gittens, 2008, p. 12). Evaluation is the ability to "assess the credibility of statements or other representations which are accounts or descriptions of a person's perception, experience, situation, judgment, belief or opinion" (Facione et al., p. 12). Inference is the ability to "identify and secure elements needed to draw reasonable conclusions" (Facione et al., p. 12).

Facione, one of the original tool developers, also added deductive and inductive reasoning scores that were based upon 30 of the 34 items. Inductive reasoning assesses the ability of the individual to be confident in the argument presented and the conclusion

described. Deductive reasoning is the ability of the individual to use cognitive skills to assess the validity of the statements and claims presented. Development of the CCTST was done with over 1,100 students, 20 instructors and five courses within three academic departments within the California State University system. The total score yielded information about individual's overall reasoning/critical thinking skill level based upon the scores in analysis, inference, and evaluation.

Validity. Users of this tool are encouraged to evaluate the items to determine if they meet their concept of critical thinking. Within the review of the literature chapter, the definition of Critical Thinking presented by Facione (1990) has been compared to the definition of Critical Thinking in nursing that was developed by Scheffer and Rubenfeld (2000). While the definition of Facione and the American Philosophical Association (APA; 1990) is lacking in two areas as compared to the definition developed by Scheffer and Rubenfeld, the APA definition was chosen for this study. Recently, Facione, Facione, and Giancarlo (2000) explained that the comprehensive CCTST assesses an individual's critical thinking skills and components of overall critical thinking skills (analysis, inference, evaluation, inductive reasoning and deductive reasoning) and not the individual's ability to use critical thinking.

When examining the concept of validity, three components came to mind: content, construct, and criterion. Content validity relates to how well the items on the exam are representative of the domain in question. The CCTST content was developed with the Delphi definition of critical thinking in focus (Facione et al., 2008). Each question has "been carefully chosen for its theoretical relationship to the Delphi CT conceptualization" (Facione et al., p. 28). Construct validity refers to how well a test

measures what it purports to measure. The CCTST was able to demonstrate gains in critical thinking skills with a comparison study that was designed to evaluate cross-sectional and matched pairs comparisons (Facione et al.). The results of the cross-sectional analysis found a statistically significant gain of 0.74 from the pre-test mean to the post-test mean (Facione et al.). Criterion validity relates to the ability of a test to predict outcomes on some external standard of measurement. This may be grade point average or scores on standardized exams. The CCTST has been shown to correlate fairly strongly with the Graduate Record Exam (GRE) total (0.719), the GRE Analytic (0.708), and the GRE Verbal (0.716) scores (Facione et al.). The correlation with the Scholastic Aptitude Test (SAT) Verbal score is 0.545 and the correlation with the SAT Math is 0.422 (Facione et al.). These numbers are lower and indicate that the relationship between the CCTST and the SAT are not as strong as the relationship between the CCTST and the GRE scores.

Reliability. The California Critical Thinking Skills Test--Form 2000 has a reported internal consistency estimate of 0.78 to 0.80 using the Kuder-Richardson 20 formula (Facione et al., 2008). These pre-test and post-test comparisons demonstrate that the tool does measure critical thinking skills with good reliability. Initially, the CCTST tool was normed based on 781 college students for the pre-test and 892 for the post-test. Initial tool internal consistency results were reported with a range of 0.69 to 0.68 using the Kuder-Richardson 20 formula (Facione et al.). The continued increase in internal consistency, from 0.69 to 0.78 for pre-test results and from 0.68 to 0.80 for posttest, is resultant from the continuous research and development of the tool over the past 20 years. The reported *t*-statistic of 2.44 for a one-tailed *t*-test with a $p < 0.0075$ presents

evidence that the CCTST is sensitive enough to detect gains in critical thinking skills of those who completed the CCTST. Further research into the possibility of test effect on results demonstrated that there was no test effect that impacted validity of the tool (Facione et al.).

Assessment of Clinical Judgment

As a part of their educational process, NP students have already taken exams which present higher order thinking questions that assess their ability to formulate a differential diagnosis based upon a case example or unique question. A variety of exam type questions were compiled from existing examinations into a survey that required students to formulate appropriate differential diagnoses to correctly answer the questions. The questions were selected from exam question data bases and are considered to be reliable and valid as they have been developed by content experts. The exam questions were selected on the type of question (synthesis vs. knowledge), the need to determine a correct differential diagnosis to correctly answer the question, and the strength of the biserial. The questions evaluated the ability of the test taker to formulate a correct differential diagnosis and select the most appropriate treatment plan based on the data presented. Exam questions were selected to have point biserials in the range of 0.26 to 0.72. A raw differential diagnosis score was determined from this section of the survey. Ten test questions assessed the NP students' clinical judgment. These questions were normed by 18 NP students in the past year. The questions, answers, and biserial can be found in Appendix C.

The clinical preceptor supervising the Nurse Practitioner student was asked to provide feedback on the ability of the student to formulate a differential diagnosis. This

was accomplished via an electronic survey link that was sent directly to these individuals or via fax. The NP students provided the researcher with contact information for the preceptor. These questions requested responses on a 10-point Likert type scale. The preceptor answered seven questions about each student. These questions represented a compilation of the current tools used at two institutions to evaluate the student's ability to formulate a differential diagnosis during clinical practicum time spent with a NP preceptor. The ranking scale is from 1 to 10 with 1 being an indication of no ability and 10 being an indication of excellent ability. Ten Nurse Practitioners who have served as preceptors reviewed the evaluation tool and provided feedback as to the clarity of the instructions, clarity of the questions asked, and the type of question asked related to the ability of the student to formulate differential diagnoses. The questions can be found in Appendix D. The reliability coefficient for this instrument was assessed based on the participants in the current study.

Clinical Decision Making in Nursing Scale

The Clinical Decision Making in Nursing Scale (CDMNS) subscale of evaluation and reevaluation of consequences was used to assess the nurse practitioner students' decision making ability. Students reviewed statements and indicated their typical patterns and responses to components of decision making within nursing. This tool was developed by Dr. Helen Jenkins and has been used with undergraduate nursing students. The tool has four sub-scales (only one was used specifically for this study): search for alternatives or options, canvassing of objectives and values, search for information and unbiased assimilation of new information, and evaluation and reevaluation of consequences. The first three scales are process oriented; the fourth scale is outcome oriented and an

appropriate indicator of clinical judgment. While the whole tool was used in data collection, the focus for this study was the subscale of evaluation and reevaluation of consequences. Although the tool has not been documented to have been used with the graduate student population, it does have established reliability and validity within nursing education. The tool contains 40 unique items that the individual responds to on a 5-point Likert-type scale. Each ranges from 5—*always* to 1—*never*. The scores can range from 40 to 200. Higher scores are related to stronger clinical decision making skills (Jenkins, 1985). The information sheet relating to the CDMNS tool was obtained and was used to separate the questions into appropriate subscales. This tool and information sheet can be found in Appendix E.

Validity. Content validity was established via (a) a comprehensive literature review related to decision making in nursing, (b) a compilation of a preliminary test which was taken initially by 32 senior nursing students, (c) a secondary evaluation of the tool completed by 30 nursing students for further improvement, and (d) evaluation of the results by eight nursing educators familiar with the decision making process in nursing. At the completion of the eight-person critique, five nurse educators evaluated the tool and provided a rating of each item for appropriateness, construction, degree of independence from other items on the questionnaire, and representativeness with a specific matrix (Jenkins, 1985). Any item that had an evaluation score of less than 70% was excluded; those with a score of 70 to 75% were carefully evaluated for inclusion or exclusion from the tool. Formal tool testing was completed with a stratified sample of 111 nursing students at a variety of levels within the undergraduate education process.

Reliability. Reliability was assessed via Cronbach's alpha for the tool. With 44 items on the tool for the formal tool test, the alpha was 0.79. When the four items with the lowest coefficients were removed from the tool, the Cronbach's alpha for all questions and scores was 0.83 (Jenkins, 1985).

Data Collection

Permission from the educational administrators at the respective institutions of higher education was obtained prior to inviting students to participate in the study. Some institutions required additional permission from their Institutional Review Board (IRB), while others accepted the IRB permission from the University of Northern Colorado. The CCTST and the CDMNS were administered to the students electronically. The study was explained to the students, emphasizing the confidentiality of the information and that participation was voluntary. Each student was provided with informed consent documentation via email, hard copy, or the survey tool. Upon providing consent to participate in the study, the students completed the web based assessments.

The power of the study is a measurement of the probability to reject a false null hypothesis. When calculating the power of the test, several factors are considered: sample size, the effect size of the study, the level of significance, and the type of analysis. The size of the effect is a measurement of the magnitude of the relationship between independent and dependent variables in the analysis.

For the purpose of this study, the main statistical procedure was correlation analysis. Assuming there are a minimum of 50 subjects in the study, a moderate effect size ($r=.30$) and significance level $=.05$, the power of testing expected effect size will be 0.71 for correlation analysis by computer program G*Power. With a minimum of 50

subjects in the study and one to five covariates (independent variables, which also could include any demographic variables if strongly associated with variables of interest) involved in multiple regression analysis, a moderate effect size ($f^2 = 0.15$), and significance level = 0.05, the power for testing expected effect size was 0.52-0.68 by computer program G*Power. This power demonstrates that the sample size was too small to use multiple regression analysis and have statistically reliable outcomes. Analysis of variance was also considered but with a minimum of 50 subjects in the study, with two to three groups for independent variables, a moderate effect size ($f^2 = 0.25$) and a significance level = 0.05, the power for testing expected effect size was 0.32-.041 for ANOVA analysis by computer program G*Power 3.1.0. This power analysis does not demonstrate that statistically reliable outcomes would be resultant with ANOVA. Post-hoc power analysis for the ANOVA was calculated with the given sample population of 50, a medium effect size of 0.25, and a 0.05 error possibility of 0.41. Further post-hoc evaluation for the effect size was 0.41. These statistical analyses demonstrate the need for further participants before statistically reliable outcomes can result.

Research Question and Research Hypotheses

Q1 Is there a relationship between critical thinking skills and clinical judgment in Nurse Practitioner students?

In line with the research question, the following research hypotheses were proposed:

H1 NP students who demonstrate higher scores on the California Critical Thinking Skills Test will also demonstrate more accuracy in the formulation of differential diagnoses as determined by their results on the exam style questions.

- H2 NP students who demonstrate higher scores on the California Critical Thinking Skills Test will also demonstrate higher scores on the evaluation and reevaluation of consequences subscale of the Clinical Decision Making in Nursing Scale.
- H3 NP students who demonstrate higher scores on the California Critical Thinking Skills Test will also demonstrate more accuracy in the formulation of differential diagnosis as determined by the preceptor clinical evaluation tool.
- H4 Professional work experience of the NP student as a registered nurse will have some relationship to the NP students' scores and sub-scores on the California Critical Thinking Skills Test.

Data Analysis Procedures

The goal of the statistical analysis for this study was to test hypotheses 1-4 for (a) the relationship between critical thinking skills scores and sub-scores and the accuracy in the formulation of differential diagnosis; (b) the relationship between critical thinking skills scores and sub-scores and score on the evaluation and reevaluation of consequences subscale of the Clinical Decision Making in Nursing Scale; (c) the relationship between critical thinking skills scores and sub-scores and the ability of the NP student to formulate a differential diagnosis as evaluated by the preceptor; and (d) the relationship between work experiences as a registered nurse and critical thinking skills scores and sub-scores among NP students. This study also sought to evaluate the relationship between demographic characteristics of the NP student and critical thinking skills and their clinical judgment skills.

The major statistical analysis procedure for testing hypotheses 1-4 was correlation analysis. Regression analysis may also be conducted to gain a greater understanding of the relationships between the independent variables and dependent variable. Power

analysis demonstrated that the sample size was too small to have sufficient power for statistically reliable results with regression analysis.

The preliminary analytical step was data screening. Critical thinking skill scores, critical thinking sub-scores, evaluation and reevaluation of consequences sub-score in the clinical decision making in nursing tool, and scores of differential diagnosis formulation are displayed in tables. Each of the *CCTST* test sub-scores and the overall score were evaluated for normality, linearity, and heteroscedasticity. The descriptive statistics for measures including mean, standard deviation, and skewness of distribution are summarized. At this stage, any outliers were addressed. Additionally, descriptive statistics for demographic variables are displayed in tables. Those variables include years of experience as a registered nurse (RN experience), types of work experience as a RN (types of RN experience), life experience prior to entry into the program (life experience), and educational pathway prior to entering into the NP program (education).

Another preliminary analytical step was evaluating the association between workplace environment as a Registered Nurse and the primary variable critical thinking skills (overall *CCTST* score) and critical thinking sub-scores. Correlation analysis was conducted and the Pearson's correlation coefficient was obtained to determine the strength and direction of the relationship between critical thinking skill score and critical thinking sub-scores. Years of experience as a registered nurse (RN) were also included in the correlation analysis. In addition, the critical thinking skill scores and critical thinking sub-scores were tested for difference between types of RN experience. This was done by parametric evaluation using ANOVA (one-way analysis of variance) if data were

normally distributed or non-parametric evaluation using Kruskal-Wallis test if the data were not normally distributed.

A correlation analysis was conducted to determine whether there was a strong association between continuous variables including the primary variable of interest, critical thinking skills (overall *CCTST* score), and years of experience as a registered nurse. Spearman's rho was used to indicate the strength and direction of association for numeric variables. Pearson's *r* was used to evaluate the covariance between critical thinking scores and years of experience as a registered nurse and their respective standard deviations. The combined analysis of Spearman's rho and Pearson's *r* can be used to determine if there is a correlation between the variables when there does not appear to be a linear relationship.

