DISSERTATION

THE RELATIONSHIP OF CRITICAL THINKING TO PERFORMANCE ON THE NATIONAL COUNCIL LICENSURE EXAMINATION FOR REGISTERED NURSES (NCLEX-RN)

Submitted by

Jean Foret Giddens

School of Education

In partial fulfillment of the requirements

for the degree of Doctor of Philosophy

Colorado State University

Fort Collins, Colorado

Fall, 2002

COLORADO STATE UNIVERSITY

October 23, 2002

WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY JEAN FORET GIDDENS ENTITLED THE RELATIONSHIP OF CRITICAL THINKING TO PERFORMANCE ON THE NATIONAL COUNCIL LICENSURE EXAMINATION FOR REGISTERED NURSES (NCLEX-RN) BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

Committee on Graduate Work

Adviser

Director

ABSTRACT OF DISSERTATION

THE RELATIONSHIP OF CRITICAL THINKING TO PERFORMANCE ON THE NATIONAL COUNCIL LICENSURE EXAMINATION FOR REGISTERED NURSES (NCLEX-RN)

This purpose of this ex-post-facto research study was to investigate the relationship of critical thinking to performance (pass or fail) on the NCLEX-RN. The sample (N= 218) was composed of baccalaureate nursing students who graduated between 1998 and 2001 from a university-based nursing program in the Southwest. The participants completed two critical thinking instruments: the California Critical Thinking Skills Test (CCTST) and the California Critical Thinking Disposition Inventory (CCTDI). Both instruments generate a total score and several sub-scale scores. Participants completed these instruments during their final semester of nursing school. About half of the sample also completed these instruments upon entry into the program.

Results of *t*-test analyses showed that there was a statistically significant difference between participants who passed and failed NCLEX-RN on the exit CCTST. Pass group scores exceeded fail group scores on all 6 scales; the effect size for each was medium to large. Scores for the pass group also exceeded the fail group on 3 of 6 scales upon program entry. On the exit CCTDI, the pass group had statistically significantly higher scores on 5 of 8 scales with medium to large effect sizes. The CCTDI scores for the fail group, however, were comparable with national norms for student nurses.

There was no change in CCTST or CCTDI total scores over time between program entry and exit; improvement was noted on one sub-scale for both instruments. There was no difference in gain scores between the pass and fail groups. The prediction of NCLEX-RN performance (as determined by multiple regression analysis and discriminant analysis) was not improved by adding CCTST and CCTDI to the prediction from nursing grade point average.

There was no difference in age or gender between pass and fail groups. Chi-square analysis revealed a statistically significant difference in NCLEX-RN performance based on ethnicity. The effect size for this finding was small to medium.

In conclusion, results from this study show that critical thinking skills are related to NCLEX-RN performance, however, the relationship of critical thinking disposition to NCELX-RN performance remains unclear. These results enhance the understanding of factors associated with NCLEX

Jean Foret Giddens
School of Education
Colorado State University
Fort Collins, CO 80523
Fall, 2002

ACKNOWLEDGMENTS

The author wishes to thank those who provided their expert assistance in the planning, implementation and evaluation of this research project including Dr. Ken Miller, Shari Bowie, Dr. Jeff Gliner, and Dr. June Thompson. Special thanks to Dr. Gene Gloeckner and Dr. George Morgan who gave freely of their time and expertise, and provided much needed encouragement during this process.

I am especially grateful to my husband, Jay Corazza, and my sons Christopher and John for their ongoing understanding, support, and encouragement.

TABLE OF CONTENTS

LIST OF TABLES

Table

CHAPTER 1

INTRODUCTION

Nursing education programs throughout the country are charged with producing graduates who can enter the profession of nursing. Nursing graduates must be able to deliver competent health care to the public based on standards of clinical nursing practice (American Nurses Association [ANA], 1998). The graduate nurse, through a national licensure exam, must ultimately demonstrate minimum nursing competence. All graduates of nursing programs throughout the country must successfully pass the National Council Licensure Examination for Registered Nurses (NCLEX-RN) in order to obtain a nursing license (Guido, 2001).

Nursing, like most professions, requires a license in order to practice. In each state, licensure is enacted through legislative action in the form of the state nurse practice act. All states have a state board of nursing (or a state board of nurse examiners) which functions to ensure enforcement of the nurse practice act. Although the board of nursing in each state varies somewhat in specific administrative and regulatory practice, all boards oversee nursing education programs (through accreditation standards), licensure, disciplinary action, and regulate specialty practice (Guido, 2001).