The evaluation of hypothesis 1 was to determine if NP students who demonstrated higher critical thinking skills would also demonstrate higher skills in the formulation of differential diagnosis. Pearson correlation analysis was used. In order to evaluate hypothesis 2, NP students who demonstrated higher scores on the California Critical Thinking Skills Test would also demonstrate higher scores on the evaluation and reevaluation subscale of the Clinical Decision Making in Nursing Scale, Pearson correlation analysis was again used.

To test hypothesis 3, NP students who demonstrated higher scores on the California Critical Thinking Skills Test would also demonstrate more accuracy in the formulation of differential diagnosis as determined by the preceptor clinical evaluation tool. Pearson correlation analysis was used similarly.

To assess hypothesis 4, professional work experience of the NP student as a registered nurse would have some influence on the NP students' scores on the California Critical Thinking Skills Test, a variety of statistical approaches were used. Correlation analysis with Spearman's rank correlation was used first. Kruskal-Wallis analysis was conducted with critical thinking score as the independent variable and years of experience as the dependent variable. When any demographic factors were found to be significantly associated with any of the above variables, they were included in further statistical evaluation. Analysis of Variance (ANOVA) analysis was used with area of work as the independent variable and critical thinking skills scores as the dependent variable.

All data were analyzed by statistical software SPSS (version 16.0 for Windows) and Smiths Statistical Package (version 2.80, September 2005).

CHAPTER IV

ANALYSIS OF RESULTS

Introduction

The purpose of this study was to investigate the relationship between critical thinking skills and clinical judgment in the nurse practitioner (NP) student. This chapter represents a comprehensive summary of the data collected by this researcher in narrative and tabular form. The data related to the participants include (a) demographic data on participants; (b) characteristics of educational pathways; (c) areas of nursing experience; (d) areas of most recent nursing experience; (e) California Critical Thinking Skills Test--Form 2000, scores, and sub-scores; (f) scores on the 10 exam type questions related to differential diagnosis formulation; (g) scores on the evaluation and reevaluation of the consequences subscale of the Clinical Decision-Making in Nursing Scale; and (h) clinical preceptor feedback. Data are presented via descriptive and numerical statistics.

Following the presentation of data, an overview of the statistical evaluation that was performed is presented. Further information related to reliability analysis of the tools used in the study, with a brief review of the normality of variables and a listing of which statistical test was used for each hypothesis, is presented. Upon completion of the overview of statistical evaluation, each of the following four hypotheses was evaluated relative to the statistical analysis.

- H1 NP students who demonstrate higher scores on the California Critical Thinking Skills Test will also demonstrate more accuracy in the formulation of differential diagnoses as determined by their results on the exam style questions.
- H2 NP students who demonstrate higher scores on the California Critical Thinking Skills Test will also demonstrate higher scores on the evaluation and reevaluation of consequences subscale of the Clinical Decision-Making in Nursing Scale.
- H3 NP students who demonstrate higher scores on the California Critical Thinking Skills Test will also demonstrate more accuracy in the formulation of differential diagnosis as determined by the preceptor clinical evaluation tool.
- H4 Professional work experience of the NP student as a registered nurse will have some relationship to the NP students' scores and sub-scores on the California Critical Thinking Skills Test.

Participant Information

During the course of the study, 83 Family Nurse Practitioner educational programs were contacted regarding participation in the study. Over 70 schools demonstrated willingness to pass the study information on to their students. Some educational programs had as few as 12 eligible NP student participants; others had over 100 eligible student participants. For this study, 51 participants completed the Clinical Decision-Making in Nursing scale (CDMNS) and exam style questions. Of these 51, only 50 completed the California Critical Thinking Skills Test (CCTST) despite numerous reminder emails requesting completion of the tools. For the purpose of data analysis, the participant who did not complete the CCTST was dropped. Obtaining preceptor feedback was more difficult than anticipated. Participants were asked for contact information of the preceptor; the preceptor was then contacted and asked to complete the preceptor evaluation tool. Completed preceptor evaluation tools were obtained for 47 of the 50 participants.

Demographic Data

The age of the student participants in this study ranged from 23 to 53 years. The youngest participant was 23 and the oldest participant was 53. The median age was 34.5 years, the mean age was 36.18, the mode was 26 years, and the standard deviation was 10.05 years. Table 1 presents these data.

Table 1

Participant Ages

	Years of Age
Range	23 to 53
Median	34.5
Mean	36.18
Mode	26
Standard Deviation	10.05

Note. $n = 50$.

Participants were further grouped into categories by 5 and 10 year increments for data analysis. Five participants were in the age range of 20 to 25 years, 17 in the age range of 26 to 30 years, three within the 31 to 35 year old age range, five in the age range of 36 to 40 years old, seven between 41 and 45 years old, nine within the age range of 46 to 50 years old, and four in the 51 to 55 years old age range. Using 10 year increments, there were 22 within the 21 to 30 years old age range, eight within the 31 to 40 years old age range, 16 within the age range of 41 to 50 years old, and four who were within the age range of 51 to 60 years old. These data can be found in Table 2.

Table 2

Age Breakdown by Five and Ten Year Increments

Five Year Increment Age Range	Number of Participants	Ten Year Increment Age Range	Number of Participants
20 to 25 years old	5	21 to 30 years old	22
26 to 30 years old	17	31 to 40	8
31 to 35 years old	3	41 to 50	16
36 to 40 years old	5	51 to 60	4
41 to 45 years old	7		
46 to 50 years old	9		
51 to 55 years old	4		

Note. $n = 50$.

Years of Nursing Experience

The years of nursing experience were also varied--one person had no nursing experience and one had 33 years of nursing experience. The median for years of nursing experience was 6.0 years with a mean of 10.2, a mode of 5.0, and a standard deviation of 8.8 years. Of the 50 participants, four were male (8%) and 46 were female (92%). This representation of males within the sample was greater than the overall number of men who comprise 5.8% of the nursing workforce (American Association of Colleges of Nursing, 2010), but less than the “9.1% of male students in master’s nursing programs” nationally (American Association of Colleges of Nursing, para 14). Table 3 presents the years of nursing experience for study participants.

Table 3

Years of Nursing Experience

Years of Nursing Experience	
Range	0 to 33 years
Median	6.0
Mean	10.2
Mode	5.0
Standard Deviation	8.8

Note. $n = 50$.

Further sorting of the years of experience found 24 participants with zero to 5 years of nursing experience, nine participants with 6 to 10 years of nursing experience, seven participants with 11 to 15 years of experience, three participants with 16 to 20 years of experience, one participant with 21 to 25 years of experience, five participants with 26 to 30 years of experience, and one participant with 31 to 35 years of nursing experience. When grouped into 10 year increments of nursing experience, there were 33 with zero to 10 years of experience, 10 with 11 to 20 years of nursing experience, six with 21 to 30 years of nursing experience, and one with more than 30 years of nursing experience. These data are demonstrated in Table 4.

Table 4

Years of Nursing Experience in Five and Ten Year Increments

Five Year Increment Nursing Experience	Number of Participants	Ten Year Increment Nursing Experience	Number of Participants
0 to 5 years	24	0 to 10 years	33
6 to 10 years	9	11 to 20 years	10
11 to 15 years	7	21 to 30 years	6
16 to 20 years	3	31 to 40 years	1
21 to 25 years	1		
26 to 30 years	5		
31 to 35 years	1		

Note. $n = 50$.

Characteristics of Educational Pathways

In this study, 50 participants were enrolled in the Family Nurse Practitioner (FNP) educational program. Participants were provided with a list of six common educational pathways and a descriptive text box to describe their educational pathway if it was not one of the following six common pathways.

- Bachelor of Science in Nursing (BSN) to current program
- Associate degree to BSN to current program
- Other bachelor's degree to associate degree to BSN to current program
- Other bachelor's degree to BSN to current program
- Master's degree to BSN to current program

- Master's degree to associate degree to BSN to current program
- Other--participants were asked to specify their educational pathway

The most common educational pathway prior to entering into the FNP educational program for the participants was the BSN to current program; 33 (66%) participants indicated that this was their pathway. Eight participants (16%) indicated that their educational pathway was that of the associate degree to BSN to the current program. Five participants (10%) indicated that their educational pathway was that of the master's degree to BSN to the current program. Two participants (4%) indicated that their educational pathway was from a bachelor's degree to associate degree to BSN to the current program. One participant (2%) went from a bachelor's degree to BSN to the current program. Only one participant (2%) had an educational pathway from Licensed Practical Nurse (LPN) to BSN to the current program, which was not one of the options listed. Table 5 presents the educational pathways of the study participants.

Table 5

Educational Pathways of Participants Prior to Entering FNP Educational Program

Educational Pathway	Number	% of total
Bachelor of Science in Nursing (BSN) to current program	33	66.0
Associate degree (AD) to BSN to current program	8	16.0
Master's degree to BSN to current program	5	10.0
Bachelor's to AD to BSN to current program	2	4.0
Bachelor's degree to BSN to current program	1	2
Other: LPN to BSN to current program	1	2

Note. $n = 50$.

Areas of Nursing Experience--Practice

The areas of nursing experience varied within the participants with 20 unique practice experience areas and many secondary practice experience areas. Participants were provided eight standard options to indicate their areas of practice. Participants were also provided with an option of “Other” that had a text box for them to note the area of nursing practice experience if it was not listed. These eight areas were intensive care unit, inpatient hospital, surgery, post-anesthesia, outpatient clinic, school nursing, home health nursing and public health. A text box for “Other” asked the participant to specify the area of nursing experience.

The most common area of experience for participants in this study was inpatient hospital nursing; 28 participants noted this area. The second most common area of experience was intensive care unit; 12 participants noted this area of experience. Of the group remaining, four participants reported home health care, three indicated outpatient nursing, and the remaining areas (emergency, public health, and no nursing experience) were identified by one participant each. Table 6 presents the areas of nursing experience for the study participants.

A further breakdown of the experience area of participants found that of the 28 participants who selected inpatient nursing experience, 18 listed inpatient nursing only and 10 noted that their nursing practice included inpatient as well as another area. The other areas of nursing practice experience were further broken down as follows: outpatient (4), intensive care (3), emergency (1), surgery (1), and urgent care (1). The three participants with intensive care nursing experience also noted six other areas of experience: emergency, inpatient, school nursing, nurse educator, post-anesthesia care

unit, and neonatal intensive care. Of the four participants who indicated home health nursing, all noted that they also had inpatient nursing experience in their background. Of the three participants who noted outpatient nursing practice, two had experiences in public health and one participant had experience in inpatient nursing. The participant who noted emergency nursing practice also noted experience in intensive care nursing. The remaining two who indicated nursing practice experience in public health had no secondary areas of nursing experience noted. Table 7 presents the secondary areas of nursing experience.

Table 6

Areas of Nursing Experience--Practice

Areas of Nursing Experience	Number
Inpatient hospital nursing	28
Intensive Care Unit	12
Home health nursing	4
Outpatient nursing	3
Emergency nursing	1
Public health	1
None	1

Note. $n = 50$.

Table 7

Secondary Areas of Nursing Experience

Areas of Nursing Experience	Number
Inpatient hospital nursing	28
Secondary Practice to Inpatient hospital	
Inpatient hospital nursing only	18
Outpatient	4
Intensive care	3
Emergency	1
Surgery	1
Urgent Care	1
Intensive Care Unit	12
Secondary Practice to Intensive Care Unit	
Intensive care unit only	3
Emergency	2
Inpatient	2
School nursing	2
Nurse educator	1
Post-anesthesia care unit	1
Neonatal intensive care unit	1
Home health nursing	4
Secondary Practice to Home health nursing	
Inpatient	4
Outpatient nursing	3
Secondary Practice to Outpatient Nursing	
Public health	2
Inpatient	1
Emergency nursing	1
Secondary Practice to Emergency Nursing	
Intensive Care Unit	1
Public health	1
None	1

Note. $n = 50$.

The overall scores on the California Critical Thinking Skills Test (CCTST) ranged from 1 to 28 with a percentile range from 1st to 87th. The median overall score was 17, the mean was 16.42, the mode was 20, and the standard deviation was 5.71. The possible range of scores on the CCTST was 0 to 34. Table 9 presents the actual scores on the CCTST by study participants.

Table 9

Range of Overall CCTST Score and Percentile Rank

Overall Score		Percentile Rank	
Range	1 to 28	Range	1 to 87
Median	17	Median	40
Mean	16.42	Mean	39.14
Mode	20	Mode	55
Standard Deviation	5.71	Standard Deviation	22.50

Note. $n = 50$.

The sub-scales of the CCTST have a variety of ranges with a total score of 34 possible. Five individual sub-scales are placed into two groups. The first group of sub-scales--analysis, inference and evaluation--can total 34 points. The analysis sub-scale has a high score of seven, the inference sub-scale has a high score of 13, and the evaluation sub-scale has a high of 10. Participant scores on the analysis subscale ranged from 0 to 7 with a median of 5.00, a mean of 4.40, a mode of 5, and a standard deviation of 1.54. On the inference subscale, the range was from 1 to 13, the median was 8.00, the mean was

7.40, the mode was 9, and the standard deviation was 2.89. The evaluation subscale had a range of 0 to 10, a median of 5.00, a mean of 4.62, a mode of 6, and a standard deviation of 2.25.

The second group of subscales on the CCTST--inductive reasoning and deductive reasoning--has a total possible score of 34 points, each sub-scale having a maximum of 17 points. The participant scores on inductive reasoning ranged from 1 to 16 with a median of 10.50, a mean of 9.92, a mode of 12.00, and a standard deviation of 3.55. The participant scores in the area of deductive reasoning had a range of 0 to 12, a median of 6.50, a mean of 6.55, a mode of 7, and a standard deviation of 2.81. Table 10 shows the range, median, mean, mode and standard deviation of participants' overall scores and scores on the subscales of the CCTST.

Table 10

Range of Scores on CCTST and Subscales

Subscale	Analysis	Inference	Evaluation	Inductive Reasoning	Deductive Reasoning	Overall Score	Percentile Rank
Range	0-7	1-13	0-10	1-16	0-12	1-28	1-87
Median	5.00	8.00	5	10.50	6.50	17	40
Mean	4.40	7.40	4.62	9.92	6.55	16.42	38.81
Mode	5	9	6	12	7	20	55
Standard Deviation	1.54	2.89	2.25	3.55	2.81	5.71	22.50

Note. $n = 50$.

The range of scores on the CCTST subscales was large--percentile rankings from 0 to 99--with some participants reaching the 99th percentile in analysis. The total score on the CCTST represented a range of the 1st percentile to the 87th percentile, a median of 40, a mean of the 39th percentile, a mode of 55, and standard deviation of 22.50.

Exam Style Question Scores

The exam style questions required the participants to evaluate the situation described, determine the correct differential diagnosis, and then correctly identify the course of treatment for the case presented in the question. Scores ranged from 10 correct to only three correct. The median score was 7, the mean was 6.92, the mode was 6, and the standard deviation was 1.81 (see Table 11).

Table 11

Exam Style Questions

	Overall Score
Range	3 to 10
Median	7.00
Mean	6.92
Mode	6
Standard Deviation	1.81

Note. $n = 50$.

Scores on Evaluation and Reevaluation
of Consequences Subscale

The Clinical Decision-Making in Nursing Scale (CDMNS) tool provides an overall score and four other subscales--Search for Alternatives and Options, Canvassing of Objectives and Values, Evaluation and Reevaluation of Consequences, and Search for Information and Unbiased Assimilation of New Information--that can be individually evaluated. For the purpose of this study, only the Evaluation and Reevaluation of Consequences subscale was used. This subscale contained 10 questions, each having a value of 1 to 5. The total possible score for this subscale was 50. The range of scores was 29 to 47 with a median of 37.5, a mean of 37.24, a mode of 38, and a standard deviation of 3.89. Table 12 provides this information.

Table 12

Scores on Evaluation and Reevaluation of Consequences Subscale

	Scores
Range	29 to 47
Median	37.50
Mean	37.24
Mode	38
Standard Deviation	3.89

Note. $n = 50$.

For nine of the questions, the median and mode were 4.0. For one item, the median and mode were 3.0. The scoring scale for the CDMNS offered a choice of responses on a continuum from *Always* to *Never*; specific instructions were provided as how to score each item, depending upon the question framework. If the question was within the positive framework, *Always* was scored as 5 and *Never* was scored as 1. If the question was within a negative framework, *Always* was scored as 1 and *Never* was scored as 5.

Clinical Decision-Making in Nursing Scale Tool

The overall score on the Clinical Decision-Making in Nursing Scale (CDMNS) was not used in the primary statistical analysis of data; however, overall scores were compiled. The score for this tool was calculated by assigning each response with a value of 1 to 5. The scores on the tool could range from 40 to 200; higher scores related to stronger clinical decision-making skills (Jenkins, 1985). Within the study population, the overall scores ranged from 132 to 173 with a median of 149.50, a mean of 151.02, a mode of 139, and a standard deviation of 9.58 (see Table 13).

Table 13

Scores on Clinical Decision-Making in Nursing Scale

	Overall Score
Range	132 to 173
Median	149.50
Mean	151.02
Mode	139
Standard Deviation	9.58

Note. $n = 50$.

Clinical Preceptor Feedback

Participants were asked to provide contact information for their clinical preceptor. This information was then used to contact the preceptors and seek their feedback on seven statements related to the NP students' ability within the clinical setting. The ranking scale for these statements ranged from 1 to 10 (1--*No ability* and 10--*Excellent ability*). On this tool, the highest possible score was 70 and the lowest possible score was 10. Overall scores ranged from 24 to 69 with a median of 56, a mean of 53.67, a mode of 56, and a standard deviation of 9.53. This information is presented in Table 14.

Table 14

Overall Scores on Clinical Preceptor Feedback

	Scores
Range	24 to 69
Median	56
Mean	53.67
Mode	56
Standard Deviation	9.53

Note. $n = 47$.

Statistical Tests Used

This study employed a quantitative correlational approach; it aimed to determine if a relationship existed between critical thinking skills and clinical judgment in the nurse practitioner (NP) student. Tests for normality for the variables being considered were first conducted to determine which specific test to use for correlation analysis. Upon

completion of normality testing, further evaluation of the reliability of the tools and point Biserial results for the exam style questions were completed.

Normality Evaluation

The Kolmogorov-Smirnov statistic was used to determine if the data for the variable being examined were normal. For the first three hypotheses, the tools used were the CCTST, the CDMNS, and the Exam Style Questions. Statistical evaluation demonstrated that the CCTST--with a Kolmogorov-Smirnov value of 0.611 and a p -value of 0.850--had a normal distribution. Evaluation of the CDMNS tool found a Kolmogorov-Smirnov value of 0.632 and a p -value of 0.820, demonstrating normal distribution. The Exam Style Questions tool had a Kolmogorov-Smirnov value of 0.760 and a p -value of 0.610, also demonstrating normal distribution. Evaluation of the preceptor evaluation tool demonstrated a Kolmogorov-Smirnov value of 0.969 and a p -value of 0.305, demonstrating normal distribution. Evaluation of years of experience demonstrated a Kolmogorov-Smirnov value of 1.567 and a p -value of 0.015, demonstrating data that are not normally distributed. With the Kolmogorov-Smirnov test, the p -value had key importance; a p -value greater than 0.05 demonstrated that the variable being evaluated was normally distributed and, hence, parametric statistical tests could be used (see Table 15).

Table 15

Normality of Variables

Variable	Kolmogorov-Smirnov	<i>p</i> -value
CCTST	.611	.850
CDMNS	.632	.820
Exam style questions	.760	.610
Preceptor tool	.969	.305
Years of Experience	1.567	0.015

Based upon the results of the Kolmogorov-Smirnov analysis, it was determined that for first three hypotheses, the Pearson correlation statistic would be used as these hypotheses demonstrated normally distributed variables. If the data were not normally distributed, a Spearman correlation statistic would have been used. For Hypothesis 4, the data were not normally distributed; therefore, a Spearman correlation statistic was used. Additionally, Analysis of Variance (ANOVA) was used when the dependent variable was determined to be normal. If the dependent variable had been determined to not have normal distribution, the Kruskal-Wallis analysis was used. The specific statistical tests used to address the hypotheses are shown in Table 16.

Table 16

Statistical Tests Used for the Hypotheses

Hypothesis	Variables involved	Statistical test
1	CCTST and ExamQ	Pearson
2	CCTST and CDMNS	Pearson
3	CCTST and Preceptor tool	Pearson
4	Years experience grouped, nursing experience and CCTST	Kruskal-Wallis
4	Area of Work and CCTST	ANOVA
4	Years experience and CCTST	Spearman

Reliability Analysis

The reliability or the internal consistency of the instruments used in this study was evaluated to determine if the items within each tool were closely related. Cronbach's alpha was used for the CCTST ($\alpha=0.809$), CDMNS evaluation and reevaluation subscale ($\alpha=0.670$), CDMNS overall ($\alpha=0.738$), and the preceptor tool ($\alpha=0.917$) as these tools use Likert-type scales. The Kuder-Richardson 20 statistic was used for evaluation of the Exam Style Questions (0.443) as the data for this instrument were dichotomous. The results of the statistical tests conducted to determine reliability for these instruments are shown in Table 17.

Table 17

Reliability of Instruments

Instrument	Reliability
CCTST	0.809
CDMNS subscale	0.670
CDMNS overall	0.738
Exam Style Questions	0.443
Preceptor tool	0.917

Of the four instruments used, the CCTST, the CDMNS overall, and the preceptor tool showed adequate reliability; their respective Cronbach's alpha values were greater than 0.70. Evaluation of the reliability of CDMNS subscale demonstrated that while not greater than the 0.70 minimal acceptance rate, it fell in the upper end of the questionable area. The reliability of the exam style questions ($\alpha = 0.443$) demonstrated poor internal consistency. The finding of poor reliability for the Exam Style Questions tool may have affected further statistical evaluations.

Point Biserial values for the exam questions were also calculated. They ranged from -0.056 to 0.399, with p -values ranging from 0.53 to 0.90. This further demonstrated that while the exam questions demonstrated good discrimination in the prior testing, the questions were not reliable for assessing the ability of the participant to synthesize and respond correctly to the question within this study group. Table 18 presents the Point Biserial value for each of the exam questions.

Table 18

Exam Question Point Biserial Value

Question	Point Biserial
1	0.049
2	0.343
3	-0.056
4	0.124
5	0.124
6	0.399
7	0.177
8	0.202
9	0.074
10	0.206

Post-hoc power analysis for the ANOVA was calculated using G*Power. The results of the power analysis, given a sample population of 50 respondents, a medium effect size of 0.25, and a 0.05 error probability, the power for testing of the analysis of variance conducted was 0.41. In order to increase the power, a larger sample size would be needed.

Evaluation of Hypotheses

Hypothesis 1

- H1 NP students who demonstrate higher scores on the California Critical Thinking Skills Test will also demonstrate more accuracy in the formulation of differential diagnoses as determined by their results on the exam style questions.

To evaluate this hypothesis, a Pearson correlation test was used to determine if a relationship between critical thinking skills and formulation of differential diagnoses was assessed via the exam style questions. Not only was the overall score on the CCTST used in statistical evaluation, each of the five subscales was evaluated to determine if there was any correlation between participant results on these two tools. The statistical evaluation of CCTST and exam style questions demonstrated a Pearson Correlation Coefficient ($r = 0.073$, $p = 0.617$), indicating no significant relationship between CCTST overall results and the exam style question results. Further evaluation of the subscales was undertaken to determine if any correlation existed between any aspect of critical thinking skills and the exam style question results. Correlation testing of the analysis subscale ($r = -0.106$, $p = 0.435$), the inference subscale ($r = 0.174$, $p = 0.226$), evaluation ($r = 0.002$, $p = 0.987$), inductive reasoning ($r = 0.002$, $p = 0.988$), and deductive reasoning ($r = 0.122$, $p = 0.400$) demonstrated no significant relationship between any of the critical thinking skills subscales and the exam style questions. The results of correlation analysis for the CCTST total score and subscale scores are shown in Table 19.

Table 19

Hypothesis 1 Results

Variable 1	Variable 2	Pearson Correlation Coefficient (<i>r</i>)	<i>p</i> -value
CCTST	ExamQ	0.073	0.617
Analysis	ExamQ	-0.106	0.435
Inference	ExamQ	0.174	0.226
Evaluation	ExamQ	0.002	0.987
Inductive Reasoning	ExamQ	0.002	0.988
Deductive Reasoning	ExamQ	0.122	0.400

Note. $n = 50$.

As can be seen in Table 19, the *p*-values of the Pearson correlation tests conducted for Hypothesis 1 were all above the critical value of 0.05. These results led to the rejection of the hypothesis that students who demonstrate higher scores on the CCTST will demonstrate greater accuracy in the formulation of differential diagnoses as determined by exam style questions.

Hypothesis 2

- H2 NP students who demonstrate higher scores on the California Critical Thinking Skills Test will also demonstrate higher scores on the evaluation and reevaluation of consequences subscale of the Clinical Decision-Making in Nursing Scale.

Hypothesis 2 looked to evaluate the relationship between results on the CCTST and results on the evaluation and reevaluation of consequences subscale of the CDMNS tool. To evaluate this hypothesis, Pearson correlation testing was used to determine if

there was any relationship between the overall score on the CCTST and the evaluation and reevaluation subscale of the CDMNS tool. The statistical evaluation of the overall CCTST and the evaluation and reevaluation subscale of the CDMNS ($r = 0.011$, $p = 0.940$) demonstrated no significant relationship between the two variables. Further evaluation of the CCTST subscales was also computed; it was determined that there was no significant relationship between analysis ($r = -0.010$, $p = 0.948$), inference ($r = 0.035$, $p = 0.810$), evaluation ($r = -0.052$, $p = 0.718$), inductive reasoning ($r = -0.044$, $p = 0.759$), and deductive reasoning ($r = 0.066$, $p = 0.649$). The results of the CCTST total score and the subscales and the CDMNS evaluation and reevaluation subscale are noted in Table 20.

Table 20

Hypothesis 2 Results

Variable 1	Variable 2	Pearson Correlation Coefficient (r)	p -value
CCTST	CDMNS subscale	0.011	0.940
Analysis	CDMNS subscale	-0.010	0.948
Inference	CDMNS subscale	0.035	0.810
Evaluation	CDMNS subscale	-0.052	0.718
Inductive Reasoning	CDMNS subscale	-0.044	0.759
Deductive Reasoning	CDMNS subscale	0.066	0.649

Note. $n = 50$.

Evaluation of the results on the subscale evaluation and reevaluation found that one question (#29) had a mean that was quite different from the means of all the other questions on the subscale. Reliability analysis demonstrated that this question had the highest standard deviation (0.944) and that the Cronbach's alpha would be slightly decreased ($\alpha = 0.655$) if the question was removed from the tool and the tool score. Therefore, consideration of removal of this question was not a valid option or explanation for the results of the correlation analysis.