The primary purpose of licensure is for the protection of the public and the nursing profession. According to Gross (1984), the consumer is generally unable to distinguish competent from incompetent health care practitioners, thus standards must be

in place to ensure minimum competence through licensure. Gross also indicates that the licensing process is necessary to protect the profession and individuals within the profession. By regulating practice through licensure, the quality and reputation of a given profession is maintained. This in turn results in job and income security for those working in the profession.

Individuals wishing to obtain a nursing license must apply within the state they wish to practice. Nursing graduates are required to take the NCLEX-RN examination. The candidate applies to take the NCLEX-RN with the state board of nursing. Because all states recognize the NCLEX-RN, a licensed nurse is not required to take another examination in order to obtain a license in another state (Guido, 2001).

Problem Statement and Context

As the minimum pass requirement for the NCLEX-RN has increased and national pass rates have steadily decreased (National Council for State Boards of Nursing [NCSBN], 2002), administrators and faculty of nursing programs have become increasingly interested in factors associated with NCLEX-RN success. NCLEX-RN is a high-stakes examination for both the graduate nurse and nursing programs. This study was designed to attain a better understanding of factors associated with NCLEX-RN performance and potentially enable nursing education programs to select qualified applicants, improve pedagogical directives, and identify and assist students who are at risk for failure.

Nursing Licensure Examinations: Purpose and Historical Perspectives

Nursing licensure did not begin in this country until 1903 when four states (New York, New Jersey, North Carolina, and Virginia) passed legislation requiring licensure to

practice nursing. Although the initial impact of the legislative efforts of these four states was considered weak, New York had the strongest laws in part because it had an all nurse board of examiners and obtained the right to require examinations of applicants for licensure. By 1923 all states had legislation in place to regulate nursing practice (Greenlaw, 1985; Shannon, 1975).

As other states followed the licensure trend, most implemented education guidelines as well as a licensure examination process. During these early years, each state had its own licensure examination thus, there was significant variability from state to state. Written examinations typically consisted of essay type questions. Many states also included a practice component to the examination (Robey, 1979).

Collaboration between states in the examination process evolved gradually. Initially, a group of objective examinations were developed and made available for nursing boards from various states to use. In 1944 the National League for Nursing (NLN), initiated a program of nationwide testing which was referred to as the State Board Test Pool Examination (SBTPE). By 1952, all the states were using the SBTPE for their licensure examination (Matassarin-Jacobs, 1989). This plan provided consistency among the states in regard to the licensure examination yet allowed states to set pass/fail requirements. Over time, the SBTPE developed into a norm-referenced examination with standardized passing score used by all states (Robey, 1979).

The SBTPE was the nursing licensure examination for nearly forty years. The American Nurses Association (ANA) assumed control of the SBTPE in 1955 and made periodic revisions to the blueprint, although no major changes were made (Matassarin-Jacobs, 1989). In the 1970s the ANA and the Council of State Boards determined a

major revision was needed. One of the primary criticisms of the SBTPE was that it was patterned after a medical model as opposed to a nursing model (Smeltzer, 1982). In 1978 the National Council of State Boards of Nursing (NCSBN) was given charge of test development and administration by the ANA. Once the NCSBN assumed control of the nursing licensure examinations, plans were soon underway to initiate major changes to the nursing licensure examination.

Development and Administration of NCLEX-RN

After several years of development, the NCLEX examination, was implemented in 1982, and has been the national licensure examination for nurses since that time. NCLEX-RN has undergone two significant changes since it was implemented. In 1988, the format for reporting performance changed from an overall total score to a pass/fail score. In 1994 the format for test administration changed from a paper-pencil test to a computerized testing format.

NCLEX-RN continues to be developed and administered by the NCSBN. This agency is charged with ensuring that the NCLEX-RN reflects the competencies needed for entry-level nurses (NCSBN, 2000). Because every state board of nursing in the country subscribes to the use of NCLEX-RN, all nursing graduates entering the nursing profession are held to the same standard.

Pass Rates for NCLEX-RN

The national and state pass rates for NCLEX-RN are reported by the NCSBN. Because NCLEX-RN examination can be taken on a year-round basis, candidate performance is reported quarterly. Pass rates are reported as the percent passing by type of candidate (such as type of educational program, foreign educated candidates, repeat

candidates) as well as total pass rate scores. In the year following the implementation of the computerized testing format for NCLEX-RN, pass rates began to drop. The national pass rate for all first-time, United States educated candidates dropped each year between 1995 (90.4% pass rate) and 2000 (83.8% pass rate). Pass rates did increase somewhat, however, in the year 2001 (NCSBN, 2002). Table 1 shows the NCLEX-RN pass rate trends for first-time and repeat candidates educated in the United States over the past five years as well as total pass rates which include foreign educated candidates.