Results of the statistical evaluation of the relationship between CCTST, the CCTST subscales, and the CDMNS evaluation and reevaluation subscale demonstrated a critical p -value of greater than 0.05, indicating no significant relationship between CCTST, its subscales, and the CDMNS evaluation and reevaluation subscale in this study. Thus, it was appropriate to reject the hypothesis that higher NP students who demonstrate higher scores on the CCTST will also demonstrate higher scores on the CDMNS.

Hypothesis 3

- H3 NP students who demonstrate higher scores on the California Critical Thinking Skills Test will also demonstrate more accuracy in the formulation of differential diagnosis as determined by the preceptor clinical evaluation tool.

Evaluation of the third hypothesis was then undertaken. Hypothesis 3 looked to evaluate the relationship between results on the CCTST and the results on the preceptor clinical evaluation tool. Pearson correlation testing was used to determine if there was any relationship between CCTST and the preceptor evaluation of the NP students. Statistical analysis of the overall score on the CCTST and the preceptor tool ($r = 0.153$, $p = 0.306$) demonstrated no significant relationship between these two variables. Further

evaluations to assess if there was any relationship between the CCTST subscales and the preceptor evaluation were also undertaken. Pearson correlation testing demonstrated no relationship between the subscale scores of analysis ($r = 0.221$, $p = 0.135$), inference ($r = 0.098$, $p = 0.512$), evaluation ($r = 0.148$, $p = 0.322$), inductive reasoning ($r = 0.144$, $p = 0.334$), deductive reasoning ($r = 0.154$, $p = 0.300$), and scores on the preceptor evaluation tool. Results of Pearson correlation testing are noted in Table 21.

Table 21

Hypothesis 3 Results

Variable 1	Variable 2	Pearson Correlation Coefficient (r)	p - value
CCTST	Preceptor evaluation tool	0.153	0.306
Analysis	Preceptor evaluation tool	0.221	0.135
Inference	Preceptor evaluation tool	0.098	0.512
Evaluation	Preceptor evaluation tool	0.148	0.322
Inductive Reasoning	Preceptor evaluation tool	0.144	0.334
Deductive Reasoning	Preceptor evaluation tool	0.154	0.300

Note. $n = 47$.

These results demonstrated that there was no significant relationship between the overall score on the CCTST and the preceptor evaluation tool as well as with the subscale scores on the CCTST and the preceptor evaluation tool. These results led to the rejection of the hypothesis stating that those students who demonstrated higher scores on the

CCTST would demonstrate more accuracy in the formulation of differential diagnosis as determined by the preceptor clinical evaluation tool.

Hypothesis 4

- H4 Professional work experience of the NP student as a registered nurse will have some relationship to the NP students' scores and sub-scores on the California Critical Thinking Skills Test.

Evaluation of the fourth hypothesis was undertaken as the last step in the statistical analysis process. Hypothesis 4 examined the relationship between critical thinking skills and professional work experience. This hypothesis was evaluated in a number of ways. A simple correlation between years of the CCTST overall score and the subscale scores and years of nursing experience was performed first. Statistical analysis of the overall score on the CCTST and years of experience ($\rho = -0.101, p = 0.487$) demonstrated no significant relationship between these two variables. Further evaluations to assess if there was any relationship between the CCTST subscales and the years of nursing practice were also undertaken. Spearman rank correlation testing demonstrated no relationship between the subscale scores of analysis ($\rho = 0.109, p = 0.451$), inference ($\rho = 0.000, p = 0.999$), evaluation ($\rho = -0.274, p = 0.054$), inductive reasoning ($\rho = -0.109, p = 0.453$), deductive reasoning ($\rho = -0.095, p = 0.512$), and years of nursing practice. The results of Spearman rank correlation coefficient testing are presented in Table 22.

Further evaluation was then undertaken using Kruskal-Wallis statistical analysis to evaluate the relationship between the overall CCTST score, the CCTST subscale scores, and years of work experience,. In this analysis, the null hypothesis was as follows: There is no significant difference between all the rank orders. The alternative hypothesis

was as follows: There is at least one rank order that is different. The analysis was based on the fact that the data were not normally distributed. The analysis compared the CCTST with groups of five years of experience and then with groups of 10 years of experience. The relationship between the overall CCTST score and the scores on the subscales was analyzed against years of experience.

Table 22

Years of Nursing Practice and CCTST Scores

Variable 1	Variable 2	Spearman Rank Correlation Coefficient (ρ)	p - value
CCTST	Years of nursing practice	-0.101	0.487
Analysis	Years of nursing practice	0.109	0.451
Inference	Years of nursing practice	0.000	0.999
Evaluation	Years of nursing practice	-0.274	0.054
Inductive Reasoning	Years of nursing practice	-0.109	0.453
Deductive Reasoning	Years of nursing practice	-0.095	0.512

Note. $n = 50$.

When grouping the years of experience into five year intervals using the CCTST as the dependent variable, no statistically significant relationships were found between the overall score on the CCTST-- $\chi^2(6, N = 50) = 4.162, p = 0.655$ and years of nursing experience. Breaking this down further into the subscale scores of analysis--

$\chi^2(6, N = 50) = 3.073, p = 0.800$, inference-- $\chi^2(6, N = 50) = 4.664, p = 0.588$,

evaluation-- $\chi^2(6, N = 50) = 4.851, p = 0.563$, inductive reasoning--

$\chi^2(6, N = 50) = 3.886, p = 0.692$, and deductive reasoning--

$\chi^2(6, N = 50) = 5.304, p = 0.505$ and years of nursing experience also demonstrated no

statistically significant relationships. When grouping the participants into 10 year

intervals, no statistically significant relationships were found between the CCTST--

$\chi^2(3, N = 50) = 1.023, p = 0.796$ overall and years of experience. Breaking down the

CCTST subscales and years of experience also demonstrated no statistically significant

relationships. The findings in the areas were as follows: analysis--

$\chi^2(3, N = 50) = 1.539, p = 0.673$, inference-- $\chi^2(3, N = 50) = 1.696, p = 0.638$,

evaluation-- $\chi^2(3, N = 50) = 3.572, p = 0.311$, inductive reasoning--

$\chi^2(3, N = 50) = 1.944, p = 0.584$, and deductive reasoning--

$\chi^2(3, N = 50) = 0.805, p = 0.848$. These results are shown in Table 23.

Table 23 demonstrates that the p -values of all the Kruskal-Wallis tests conducted were above the critical value of 0.05, indicating that years of experience did not have a significant effect on CCTST overall scores or on any of the scores on the subscales.

To evaluate the relationship between the CCTST results and area of nursing experience, the following four groups were identified: inpatient (28 participants), critical care (13 participants), outpatient care (8 participants), and none (1 participant). One way Analysis of Variance using the overall CCTST score and area of nursing experience found no statistically significant relationships between the CCTST overall-- $F(3,46) = 0.985, p = 0.408$ and area of nursing experience. Breaking down the CCTST subscales and area of nursing experience also demonstrated no statistically significant relationships.

The findings in the areas were as follows: analysis-- $F(3,46) = 1.139, p = 0.343$, inference-- $F(3,46) = 1.092, p = 0.362$, evaluation-- $F(3,46) = 0.766, p = 0.519$, inductive reasoning-- $F(3,46) = 0.472, p = 0.703$, and deductive reasoning-- $F(3,46) = 1.860, p = 0.150$. These results are shown in Table 24.

Table 23

Years of Experience and CCTST

Grouping Variable	Dependent Variable	χ^2	p -value
Years of experience grouped by 5	CCTST	4.162	0.655
	Analysis	3.073	0.800
	Inference	4.664	0.588
	Evaluation	4.851	0.563
	Inductive Reasoning	3.886	0.692
	Deductive Reasoning	5.304	0.505
Years of experience grouped by 10	CCTST	1.023	0.796
	Analysis	1.539	0.673
	Inference	1.696	0.638
	Evaluation	3.572	0.311
	Inductive Reasoning	1.944	0.584
	Deductive Reasoning	0.805	0.848

Note. $n = 50$.

Table 24

Nursing Experience and CCTST Overall Scores

Grouping Variable	Dependent Variable	<i>F</i>	<i>p</i> -value
Area of Nursing Experience	CCTST	0.985	0.408
	Analysis	1.139	0.343
	Inference	1.092	0.362
	Evaluation	0.766	0.519
	Inductive Reasoning	0.472	0.703
	Deductive Reasoning	1.860	0.150

Note. n = 50.

Results of the statistical analysis procedures of correlation and analysis of variance as described above led to the rejection of the fourth hypothesis which stated that professional work experience of the NP student as a registered nurse would have some influence on the NP students' scores and sub-scores on the California Critical Thinking Skills Test.

Summary of Results

In summary, preliminary determination of the normalcy of data was conducted to determine the appropriate statistical evaluation tools to use in the analysis of data. Reliability assessment of the tools was undertaken with the CCTST and preceptor clinical evaluation tool demonstrating adequate internal consistency. The CDMSN demonstrated fair internal consistency and the exam style questions did not demonstrate adequate

internal consistency. These evaluations used Cronbach's alpha and Kuder-Richardson 20 as appropriate.

Evaluation of each hypothesis was conducted using Pearson correlation for hypotheses 1, 2 and 3 in which complete data sets were present for all 50 participants. Analysis of variance was used to evaluate hypothesis 4. In the analysis of hypothesis four, three preceptor evaluations were never completed in spite of multiple reminders. No significant relationships were found between: CCTST, CCTST subscale scores and exam style questions; CCTST overall score, CCTST subscale scores and CDMNS; CCTST overall score, and CCTST subscale scores and preceptor clinical evaluation tool. Years of experience was found to have no significant effects on the overall CCTST score or any of the scores on the CCTST subscales.

These results led to the rejection of all four hypotheses. This rejection then led to the answer of NO to the research question, "Is there a relationship between critical thinking skills and clinical judgment in nurse practitioner students?" The rejection of all hypotheses and the research question were within the limitations of the study: the small sample size, the context of the tool administration, difficulty in obtaining sufficient number of participants who met study guidelines, and the reliability of the tools.

CHAPTER V

DISCUSSION OF RESULTS

Overview

The purpose of this study was to investigate the relationship between critical thinking skills and clinical judgment in the nurse practitioner (NP) student. While this study found no statistically significant relationships between critical thinking and clinical judgment skills in NP students, it provided some interesting perspectives on these two topics. This chapter presents some brief background information related to the context of the overall research question and the four hypotheses. Within the discussion of each hypothesis, the statistical findings are reviewed. Further statistical evaluation of the data, the findings of this study as compared to those reported in the literature, and perspectives related to the educational process and evaluation of NP students are also shown. A brief summary of the overall findings of this study will then be presented.

Introduction

Upon entering practice, the NP is required to use clinical judgment on a daily basis as he/she makes decisions regarding patient care. Decision-making in a patient care arena is complex, involving the ability to think analytically or critically related to the patients' current condition and make judgments about their care (Brooks & Shepherd, 1990; del Bueno, 1994, 2005; Ford & Profetto-McGrath, 1994; Paul & Heaslip, 1995). For a practicing NP, each patient presents a unique set of circumstances, symptoms, and

context upon which a clinical decision is based. The NP will have to evaluate each fact, all the data presented and gathered, and determine which information is most important to focus on as he/she makes appropriate clinical decisions. This can involve determining which information is most important and which information has no bearing on the current problem as he/she works toward making a decision using their clinical judgment.

Knowing that clinical decision-making is a key component of the role of the NP, the question of the relationship between critical thinking skills and clinical judgment in NP students was investigated. If NPs use critical thinking skills and clinical judgment as they care for patients, then the educational programs for NP students should work to prepare the students in the areas of critical thinking and clinical judgment. This concept drove the research question for this study.

Q1 Is there a relationship between critical thinking skills and clinical judgment in nurse practitioner students?

This question was evaluated by the following four research hypotheses.

- H1 NP students who demonstrate higher scores on the California Critical Thinking Skills Test will also demonstrate more accuracy in the formulation of differential diagnoses as determined by their results on the exam style questions.
- H2 NP students who demonstrate higher scores on the California Critical Thinking Skills Test will also demonstrate higher scores on the evaluation and reevaluation of consequences subscale of the Clinical Decision-Making in Nursing Scale.
- H3 NP students who demonstrate higher scores on the California Critical Thinking Skills Test will also demonstrate more accuracy in the formulation of differential diagnosis as determined by the preceptor clinical evaluation tool.
- H4 Professional work experience of the NP student as a registered nurse will have some relationship to the NP students' scores and sub-scores on the California Critical Thinking Skills Test.

Within the literature, a substantial amount of research examined the process of critical thinking within baccalaureate nursing students (Alfaro-LeFevre, 2008; Brunt, 2005; Dickerson, 2005; Girot, 2000; Niedringhaus, 2001; Paul & Heaslip, 1995; Riddell, 2007; Suliman, 2006; Turner, 2005). However, there was limited literature related to critical thinking among graduate nursing students. This lack of literature was troublesome as the process of using clinical judgment to formulate a differential diagnosis requires the NP or physician to think critically about the situation when providing patient care (Levin et al., 2004; Van Puymbroeck et al., 2003; Windish et al., 2005).

Hypothesis One

H1 NP students who demonstrate higher scores on the California Critical Thinking Skills Test will also demonstrate more accuracy in the formulation of differential diagnoses as determined by their results on the exam style questions.