Table 1

Percent of Candidates Passing NCLEX-RN by Type of Candidate for 1997-2001

Type of candidate	1997	1998	1999	2000	2001
First-time US educated candidates	87.7%	85.0%	84.8%	83.8%	85.5%
Repeat candidates US educated candidates	53.3%	47.9%	50.5%	48.5%	50.0%
All Candidates	76.2%	71.8%	70.8%	68.8%	69.4%

Note. Passing standard raised April 1, 1998. (NCSBN, 2002)

Implications of NCLEX-RN Success

The NCLEX-RN pass rate is one of the most important indicators of a nursing program's success. Pass rate not only affects the reputation of a nursing program, but also is one of the standards noted in the accreditation process (National League for Nursing Accrediting Commission [NLNAC], 2001; Commission on Collegiate Nursing Education [CCNE], 1998). Because the competition for qualified applicants into nursing programs has increased, student enrollment may be affected by poor NCLEX-RN pass rates. Low enrollment impacts funding for nursing programs in public institutions. Obviously, it is in a nursing program's best interest to select students who are most likely

to succeed in the nursing program and on the NCLEX-RN exam. Additionally, identification of students who are at risk of failing NCLEX-RN is important so that remedial work can be offered to the student at risk.

Need for Research

Because of the pressure to maintain high pass rates, factors associated with students' success on the NCLEX-RN has been an area of interest for nursing research over the last several years. There have been several recent studies investigating variables associated with NCLEX-RN performance. Current research findings support evidence that certain academic variables such as Scholastic Aptitude Test (SAT) scores, American College Test (ACT) scores, cumulative grade point average (CGPA), nursing grade point average (NGPA), and success in certain nursing courses are effective predictors of NCLEX–RN success (Alexander & Brophy, 1997; Beeson & Kissling 2001; Endres, 1997; Waterhouse, Caroll, & Beeman, 1993). Standardized assessment tests given to senior nursing students have also been shown to be significant predictors of NCLEX-RN success in a number of studies (Alexandar & Brophy, 1997; Beeson & Kissling, 2001; Brisco & Anema, 1999; Endres,1997; Lauchner, Newman & Britt, 1999).

One possible variable associated with NCLEX-RN performance that has been minimally investigated is critical thinking. Critical thinking (CT) has been recognized as an important component of nursing education and practice. Although CT measurement has been heavily documented in the nursing literature, this has been primarily in the context of demonstrating CT as an outcome of the educational process. Because CT is an expected educational outcome (CCNE, 1998; NLNAC, 2001), and because NCLEX-RN

is a reflection of knowledge needed for entry level nursing practice (NCSBN, 2000), it can be assumed that CT skills are necessary for NCLEX-RN success.

Purpose Statement

The purpose of this non-experimental study was to examine the relationship between CT and NCLEX-RN performance in baccalaureate nursing students. Essentially, this study involved the analysis of critical thinking skills and dispositions among nursing students related to their NCLEX-RN performance. Additionally, this study investigated the possibility that a combination of variables including critical thinking skills and critical thinking dispositions adds to the prediction of NCLEX-RN performance.

CT was measured with two instruments that have recently emerged and gained popularity with nurse researchers: the California Critical Thinking Skills Test (CCTST) and the California Critical Thinking Dispositions Inventory (CCTDI) (N.C Facione & P.A. Facione, 1997). The CCTST is a non-discipline specific tool used to measure CT skills in college-aged individuals. The CCTDI is designed to assess an individual's attitudinal dimensions of critical thinking.

Research Questions

1. Is there a difference in performance on the entry CCTST between individuals who pass or fail the NCLEX-RN examination?
2. Is there a difference in performance on the entry CCTDI between individuals who pass or fail the NCLEX-RN examination?
3. Is there a difference in performance on the exit CCTST between individuals who pass or fail the NCLEX-RN examination?

4. Is there a difference in performance on the exit CCTDI between individuals who pass or fail the NCLEX-RN examination?
5. Is there a change in critical thinking scores for the whole sample between the entry and exit CCTST or CCTDI?
6. Is there a difference in change scores for the CCTDI and CCTST between individuals who pass or fail NCLEX-RN examination?
7. Do the CT scores add to the prediction of NCLEX-RN performance based on NGPA, CGPA, or ACT?

Definition of Terms

Baccalaureate nursing program. This refers to a four-year college or university nursing program that offers a baccalaureate degree to their graduates.