Statistical evaluation of this hypothesis demonstrated that there was no correlation between the overall score on the CCTST ($r = 0.073$, $p = 0.617$) and the exam style questions. Further evaluation of the relationship between the CCTST subscale scores of analysis subscale ($r = -0.106$, $p = 0.465$), inference subscale ($r = 0.174$, $p = 0.183$), evaluation ($r = 0.002$, $p = 0.987$), inductive reasoning ($r = 0.002$, $p = 0.988$), and deductive reasoning ($r = 0.122$, $p = 0.400$) demonstrated that there was no significant relationship between any of the subscales and exam style questions used in this study.

The CCTST tool was selected to measure critical thinking skills and has demonstrated long term reliability within the literature and also in this study. The Cronbach's alpha for the CCTST in this study was 0.809, indicating good reliability. The exam style questions used in the study were selected based upon content, requirement of synthesis, and the strength of the Biserial. The reliability of the exam style question tool

found that the Kuder-Richardson 20 was 0.443, indicating that this tool was not reliable to use. In the selection of exam style questions to be included in the study, point Biserial was obtained from prior use of the questions. The questions were selected based on acceptable ranges of point-biserial values. However within this study, when using the guideline of having a point-biserial value of 0.15 at a minimum, four questions would need to be carefully reevaluated for future use (Varma, n.d.). The lack of reliability as demonstrated by the Kuder-Richardson 20 and point-biserial results may have affected the statistical analysis of this hypothesis in a negative manner.

When evaluating the CCTST results, it was found that there were two scores that could be considered to be outlying in the CCTST results. These scores were a 1 and 2 for the overall CCTST results. Subscale results for these two participants could also be considered outliers. One of these participants was known to not have English as a first language (score 1) and the second participant (score 2) was considered to have answered the questions quickly in a random manner. When correlation analysis for the first hypothesis was performed without these two outlying scores, it was demonstrated that there was no relationship between the CCTST ($r = 0.090, p = 0.542$) and the exam style questions. Using the CCTST subscale scores of analysis ($r = -0.128, p = 0.385$), inference ($r = 0.202, p = 0.169$), evaluation ($r = 0.007, p = 0.962$), inductive reasoning ($r = 0.008, p = 0.956$), and deductive reasoning ($r = 0.137, p = 0.353$), it was again demonstrated that there was no significant relationship between any of the subscales and exam style questions used in this study when the two CCTST outlier overall scores of 1 and 2 were removed from data analysis.

Another factor that may have impacted the results was related to the content that was assessed via the exam style questions. The content of these questions was related to general medical care (3), prenatal (2), orthopedics (4), and eye care (1). If the participant had not been exposed to specific content areas prior to participating in the study, they may have been at a disadvantage when attempting to correctly answer the exam style questions. The lack of exposure to content might explain the concerning point-biserial (-0.056 with a p-value of 0.75) of one question related to prenatal content. The concern with lack of exposure to content might have contributed to overall results that were not as good as expected on the exam style questions. While this was a concern, it did not minimize the issue of reliability of the exam style question tool.

Additional consideration given to this area related to the lack of consequences for not selecting a correct response to the exam style question. In a course, a correct or incorrect answer on the exam style question directly impacts the grade the student earns. In this study, providing a correct or incorrect answer did not have an impact on the outcome for the participant. This might have created an environment where a number of study participants answered the questions with some thought but not with the same consideration for a course where they earned a grade.

A further confounding aspect might have been the brevity of the exam style questions. One manner used to increase reliability and point-biserial is that of having more questions in the tool. By increasing the number of questions asked of the study participants, the option to discard questions with poor point-biserial results might have been present. This then might have increased the overall reliability of the tool and the

ability of the tool to correctly assess the participants' ability to determine the appropriate response to the question.

Within the limitations of the findings in this study related to hypothesis one, important questions related to assessment of NP student knowledge and their ability to think critically in a clinical situation to make clinical decisions using their clinical judgment were raised. Did the use of exam style questions accurately assess the NP students' ability to think critically in a clinical situation and use clinical judgment to reach a correct conclusion? If the answer is no, then alternative methods of assessing the ability of the NP student to think critically in a clinical situation using clinical judgment should be investigated.

While exam style questions are used to assess NP graduate knowledge in certification exams, is there an alternative to exam style questions when assessing the NP student's ability to use clinical judgment when selecting a correct plan of care for a patient? This alternative would still need to prepare the NP graduate for certification exams but would also need to accurately assess their clinical judgment ability. However, noting the limitations of this tool within the study, one should be cautious when considering an alternative approach to assessment of the NP students' ability in the area of clinical judgment as related to exam style questions.

In summary relative to hypothesis one, the findings of this study were not statistically significant; the exam style question tool lacked appropriate reliability within the study. Questions related to the appropriateness of using exam style questions to assess NP student ability to use clinical judgment were raised. However, these concerns need to

be noted within the context of this small study and should not be applied to larger settings without further research in this area.

Hypothesis Two

H2 NP students who demonstrate higher scores on the California Critical Thinking Skills Test will also demonstrate higher scores on the evaluation and reevaluation of consequences subscale of the Clinical Decision-Making in Nursing Scale.

Statistical evaluation of this hypothesis demonstrated that there was no correlation between the overall score on the CCTST and the evaluation and reevaluation subscale of the CDMNS ($r = 0.011$, $p = 0.940$) demonstrates that there was no significant relationship between the two variables. Further evaluation of the CCTST subscales was also computed and it was determined that there was no significant relationship between analysis ($r = -0.010$, $p = 0.948$), inference ($r = 0.035$, $p = 0.810$) evaluation ($r = -0.052$, $p = 0.718$), inductive reasoning ($r = -0.044$, $p = 0.759$), and deductive reasoning ($r = 0.066$, $p = 0.649$).

Reliability testing of the CCTST demonstrated that in this study, the tool was quite reliable. However, the reliability of the CDMNS subscale of evaluation and reevaluation tool ($\alpha = 0.670$) was below the acceptable range, which might have caused the results of the statistical analysis to be skewed. However, the reliability of the overall CDMNS tool ($\alpha = 0.738$) was noted to be within the acceptable range. The reliability finding from this study was below the reported reliability ($\alpha = 0.83$) by Jenkins in 1985.

When considering why the reliability of this tool was different from that reported in the literature, consideration was given to the testing instructions. The directions on how to respond to the 40 questions asked the student participant to respond related to what they were doing in the clinical setting presently (Jenkins, 1985). This may have

created some confusion as to which role (the professional nurse or the student NP) they were to consider when responding to the questions. The lack of clarity for the student participants to respond to the questions related to their role as a student NP may have impacted the manner in which the participant responded. It is not known if the responses provided were within the context of practice as a registered nurse or practice as a student NP.

When initially evaluating the CDMSN tool and the subscales, the questions present within the evaluation and reevaluation subscale were in closest alignment with the concept of critical thinking related to clinical decision-making. The other three subscales--search for alternatives and options, canvassing of objectives and values, and search for information and unbiased assimilation of new information--did not directly address the process of evaluation and analysis that the NP should use when using clinical judgment to make clinical decisions. Jenkins (1985) did not report reliability for any of the subscales of the CDMNS tool.

The findings of this study are in contrast to the work of Bowles (2000) who discovered a significant positive relationship between critical thinking skills and clinical judgment in the undergraduate nursing student. That study used both the CCTST and the CDMNS tools. Resultant findings indicated a significantly positive relationship between the two ($r = 0.21, p < 0.05$; Bowles). Analysis of the CCTST sub scores and scores on the CDMNS found that within this population, inductive reasoning ($r = 0.27, p < 0.05$) and inference ($r = 0.23, p < 0.05$) were significant predictors of clinical judgment (Bowles).

Evaluating the overall CCTST score that was reported by Bowles (2000) against the overall CCTST score found in this study demonstrated different results. In Bowles'

study, the range of scores was from 8 to 27 with a mean of 18.2 and a standard deviation of 4.2. This study found the CCTST overall score to have a range of 1 to 28, a mean of 16.0, and a standard deviation of 5.7. When removing the two lowest CCTST overall scores--a total score of 1 and 2, the range was from 6 to 28, the mean was 17.04, and the standard deviation was 4.92. Upon further statistical evaluation of the CCTST overall, and the CDMNS tool was investigated with the removal of these values, no statistically significant relationships were found. The relationship between CCTST overall, without the two lowest scores, and the total CDMNS ($r = -0.030$, $p = 0.838$) found in this study was quite different from the reported results of Bowles. When evaluating the CCTST scores in inference ($r = 0.001$, $p = 0.997$) and inductive reasoning ($r = -0.074$, $p = 0.619$) with the total CDMNS score, again no statistically significant relationship was found. Statistical evaluation of the relationship between the CCTST overall score and the total CDMNS score ($r = 0.157$, $p = 0.276$) also demonstrated results that were different from those reported by Bowles.

Possible explanations for the different outcome were as follows: (a) the undergraduate participants had a different perspective on participating in research than the participants in the current study; (b) use of the tools with a graduate population that already holds a nursing license; and (c) the environment in which the tool was completed. Undergraduate students may have a better understanding of the importance of research as they are presently within an academic environment where research is discussed in a different manner than in the practice environment. In the advanced practice academic setting, students are increasingly exposed to evidence based practice, current research related to nursing practice, and are utilizing current research in their clinical practice and

in the writing of papers for courses. This is in contrast to practice where nurses may not understand the reasoning behind a change in policy and/or procedure that is based upon best practice or research. The practicing nurse may not remember that changes develop from new advances in nursing research. They know and understand that the change will mean something different in their practice. While the use of research is increasing within the practice environment, comments such as “but that’s the way we have always done it” are still frequently heard.

For those holding a nursing license and practicing, the steps involved in clinical decision-making may have become more of an automatic or subconscious response. When compared to undergraduate nursing students who are seeking entry into practice, the clinical decision-making process may be more structured and intentional. These two populations are in different places in their professional practice. On Benner’s (2001) continuum, the undergraduate student entering practice is at the novice level while the graduate student who holds a nursing license is at a level above the novice. The differences in practice and how decisions are made between the student and practicing nurse might have impacted the results on the CDMNS tool. One population is very aware of their clinical decision-making process and the other population has to stop and evaluate what they do in their clinical decision-making process.

The last consideration is that of the environment where the tool was completed. If an individual feels rushed to complete the tool, they may not give appropriate thought to the questions asked of them. If there is an environment that is quiet, without distractions and allows for ample time for tool completion, the individual has the opportunity to carefully think about the question and the response. This does not always occur, but it is

possible that this may have occurred in this study. Participants in this study completed the online tools in an environment of their choosing. The researcher did not have any knowledge of the environmental conditions or the impact of the environment on the responses provided to the questions.

In summary relative to hypothesis two, the findings of this study were in contrast to the findings of similar studies in the literature. As nurse educators and nurse researchers, it becomes important to seek out appropriate evaluation tools to not only assess the ability of the student, but to also meet established benchmarks. It also becomes important to encourage all students to not only participate in nursing research to further the science, but also to stress the importance of participation in a focused and serious manner. One way to encourage this is to provide potential study participants with some recognition for their participation within the academic setting. While this may be difficult to achieve, it may, however, increase the numbers of individuals willing to and who actively participate in nursing research.

Hypothesis Three

H3 NP students who demonstrate higher scores on the California Critical Thinking Skills Test will also demonstrate more accuracy in the formulation of differential diagnosis as determined by the preceptor clinical evaluation tool.

Statistical evaluation of this hypothesis demonstrated that there was no correlation between the overall score on the CCTST ($r = 0.153$, $p = 0.306$) and the preceptor clinical evaluation tool. When evaluating the reliability of both tools, Cronbach's alpha for the CCTST ($\alpha = 0.809$) and the preceptor clinical evaluation tool ($\alpha = 0.917$) indicated that both tools were reliable. Further evaluation to assess if there was any relationship between the CCTST subscales and the preceptor evaluation was also undertaken. Pearson

correlation testing demonstrated no relationship between the subscale scores of analysis ($r = 0.221, p = 0.135$), inference ($r = 0.098, p = 0.512$), evaluation ($r = 0.148, p = 0.322$), inductive reasoning ($r = 0.144, p = 0.334$), deductive reasoning ($r = 0.154, p = 0.300$), and scores on the preceptor evaluation tool. Statistical analysis of this hypothesis after removal of the lowest two scores on the CCTST also demonstrated no significant relationship. When the lowest scores on the CCTST were removed, the relationship between the overall CCTST score ($r = 0.151, p = 0.323$) and the subscale scores of analysis ($r = 0.234, p = 0.122$), inference ($r = 0.085, p = 0.581$), evaluation ($r = 0.140, p = 0.358$), inductive reasoning ($r = 0.139, p = 0.363$), deductive reasoning ($r = 0.150, p = 0.352$), and scores on the preceptor evaluation tool remained non-statistically significant. The preceptor evaluation tool was used to assess the ability of the NP student to formulate differential diagnoses within the clinical setting.

The differential diagnosis is seen as both an endpoint and starting point in the clinical decision-making process. Nurse Practitioners (NP) are expected to demonstrate clinical decision-making skills as they develop a differential diagnosis for patients. The decision-making process is complex, involving a systematic and organized approach to the problem at hand (Hemaida & Kalb, 2001; Millet, 1998; Saaty, 2008). This has not been considered to be a simple task for the healthcare provider (Papa et al., 2007) and it is one that should be worked on and developed both in the classroom and clinical setting while the NP student is attending school. Further literature has provided anecdotal information related to the ability of NP students to use clinical judgment to formulate a differential diagnosis. However, no research to measure this ability has been found within the literature. The findings of this study-- that there is no statistically significant

correlation between critical thinking skills and clinical judgment as assessed by the preceptor evaluation tool--perhaps highlight how difficult it has been to appropriately assess the abilities of NP students in these areas.