Critical thinking. This refers to a process utilizing a number of cognitive and affective factors associated with the analysis and interpretation of information.

Critical thinking skills. This term refers to an individual's cognitive ability or attributes associated with the critical thinking process.

Critical thinking disposition. This term refers to an individual's affective attributes or characteristics associated with the critical thinking process.

Generic nursing student. There are many types and levels of nursing students in a given nursing program. A generic student is a student in a nursing program who is admitted to the program with no previous nursing degree.

Graduate nurses. Graduate nurses refers to students who have successfully completed graduation requirements from a nursing program.

National Council of State Boards of Nursing. The National Council's mission is to lead the regulation of nursing practice by serving as a consultant, liaison, advocate and researcher to the board of nursing for each state. Among other duties, it is responsible for the development and administration of the NCLEX-RN.

NCLEX-RN. This is the national licensure examination taken by all graduates of nursing programs in order to obtain a license to practice nursing. A nurse must only successfully pass this examination once, as all states recognize this test as qualifying examination for licensure.

NCLEX-RN performance. The performance on the NCLEX-RN is reported as pass or fail; no actual scores are reported.

Nursing licensure. A nursing license grants permission to practice nursing in a given state. Nursing licensure is obtained through an application process with the state board of nursing.

Predictor variable. This term refers to an independent research variable that is entered into a multiple regression or disciminant analysis. For this study, predictor variable refers to a predictor of NCLEX-RN performance.

State board of nursing. The authorized state government agency that has the authority to enforce the nurse practice act legislation in a given state. The function of the state board of nursing includes regulation of nursing licensure.

Senior nursing student. For purposes of this study, the term "senior nursing student" refers to a nursing student in their final semester of study in a baccalaureate nursing program.

Assumptions/Limitations

There was an assumption that the sample represented a typical group of baccalaureate nursing students from the Southwest. It was assumed that participants' performance on the CT skills and dispositions instruments reflected their best efforts. It was further assumed that instructions during the administration of the critical thinking measurement instruments were made clear to the participants, and that the instruments are accurate, reflective and applicable to the nursing discipline.

The research was limited by the use of a non-experimental research approach. Because the groups were nonequivalent, it is possible that other unknown variables such as personal issues, life experiences, and individual perspectives could have affected results. Although the identified independent variables were presumed to affect the outcome of pass/fail on NCLEX-RN, there is not a clear cause and effect of inference associated with a comparative approach (Gliner & Morgan, 2000).

The sample size was small (218) and was limited to nursing students from one baccalaureate degree nursing program. Of particular concern was the small number of participants in the fail group. The findings are not generalizable to nursing students from other types of nursing education programs (such as diploma or associate degree).

Another limitation was also noted with the method of data collection and the maintenance of data records. Because this was an ex-post-facto study, there was no guarantee of the condition or accuracy of the existing data. Error in the collection and recording of data may have occurred.

Delimitations

This study was confined to evaluating variables associated with NCLEX-RN performance among nursing students enrolled in one public university in the Southwestern United States. The sample included only generic students from the nursing program. The measurement of CT skills and CT dispositions as variables were confined to the CCTST and CCTDI instruments.

Significance of the Study

Examining the relationship between CT and NCLEX-RN performance is beneficial in a number of ways. This research added to the body of knowledge related to factors affecting NCLEX-RN success. Nursing education administrators and faculty have a keen interest in information concerning NCLEX-RN success primarily because of the stakes involved regarding first-time pass rates. The stakes are high not only for the individual student, but also for the nursing program as reputation, accreditation, and funding are potentially affected. This research has significance in three primary areas: scholarly research, educational practice, and educational policy.

Scholarly Research

Although a number of studies have looked at variables associated with NCLEX-RN performance, only a limited few have specifically examined the relationship of CT on NCLEX-RN performance, or CT as a predictor variable. Interestingly enough, CT is widely found in nursing literature as a primary component of nursing practice. Examination of CT as a variable adds to the body of knowledge related to NCLEX-RN performance.

Previous research has shown that several academic variables are positively associated with NCLEX-RN success including SAT scores, ACT scores, GPA, and success in nursing courses. Gaining an understanding of the relationship CT has with NCLEX-RN performance and CT as a predictor variable has potential application not only to nursing research, but to other health science disciplines (such as medicine, dentistry, physical therapy, and occupational therapy) that also require a national licensing examination.

This research also adds to the body of scholarly knowledge related to CT. Multiple CT studies are found in the nursing literature as well as other educational disciplines. Many CT studies focus on changes in CT ability over time, measurement of change in CT ability after an intervention of some kind, or identify CT ability in various groups. This study will have a different focus than critical thinking studies previously conducted.