While this study did not demonstrate any statistically significant correlation between the preceptor evaluation tool and the CCTST scores, it did highlight that the preceptor evaluation tool, within the context of this study, had the highest reliability of any of the tools used. This unanticipated finding causes one to think about evaluation of the NP student and how clinical environments have the potential to provide reliable feedback related to the ability of the NP student to use clinical judgment as they make clinical decisions.

Another area of interest brought to light by this study was the need for tools that appropriately assess critical thinking skills and the ability to formulate differential diagnosis in the NP student population. Is there a better way to assess the NP students' ability to correctly formulate a differential diagnosis than via the use of preceptor feedback? Should a nationally standardized format be developed and used to gather information related to the ability of the NP student to formulate differential diagnoses? Would the use of simulation and standardized patients provide controlled environments where the student could be objectively assessed on their ability to formulate a correct differential diagnosis? While some of the questions have no apparent answer at the present, the need for further research in this area is great.

As nurse educators, it is important to appropriately assess the ability of the NP student to formulate appropriate differential diagnosis as they provide patient care. As nursing education seeks to evaluate the ability of the NP student, the development of

appropriate learning environments and tools to accurately measure the ability to use clinical judgment as the NP student formulates correct and appropriate differential diagnoses is important. As nursing education works to meet the increased demand for primary care providers, the quality of the educational process should be maintained or increased. The results of this study have demonstrated that the relationship between preceptor feedback and critical thinking skills were not statistically significantly correlated. If an outcome of the NP educational process is to develop and enhance the ability of the NP student to think critically related to clinical judgment (Coles, 2002; Tanner, 2006), there should be appropriate tools to assess and measure these areas.

In summary, the lack of statistically significant correlation results related to CCTST scores and preceptor feedback was found within this study. However, the results of this small study should be used with caution when considering implementing change related to evaluation tools. The preceptor feedback tool used in this study might have been subjective, reflecting interpersonal relationships and not the ability of the student. Some of the participants might not have given their best effort in answering the questions on the CCTST tool. Another aspect to consider is that of the exposure and knowledge of content area where the clinical experience was occurring. For example, if the participant had limited knowledge in the area of pediatrics, yet was evaluated by the preceptor from a pediatric setting, the outcome of the preceptor evaluation tool might reflect the lack of knowledge and not be reflective of the ability of the NP student to formulate appropriate differential diagnoses. All of these scenarios could have contributed to outcome scores that were not an accurate reflection of the ability of the participant and the subsequent statistical analysis.

Hypothesis Four

H4 Professional work experience of the NP student as a registered nurse will have some relationship to the NP students' scores and sub-scores on the California Critical Thinking Skills Test.

The first area of assessment for this hypothesis was in number of years worked as a nurse compared to the results on the CCTST. Correlational analysis between years of nursing experience and the CCTST results demonstrated no statistically significant relationship between the overall CCTST score and years of experience ($\rho = -0.101, p = 0.487$). Further correlational evaluation of the CCTST subscales of analysis ($\rho = 0.109, p = 0.451$), inference ($\rho = 0.000, p = 0.999$), evaluation ($\rho = -0.274, p = 0.054$), inductive reasoning ($\rho = -0.109, p = 0.453$), deductive reasoning ($\rho = -0.095, p = 0.512$), and years of nursing practice also found no statistically significant relationships.

When evaluating the relationship between the CCTST results and area of nursing experience, four groups were used in the statistical analysis: inpatient (28 participants), critical care (13 participants), outpatient care (8 participants), and none (1 participant). One way Analysis of Variance was calculated using the overall CCTST score and area of nursing experience and found no statistically significant relationships between the CCTST overall-- $F(3,46) = 0.985, p = 0.408$ and area of nursing experience. Breaking down the CCTST subscales and area of nursing experience also demonstrated no statistically significant relationships. The findings in the areas were as follows: analysis-- $F(3,46) = 1.139, p = 0.343$; inference-- $F(3,46) = 1.092, p = 0.362$; evaluation-- $F(3,46) = 0.766, p = 0.519$; inductive reasoning-- $F(3,46) = 0.472, p = 0.703$; and deductive reasoning-- $F(3,46) = 1.860, p = 0.150$.

While no statistically significant relationships were found between area of nursing practice experience and scores on the CCTST and its subscales, the graphs of the analysis revealed interesting findings. The 13 participants in Group 2--the critical care nursing experience group--had the highest means in the areas of overall score (18.69), analysis (5.00), evaluation (5.15), and inductive reasoning (10.77) of the CCTST. The group with no nursing practice experience (1 participant) had the highest mean in the areas of inference (10.0) and deductive reasoning (8.00). While these results were not found to be statistically significant, they demonstrated that those participants who had critical care nursing experience had higher scores on the CCTST in the areas of overall score, analysis, evaluation, and inductive reasoning. However, with the power analysis of 0.41 and with the lack of statistically significant findings, no conclusions could be drawn from these results.

Figure 2 is a representation of the mean overall CCTST score in relationship to the area of nursing practice experience. While not statistically significant, the mean score of those with critical care experience nursing practice experience (13 participants) was higher than the mean CCTST score for those with nursing practice experience in the areas of inpatient and outpatient nursing practice areas. The second highest score in this analysis was from the group (1 participant) who had no nursing practice experience. Even when analyzing the data without the group with no nursing practice experience, there was no statistically significant relationship-- $F(2,46) = 1.438, p = 0.248$ between area of nursing practice experience and the mean overall CCTST score.

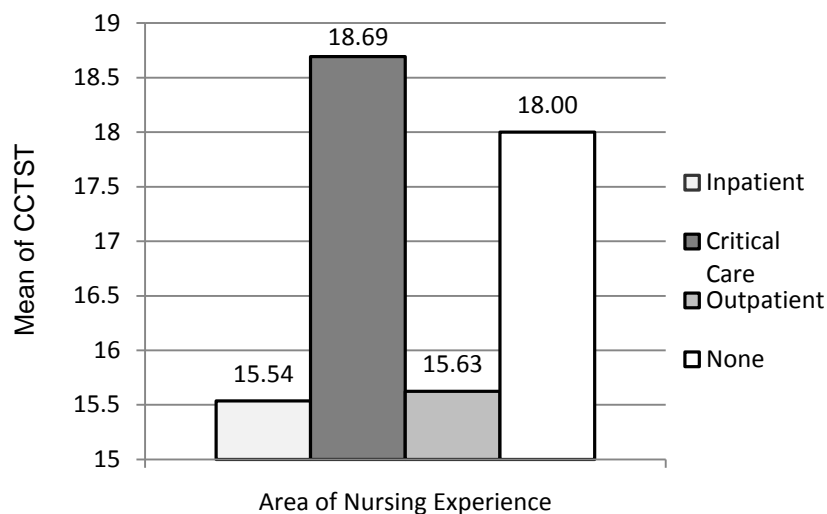


Figure 2. Mean of overall score on CCTST and Area of Nursing Practice Experience; $n = 50$.

When evaluating the mean score of the analysis subscale of the CCTST and the areas of nursing practice experience, it was found that those participants who had critical care nursing practice experience (13 participants) had a higher mean score in analysis than the remainder of the 37 participants. When removing the group with no nursing practice experience, ANOVA demonstrated also no statistically significant relationship between the analysis subscale score-- $F(2,46) = 1.282, p = 0.287$ and areas of nursing practice experience.

Statistical analysis via ANOVA to evaluate the mean of inference subscale scores on the CCTST and areas of nursing practice experience demonstrated that the group with no nursing practice experience (1 participant) had a higher mean than all other participants. When removing the group with no nursing practice experience from the statistical analysis, again there was no statistically significant relationship between the

mean of the inference subscale score-- $F(2,46) = 1.223, p = 0.304$ relative to the area of nursing practice experience.

Although no statistically significant relationships were found between area of nursing practice experience and critical thinking skills, it was interesting to note that the group with critical care nursing practice experience scored higher in four of the areas of the CCTST and the subscales when comparing the four groups. When the group of no nursing practice was removed from the statistical analysis, again no statistically significant relationships were found but the group with critical care nursing practice experience demonstrated that their mean scores on the CCTST and the subscales were the highest among the groups. These results are similar to those found by Aitken (2003). In that study, it was determined that critical care nurses with more experience tended to be continuously evaluating and reevaluating their effectiveness in interventions for the patients. Although no statistically significant differences were found in this present study, it raised the question, which goes beyond this study, of the impact of nursing practice experience on the critical thinking skills of the NP student.

Years of Nursing Experience, California Critical Thinking Skills Test Scores, and Subscale Scores

Further statistical evaluation using Kruskal-Wallis analysis demonstrated no statistically significant relationship between years of nursing experience grouped into 5- and 10-year groups as compared to CCTST scores and the subscale scores. When grouping the years of experience into 5-year intervals, using the CCTST as the independent variable, no statistically significant relationships were found between the overall score on the CCTST-- $\chi^2(6, N = 50) = 4.162, p = 0.655$ and years of nursing

experience. The analysis did not demonstrate statistically significant results. These results are noted in Figure 3.



Figure 3. CCTST means and Years of Nursing Experience, 5 year group.

Breaking this down further to the subscale scores of analysis--

$\chi^2(6, N = 50) = 3.073, p = 0.800$; inference-- $\chi^2(6, N = 50) = 4.664, p = 0.588$;

evaluation-- $\chi^2(6, N = 50) = 4.851, p = 0.563$; inductive reasoning--

$\chi^2(6, N = 50) = 3.886, p = 0.692$, deductive reasoning--

$\chi^2(6, N = 50) = 5.304, p = 0.505$; and years of nursing experience also demonstrated no

statistically significant relationships. When grouping the participants into 10-year

intervals, no statistically significant relationships were found between the CCTST--

$\chi^2(3, N = 50) = 1.023, p = 0.796$ overall and years of experience. The outcome of this

analysis is demonstrated in Figure 4.



Figure 4. CCTST means and Years of Nursing Experience, 10 year group.

Breaking down the CCTST subscales and years of experience into 10-year increments also demonstrated no statistically significant relationships. The findings in the areas were as follows: analysis-- $\chi^2(3, N = 50) = 1.539, p = 0.673$; inference-- $\chi^2(3, N = 50) = 1.696, p = 0.638$; evaluation-- $\chi^2(3, N = 50) = 3.572, p = 0.311$; inductive reasoning-- $\chi^2(3, N = 50) = 1.944, p = 0.584$; and deductive reasoning-- $\chi^2(3, N = 50) = 0.805, p = 0.848$.

The results of the statistical analysis evaluating years of nursing experience and CCTST scores demonstrated some differences in the means of the overall CCTST scores and years of nursing experience. However, these differences within this study were not significant. In the analysis of the 5-year and 10-year increment groups, the first and last groups were represented by only one participant, which might have impacted data analysis and conclusions reached. When removing the outlying groups, there continued to be no statistically significant difference between the means of the overall CCTST score,

the scores on the subscales of the CCTST, and years of experience. The individuals with 1-5 years of nursing experience had the highest means on the overall CCTST and subscale scores when compared to the other participants. This same result was noted in the 1-10 years of nursing experience analysis of the data.

Overall, it was found that the participants in this study demonstrated no statistically significant relationships between years of nursing experience and the overall CCTST mean and the mean of the subscale scores on the CCTST. In this study, these findings indicate that the participants with less than 10 years of nursing experience had better critical thinking skills than the remainder of the participants. While these findings cannot be generalized to the national FNP student population, it raises the question of requiring a specific number of years of nursing experience prior to entering into an advanced practice educational program. In the review of literature, there were no studies that supported the idea of a specific number of years of nursing experience as a prerequisite for the FNP educational programs. The present study did not find statistically significant relationships between years of experience and years of nursing experience. However, the question remains as to the optimal years of nursing experience that should be recommended for those entering into advanced practice educational programs.

Years of Practice and Clinical Decision-Making in Nursing Scale

Additional statistical testing was undertaken in this study to evaluate the relationship between years of practice and the CDMNS overall score and the CDMNS subscale of evaluation and reevaluation score to compare the findings from this study with those of Ferrario (2003). The work of Ferrario found that experienced nurses integrated prior knowledge into patient care more frequently than did less experienced

nurses. Using correlation analysis with the data from this study to evaluate the findings against those of Ferrario, no statistically significant relationship was found between years of nursing practice and clinical decision-making related to evaluation and reevaluation ($r = 0.044$, $p = 0.761$) as measured by the subscale on the CDMNS tool. Analysis of the overall score on the CDMNS tool and years of nursing practice also found no significant statistical correlation ($r = 0.142$, $p = 0.326$). The lack of similar results to those reported in the literature could be due to the use of different tools and the difference in the nursing environment of practice of the participants. However, the closing statement of Ferrario's (2003) work supported additional evaluation of nursing educational assessment tools in a range of settings with a variety of individuals representing differing nursing practice environments and experiences.

In the field of physical therapy, Noll et al. (2001) found that clinical decision-making improved with experience. The findings from this present study did not support the premise that clinical decision-making in NP students was better in those with more nursing practice experience. This finding was not anticipated as much of the literature has supported the idea of increased experience leads to improved decision-making (Cioffi, 1998; Groves et al., 2003). However, the findings of no significant relationship existing between experience and decision-making by Hoffman et al. (2004) are consistent with the findings of this present study. In summary, prior reported research is both in conflict with and in agreement with the findings of this present study. This conflict indicates the need for more research focusing on the impact of experience on clinical decision-making in the NP student population.

In summary, statistical analysis for hypothesis four demonstrated that within this study, there was no correlation between years of nursing experience and the scores on the CCTST and its subscales. Analysis of variance (ANOVA) found there may be some impact of nursing practice experience environment on the outcomes of the CCTST scores and the scores on the CCTST subscales but it was not statistically significant in this study. Additionally, with the small sample size and subsequent post-hoc power analysis, no conclusions could be reached related to the relationship between areas of nursing practice and CCTST scores or the CCTST subscale scores. Thus, further research could be considered that would statistically evaluate equal number of individuals in each group of the areas of nursing practice experience, and the mean CCTST and subscale scores to determine if there is a statistically significant relationship between these areas.

Theoretical Framework

For this study, the framework of Analytic Hierarchy Process (AHP) was chosen as the model for problem solving and decision-making making related to critical thinking. AHP was the umbrella for solving problems, requiring the decision maker to use critical thinking as they make decisions. The model below demonstrates the relationship between the conceptual framework of AHP, critical thinking skills, clinical judgment, and clinical decision-making making that guided this study.

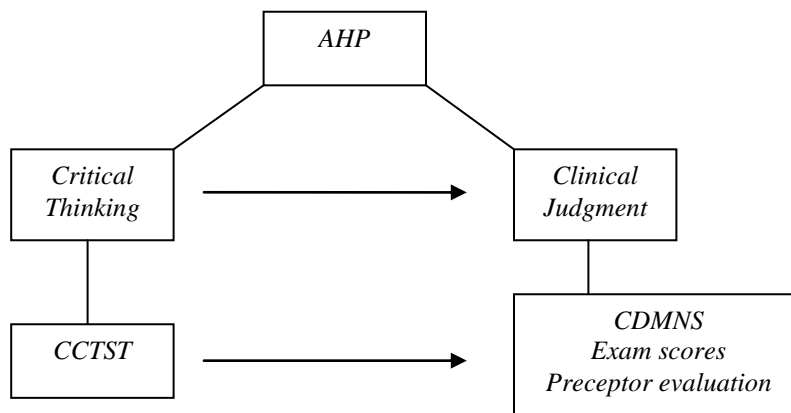


Figure 5. Review of analytic hierarchy process.

According to Saaty (2006), the AHP is a decision-making model that takes complex problems, breaks them into smaller units, and allows for the evaluation of each unit in the decision-making process. For the NP, each day is filled with many decisions, some very complex, requiring much effort to analyze and synthesize the data into meaningful pieces to reach a clinical decision; others may require less effort to reach a clinical decision. The formal steps of decision-making within the AHP framework are very similar to the clinical decision-making process that a NP will use when making clinical decisions. The problem is first defined, the ultimate outcome is defined, a comparison of all elements is made, and a weighting process is used to obtain overall priority for each element. For example, with the diagnosis of chest pain, the goal of the NP is to reduce the chest pain to acceptable levels. For some individuals, weight, diet, behavior patterns, use of tobacco, and emotional factors may all play a part in contributing to the chest pain. Each of these areas should be addressed; however, the first priority is reducing the chest pain in the most effective and timely manner.

The theoretical framework for this study, with AHP used as the umbrella and critical thinking as a key component of the problem solving process, fits well within the scope of practice and responsibilities of the NP. The ability of the NP to think critically related to all the factors contributing to the current health care problem of the patient is important. The NP must gather data, evaluate which data are pertinent to the current problem, analyze that data, and then use reasoning to make a clinical judgment. The process described uses critical thinking skills to reach a diagnosis. To reach the diagnosis, the NP must use clinical judgment as he/she considers all the possibilities. The model chosen for this study fits well with the clinical decision-making processes the NP uses on a daily basis. What is unclear is how to best measure critical thinking and clinical judgment.

If the tools used to assess critical thinking and clinical judgment were not appropriate and careful evaluation of how the tools impacted the theoretical framework was not undertaken, one may reject the theoretical framework used in this study. With careful evaluation of the tools and the outcomes obtained from those tools, the conclusion of not rejecting the theoretical framework becomes a reality. However, if the results obtained from the tools are accurate measurements of the abilities of the student participants, the theoretical framework should be rejected.

The tool used to measure critical thinking skills, the CCTST, has been tested over time and has been shown to be reliable as evidenced by the aggregated KR-20 of 0.78-0.82. Within this study, the CCTST demonstrated a Cronbach's alpha of $\alpha=0.809$, indicating that the tool was consistent in measuring critical thinking skills. The CCTST has been shown to correlate strongly with the Graduate Record Exam (GRE) total

(0.719), the GRE Analytic (0.708), and the GRE Verbal (0.716) scores (Facione et al., 2000). When evaluating tools to measure critical thinking skills, only the CCTST was able to demonstrate long term reliability and validity; thus, it was selected for use.

Within the theoretical framework chosen for this study, the results from the tool used to assess critical thinking might have impacted the overall outcome of the research process and the overall answer to the research question. Evaluation of the percentile rank of the scores on the CCTST for the student participants of this study demonstrated a range of 1 to 87 with a mean of 38.81, indicating that the average result from this test was below the 50th percentile when compared to the national aggregate of graduate students. Seven student participants were below the 10th percentile and 13 student participants were below the 20th percentile, causing one to wonder if the effort applied when taking this tool was typical for the graduate student. With the reported results of correlation analysis of the CCTST and GRE scores (0.719), one might conclude that some of the participants may not have put forth their best effort when completing this tool. Student participants were enrolled in a graduate educational program, had demonstrated prior academic success, and were within one year of graduation. If the correlation between the CCTST and GRE holds true, many of the student participants in this study should not have been admitted to graduate school or been able to demonstrate academic success.

When evaluating tools to assess clinical judgment of the NP student, the CDMNS tool had demonstrated acceptable reliability ($\alpha = 0.83$) when used by Jenkins in 1985. Within this study, the reliability of the CDMNS tool was lower ($\alpha = 0.738$) than that reported by Jenkins (1985), indicating that this tool might not have been the best tool to evaluate clinical decision-making making in nursing. However, other literature reported a

statistically significant relationship between the CCTST subscale scores in inductive reasoning ($r = 0.27, p < 0.05$) and inference ($r = 0.23, p < 0.05$; Bowles, 2000). They found that inductive reasoning and inference were significant predictors of clinical judgment as measured by the CDMNS tool. As the findings of this study were different than had been reported in the literature, it brings into question the appropriateness of the tool to measure clinical judgment. If the obtained results from the student participants are accurate representation of their clinical decision-making making, the theoretical framework should be rejected. If the obtained results are not an accurate representation of the participant's clinical decision-making making, the theoretical framework should be retained. The search for other reliable and valid tools or even the development of such tools should be considered as nursing seeks to advance the profession.

Within this study, the exam style questions tool was shown to be an unreliable tool. When using the student participants' results from this tool and evaluating the theoretical framework, one should dismiss the use of exam style scores to measure clinical judgment in NP students. However, one must consider that the statistical analysis of the point biserial on the exam style questions from the study was different than the demonstrated point biserial of the exam style questions when they were used in a setting where a correct answer was rewarded and an incorrect answer penalized the student. When taking this into consideration relative to the theoretical framework, this tool could not be seen as a reliable or valid tool to assess the ability of the student participants' ability to correctly formulate a differential diagnosis. The statistical analysis of this tool did not support its use as a valuable component of this study. Therefore, no conclusion related to the theoretical framework could be made.

The preceptor evaluation tool should be accepted as an accurate representation of the ability of the NP student in the area of clinical judgment. The evaluation came from a source with professional experience in the clinical setting. The preceptors are nurse practitioners or physicians who provide patient care within the clinical setting and have some clinical experience. The preceptor evaluation tool demonstrated the best reliability of all the tools used in the study. It is an evaluation tool used by many NP educational programs as they seek feedback on the abilities of the NP student in the clinical setting. When evaluating the theoretical framework related to the preceptor evaluation tool, it was easy to reject the framework as there was no statistically significant relationship between critical thinking skills, as measured by the CCTST, and the preceptor evaluation tool. However, if consideration is given to the idea that the results on the CCTST tool were not an accurate representation of the critical thinking skills of the NP student, then there should be no rejection of the theoretical framework.

Again, if the participant results from all of the tools are an accurate measurement of the abilities of the participants, the theoretical framework should be dismissed as one that did not fit with the decision-making making process of the NP. However, the consideration that the results obtained from the tools might not be an accurate representation of the abilities in critical thinking, clinical decision-making making and the ability to correctly answer exam style questions must be made. If the results are not accurate, the rejection of the theoretical framework could not be made without question. In keeping the theoretical framework, it becomes apparent that tools to accurately assess clinical judgment and critical thinking skills within the NP student population should be

found or developed as nursing education strives to meet internal and external benchmarks.

Conclusion

While this study found no statistically significant relationship between critical thinking skills and clinical decision-making making, and between years of nursing practice and clinical decision-making making, it brought to light several possibilities for further research in this area related to NP education. The CCTST has been validated as a reliable tool to measure critical thinking skills of individuals for over 20 years. In this study, the reliability was good with a Cronbach's alpha of $\alpha=0.809$. The CDMNS overall also demonstrated good reliability in this study ($\alpha = 0.738$) as well as the preceptor tool ($\alpha = 0.917$). The CDMNS subscale of evaluation and reevaluation of consequences demonstrated acceptable reliability ($\alpha = 0.670$), while the exam style questions demonstrated very poor reliability in the study. The tools with good or acceptable reliability demonstrated that they were appropriate for use to assess their particular content area. However, within the NP student population represented in this study, use of these tools was not reported in the literature. This lack of data related to the tools raises several questions related to the educational process of NP students.

First, is there a better way to measure the ability of the NP student to formulate differential diagnoses in the clinical setting as they evaluate and treat patients? The tool used in this study was modeled after currently used tools by NP educational programs. This tool might have been more subjective than objective when evaluating the ability of the NP student to formulate differential diagnoses. In searching for tools to evaluate NP students in the clinical setting, few options were available. If this type of tool for

assessment is currently used by NP educational programs and is considered to be acceptable practice, the need for evidence identifying and supporting the use of this type of tool is important. As nursing educators and researchers who are supporting evidence based practices and policies, it is important that our practices reflect the use of what we are teaching to our students. The findings of this limited study indicate the need for further research in this area to determine if current practice is indeed best practice based upon evidence that can be validated and replicated.

Second, did this study use the appropriate combination of tools (CDMNS, exam style questions) to assess and measure clinical decision-making making? With the limited quantitative research related to clinical decision-making making in the NP student population and the results from this study, one could consider reevaluating how these two were measured and assessed. There is a need for further quantitative research in the area of assessment of clinical decision-making making in the NP student population. Although the tools selected in this study demonstrated acceptable reliability scores in prior studies, there might be other atypical tools in existence that would allow for improved assessment of clinical decision-making making abilities of the NP student. One such atypical tool to consider is the use of simulation and standardized patients in the NP educational program. These tools allow the educators the ability to create a standardized environment, allowing for assessment based upon consistent and standard criteria. Stroud et al. (1999) described the development and use of standardized patient scenarios, used within a controlled environment, to assess the NP students' ability to demonstrate their clinical decision-making making abilities. The question of subjective versus objective evaluation

of the NP student abilities in this area could have been eliminated in the present study with the use of simulation or a standardized patient situation.

Jamison (2006) found that the use of structured study guides, simulation experiences, traditional textbooks, an online learning platform, and student self-assessment were effective methods in teaching students the generation of differential diagnoses. The instructional methods used by Jamison could serve as the model for the development of such a framework within NP educational programs. If a goal of the NP educational program is to teach students how to use their clinical judgment as they generate differential diagnoses, this may be an approach that could make a difference in the education process. However, caution should be used as no comparative data were noted in Jamison's work and the need for effective and reliable tools to measure the ability of the NP student to generate differential diagnoses.

Third, does professional work experience of the NP student have some impact upon the critical thinking skills of the NP student? While this study did not demonstrate a significant relationship between critical thinking skills and professional work experience, the scores on the CCTST and the subscales of the CCTST for the participants who had critical care experience were higher than the other participants who had professional nursing experience. However, while these scores were higher, they were not statistically significantly different from all the other scores. Therefore, the variation in scores could be caused by chance or by a real difference in CCTST scores that was related to the area of professional work experience. The need to explore this relationship further has been piqued by the findings of this limited study. If there was some statistically significant relationship between professional work experience and critical thinking skills, it could

lead to further investigation into those environments and how they impact critical thinking skills. If no statistically significant relationships were found, it could have some impact upon the emphasis placed on critical care experience by some advanced practice educational programs.

Overall, the results of this study found no statistically significant relationships between critical thinking skills and clinical judgment in NP students. The study demonstrated some of the difficulties in finding established reliable and valid tools that can be used to evaluate clinical judgment. The study also highlighted the need for further evaluation of the educational approach to assess NP students' skills in the area of clinical judgment. Also brought to light was the potential for further research in the area of critical thinking skills in graduate level NP students.

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APPENDIX A
INSTITUTIONAL REVIEW BOARD FORMS

Participant's Signature

Date

Researcher's Signature

Date

Thank you for assisting me with my research.

Sincerely,

Karen L. Gorton, RN, MSN, FNP, MS

UNIVERSITY of
NORTHERN COLORADO
 Institutional Review Board (IRB)



July 24, 2009

TO: Susan Collins
 Gerontology

FROM: Gary Heise, Co-Chair *GH*
 UNC Institutional Review Board

RE: Expedited Review of Proposal, *An Investigation into the Relationship between Critical Thinking Skills and Clinical Judgment in the Nurse Practitioner Student*, submitted by Karen L. Gorton (Research Advisor: Nancy White)

First Consultant: The above proposal is being submitted to you for an expedited review. Please review the proposal in light of the Committee's charge and direct requests for changes directly to the researcher or researcher's advisor. If you have any unresolved concerns, please contact Gary Heise, School of Sport and Exercise Science, Campus Box 39, (x1738). When you are ready to recommend approval, sign this form and return to me.

I recommend approval as is.

Susan Collins

8/5/09

Signature of First Consultant

Date

The above referenced prospectus has been reviewed for compliance with HHS guidelines for ethical principles in human subjects research. The decision of the Institutional Review Board is that the project is approved as proposed for a period of one year: *8-9-2009* to *8-9-2010*.

Gary D. Heise

21 Aug 09

Gary Heise, Co-Chair

Date

Comments: *e-mailed 13 Aug 09*

APPENDIX B

DEMOGRAPHIC DATA INFORMATION

Please answer the following questions about yourself:

Unique ID: _____

1. Gender Male: _____ Female: _____
2. Age at last birthday: _____
3. Years of active experience as an RN: _____
4. Areas of active experience and years in that environment as an RN:
 - a. Intensive Care Unit: _____
 - b. Inpatient Hospital Care: _____
 - c. Surgery: _____
 - d. Post-Anesthesia care: _____
 - e. Outpatient clinic care: _____
 - f. Outpatient school nursing: _____
 - g. Home health care: _____
 - h. Other: _____
5. Area of most recent experience as a RN prior to returning to school for the NP program: _____

6. Educational pathway (please check one):
 - a. Bachelors of Science in Nursing (BSN) to current program: _____
 - b. Associate Degree to BSN to current program: _____
 - c. Other Bachelors degree to Associate Degree to BSN to current program: _____
 - d. Other Bachelors degree to BSN to current program: _____
 - e. Masters degree to BSN to current program: _____
 - f. Masters degree to Associate Degree to BSN to current program: _____
 - g. Other: _____

APPENDIX C
EXAM STYLE QUESTIONS

Exam Style Questions

A 17 year-old female patient presents to the clinic with complaints of: sore throat. She denies fever, malaise, stomach upset or rashes. Immunizations are up-to-date. Examination reveals clear, symmetrical eyes without drainage; boggy, erythematous nares bilaterally with no drainage noted; TM's yellow-pearl in color bilaterally, no drainage or bulging; oropharynx erythematous with tonsils grade 3+, white exudate patches seen bilaterally, tonsillar pillars edematous; uvula rises in midline with phonation. Based upon your examination of the patient, which of the following would be your initial action as her NP?

- Prescribe Amoxil 500 tid X 10 days with explicit instructions to finish all medicine.
- Obtain a culture of the posterior pharynx and await results for treatment decisions.
- Instruct patient and her mother to perform salt water gargles 2-3 times daily to decrease edema and promote comfort.
- Obtain a rapid strep antigen test and culture at this time.

Correct answer D. 17 correct answers. Biserial 0.40

More examination is necessary for the above patient. Which of the following would you perform to complete your examination?

- Ophthalmoscopic examination or retinal exam.
- Abdominal examination.
- Tympanic pneumoscopy bilaterally.
- All of the above are essential examinations for the 17 year-old patient.

Correct answer C. 15 correct answers. Biserial 0.32

Your 25 year-old G:2 P:1 patient is at the clinic for a visit at 25 6/7 weeks. She has had no complications, FHT are 130's and audible with Doppler, and her fundal height is measuring at 27 cms. Her blood type is O negative. She has not had any complications with this or her first pregnancy. Her first baby was a little jaundiced at birth with no need for bililights and blood type of A positive. The patient is now 140 pounds, and has gained approximately 15 pounds with this pregnancy. Her Quad Screen showed low risk for fetal abnormalities. Which of the following should be done in addition to the plan of care that is currently in place?

- Order a H & H and Antibody Screen. If negative give antenatal Rhogam.
- Order a blood type on the patient's husband.
- Counsel the patient and her husband about the availability of genetic testing and counseling.
- Have the patient come back in 4 weeks as everything is normal with mom and baby?

Correct answer A. 17 correct answers. Biserial 0.41

A 45 year-old woman returns from a golfing vacation to report that she has a painful right elbow. On examination, the right medial epicondyle is tender to palpation and the patient has increased pain with wrist flexion. The best course of action is to:

- a) Refrain from golfing for suspected golfer's elbow
- b) Refer to orthopedics for this unusual presentation
- c) Recommend surgery for radial tunnel decompression
- d) Obtain x-rays for suspected radial head fracture
- e) Splint the elbow for triceps tendonitis

Correct answer A. 16 correct answers. Biserial 0.54

C.H. is a 35 year-old obese female patient presenting with acute abdominal pain. It appears to be primarily RUQ radiating to the epigastric area and her back. Which is the most appropriate imaging study?

- a. Abdominal Ultrasound
- b. CXR
- c. CT with contrast
- d. CT without contrast
- e. Abdominal flat plate film

Correct answer is A. 13 correct answers. Biserial 0.35

A pregnant female at 30 weeks gestation presents with a report of domestic violence. Your physical assessment reveals boot shaped ecchymotic areas on the patient's abdomen and facial lacerations. Your most immediate concern is that this patient is at high risk for:

- a) Abrupt placenta
- b) Premature ruptured membranes
- c) Ruptured spleen
- d) Facial scarring and emotional difficulties

Correct answer is A. 16 correct answers. Biserial 0.54

The Clinic MA comes into your office with a patient phone call. It is noon and all other providers have left for lunch. The MA tells you that the 24 year-old on the phone has been having unilateral eye pain since this morning, which seems to be getting worse. She hasn't noticed any drainage, but the eye has been tearing and is very tender. She is unable to wear her contacts and has called in sick to work for the day, as she is unable to be out in the sun without her dark sunglasses.

Which of the following is the most appropriate for you to tell the MA?

- a) Have the patient come in to see her provider after lunch if there is an open slot.
- b) Have the patient come in now and see her yourself
- c) Have the MA tell the patient to call her eye doctor
- d) Call your consulting physician to ask for advice, and then give the advice to the MA
- e) Refer the patient to urgent care.

Correct answer is B. 10 correct answers. Biserial 0.26

A 36 year-old data entry clerk presents to your office complaining of tingling and pain in the right thumb and wrist, worse by the end of the day. Occasionally, he is awakened at night from the pain. Phalen's, Tinel's and median nerve compression tests are positive. The hand and wrist appear otherwise normal, with full range of motion, good perfusion, and no signs of inflammation or trauma. Which of the following treatment modalities would be your first choice in alleviating pain in this patient?

- a) Steroid and lidocaine injection into the tunnel
- b) Wrist splinting in neutral or slight extension
- c) Surgical release of the transverse ligament
- d) Iontophoresis therapy
- e) NSAID's

Correct answer B. 12 correct answers. Biserial 0.39

A 70 year-old man presents to your office complaining of left upper arm pain after falling off his porch. He states he broke his fall by catching the railing with his left arm. He has noticed pain and weakness with movement, especially abduction of the shoulder. What is the most likely diagnosis?

- a) Adhesive capsulitis.
- b) Rotator cuff tear.
- c) Posterior shoulder dislocation.
- d) Epicondylitis.
- e) Acromioclavicular sprain.

Correct answer B. 16 correct answers. Biserial 0.54

A 25 year old male reports to your office complaining of low back pain and right leg numbness. He reports acute onset of symptoms after lifting a heavy box. Physical exam reveals numbness of his lateral thigh and anterior shin along with weakness in dorsiflexion of his right great toe. The remainder of the physical exam is unremarkable and history reveals no other reported deficits or symptoms. What is the next best step for this injury?

- a) Radiographs of the thoracic and lumbar spine to evaluate for bony injury
- b) Bed rest for 1 or 2 weeks
- c) Immediate surgery
- d) Muscle relaxants, NSAIDs, and cold packs followed by physical therapy
- e) Back bracing until symptoms subside

Correct answer D. 15 correct answers. Biserial 0.42

APPENDIX D

QUESTIONS RELATED TO THE FORMULATION OF DIFFERENT
DIAGNOSES TO BE ASKED OF THE CLINICAL
PRECEPTOR AND FACULTY

Please indicate your response for each question using the following scale. This scale is similar to the pain scale and a response of 1 indicates no ability and a response of 10 indicates excellent ability.

No ability

Excellent ability

1 2 3 4 5 6 7 8 9 10

Name of NP Student: _____

1. The Nurse Practitioner student demonstrates the ability to formulate appropriate differential diagnoses for patients.
2. The Nurse Practitioner student considers more than one possible differential diagnosis for the patient.
3. The Nurse Practitioner student orders and performs appropriate screening tests to facilitate the formulation of a differential diagnosis.
4. The Nurse Practitioner student identifies health problems and needs and prioritizes them collaboratively with the patient as they formulate differential diagnoses.
5. The Nurse Practitioner student validates and verifies findings to formulate a plan of care that is appropriate for the differential diagnosis.
6. The Nurse Practitioner student demonstrates the ability to formulate appropriate nursing diagnoses.
7. The Nurse Practitioner student demonstrates the ability to formulate appropriate medical diagnoses.

APPENDIX E

THE CLINICAL DECISION-MAKING IN NURSING SCALE

THE CLINICAL DECISION-MAKING IN NURSING SCALE

The scale is used with permission from the Associate Dean for Research at George Mason University.

Circle whether you would likely behave in the described way:

- A – Always: what you consistently do every time
- F – Frequently: What you usually do most of the time
- O – Occasionally: What you sometimes do on occasion
- S – Seldom: What you rarely do
- N – Never: What you never do at any time

Be sure you respond in terms of what you are doing in the clinical setting at the present time.

1. If the clinical decision is vital and there is time, I conduct a thorough search for alternatives.
2. When a person is ill, his or her cultural values and beliefs are secondary to the implementation of health services.
3. The situational factors at the time determine the number of options that I explore before making a decision.
4. Looking for new information in decision making is more trouble than it's worth.
5. I use books or professional literature to look up things I don't understand.
6. A random approach for looking at options works best for me.
7. Brainstorming is a method I use when thinking of ideas for options.
8. I go out of my way to get as much information as possible to make decisions
9. I assist clients in exercising their rights to make decisions about their own care.
10. When my values conflict with those of the client, I am objective enough to handle the decision making required for the situation.
11. I listen or consider expert advice or judgment, even though it may not be the choice I would make.
12. I solve a problem or make a decision without consulting anyone, using information available to me at the time.

13. I don't always take time to examine all the possible consequences of a decision I must make.
14. I consider the future welfare of the family when I make a clinical decision which involves the individual
15. I have little time or energy available to search for information.
16. I mentally list options before making a decision.
17. When examining consequences of options I might choose, I generally think through "If I did this, then. . .".
18. I consider even the remotest consequences before making a choice.
19. Consensus among my peer group is important to me in making a decision.
20. I include clients as sources of information
21. I consider what my peers will say when I think about possible choices I could make.
22. If an instructor recommends an option to a clinical decision making situation, I adopt it rather than searching for other options.
23. If a benefit is really great, I will favor it without looking at all the risks.
24. I search for new information randomly.
25. My past experiences have little to do with how actively I look at risks and benefits for decisions about clients.
26. When examining consequences of options I might choose, I am aware of the positive outcomes for my client.
27. I select options that I have used successfully in similar circumstances in the past.
28. If the risks are serious enough to cause problems, I reject the option.
29. I write out a list of positive and negative consequences when I am evaluating an important clinical decision.
30. I do not ask my peers to suggest options for my clinical decisions.

31. My professional values are inconsistent with my personal values.
32. My finding of alternatives seems to be largely a matter of luck.
33. In the clinical setting I keep in mind the course objectives for the day's experience.
34. The risks and benefits are the farthest thing from my mind when I have to make a decision.
35. When I have a clinical decision to make, I consider the institutional priorities and standards.
36. I involve others in my decision making only if the situation calls for it.
37. In my search for options, I include even those that might be thought of as "far out" or not feasible.
38. Finding out about the client's objectives is a regular part of my clinical decision making.
39. I examine the risks and benefits only for consequences that have serious implications.
40. The client's values have to be consistent with my own in order for me to make a good decision.

Clinical Decision Making in Nursing Scale
Information Sheet

The following is important information to use when scoring the CDMNS and arranging for statistical analysis.

- I. These 22 items are rated as positive and the frequency anchors Always (5) to Never (1):

1, 3, 5, 7, 8, 9, 10, 11, 14, 16, 17, 18, 20, 26, 27, 28, 29, 33, 35, 36, 37, 38

All other items are rated as negative and use frequency anchors from Always (1) to Never (5).
- II. Subscales are composed of the following items:
 - a. Subscale A: Search for Alternatives and Options

1, 3, 6, 7, 16, 22, 27, 30, 32, 37
 - b. Subscale B: Canvassing of Objectives and Values

2, 9, 10, 14, 21, 31, 33, 35, 38, 40
 - c. Subscale C: Evaluation and Reevaluation of Consequences

13, 17, 18, 23, 25, 26, 28, 29, 34, 39
 - d. Subscale D: Search for Information and Unbiased Assimilation of New Information

4, 5, 8, 11, 12, 15, 19, 20, 24, 36

I hope this information is helpful as you work with the CDMNS. Thank you for your interest.

Helen M. Jenkins

From unpublished dissertation of D. J. Saunders, pg 178.