The measurement of CT is another way this study contributes to scholarly research. One of the inherent difficulties with CT research is accurate measurement. The two CT instruments used in this study will add to the body of knowledge regarding application and applicability of these tools not only to general educational research, but also to the discipline of nursing.

Improving Educational Practice

This research potentially benefits nursing education practice. A strong emphasis is placed on educational and evaluation strategies in nursing education literature. Educational strategies associated with constructivism (such as problem based learning) stimulate problem solving and critical thinking skills (Baker, 2000; Peters, 2000).

Heavier emphasis on such strategies may help students develop stronger critical thinking skills that may in the end help them be successful on NCLEX-RN.

The practice of evaluating nursing through examination could also be influenced by this research. It is suggested that CT skills are necessary for multiple choice questions written at the analysis level (Morrison & Free, 2001; Wendt & Brown, 2000). Although NCLEX-RN questions are written at various cognitive levels, the majority are written at the application and analysis level (NCSBN, 2000). Showing a link between CT and NCLEX-RN success may prompt more faculty to develop examinations with a larger percent of multiple choice items written at the analysis level. This ultimately will help students by simulating expectations they will encounter on the NCLEX-RN. This practice will also help nursing programs demonstrate evidence of CT as part of educational outcomes in the curriculum to satisfy accreditation requirements.

Drive Nursing Policy

Nursing research has been partly responsible for policy pertaining to admission criteria for nursing programs. Nursing schools are interested in admitting students who fit a profile of likely to succeed – not only in the academic program, but ultimately on NCLEX-RN as well. Adoption of CT measurement as an entry requirement along with other known predictors could potentially improve program graduation rates and first-time NCLEX-RN pass rate.

Another application for the research is related to identification of high-risk students who are already in the nursing program. Many nursing programs currently have progression policies associated with academic performance. The administration of CT

skills tests could be one of several tools used to identify students who might benefit from remedial work and strategies designed to enhance CT ability.

Researcher's Perspective

I have a professional and personal commitment to nursing and the students that I teach. Contributing to nursing education research is but one aspect of this professional commitment. As a nursing educator for 18 years, and a former writer for the NCLEX-RN, I have a long-standing interest in understanding variables associated with NCLEX-RN performance. I have a strong belief that CT is a necessary component of successful nursing practice and is a factor in success on NCLEX-RN. What remains to be seen is if this CT component can be adequately captured and measured by instrumentation in a way to be useful for predicting NCLEX-RN outcomes.

Often times nursing faculty have strong hunches regarding the outcome of NCLEX-RN testing for various students. However, as accurate as hunches can be, they are not scientifically based, thus are difficult to act on. The more that can be learned about variables associated with NCLEX-RN performance, the better nursing programs can be in the selection of students, as well as identifying and intervening with students at risk for failure.

CHAPTER 2

LITERATURE REVIEW

The purpose of this study was to investigate the relationship of critical thinking (CT) to NCLEX-RN performance. The primary purpose of this review of the literature was to present research associated with known variables associated with nursing licensure examinations as well as research associated with CT. Through this literature review, a theoretical framework justifying critical thinking as a variable related to NCLEX-RN performance emerged.

The first half of this literature review focuses on the concept of licensure examination. Several components related to this concept are presented and include the use of standardized examinations in primary and secondary education, licensure examinations in non-health related fields, licensure examinations in non-nursing health care professions, and nursing licensure examinations. Nursing research related to variables associated with performance on the various nursing licensure examinations are discussed in detail, particularly research associated with the most recent version of NCLEX-RN.

The second half of this literature review primarily focuses on the concept of CT within the perspective of nursing. The goal of this second section is to present literature and results of research that supports a theory that CT is associated with NCLEX-RN performance. Specific components addressed include definitions of CT, CT as a

component of nursing practice, CT as a component of NCLEX-RN, CT and NCLEX-RN performance, and literature associated with measurement of CT.

Examinations to Demonstrate Competence – A Life-Long Process

The demonstration of competence through examination is prevalent throughout our society. Examinations are used in nearly every facet of our lives. Well over half of the states use the results of standardized tests in elementary and secondary (K-12) education to make decisions related to student progression (including being allowed to graduate), or as an evaluation measure of teacher or school quality (Miller, 2001). Children, in fact, are introduced to standardized testing early in primary education despite the concerns of many whom question the appropriateness of such practice (James & Tanner, 1993). Although multiple issues and concerns regarding the use of standardized tests in the K-12 setting have been raised, (Miller, 2001; Thompson, 2001), they continue to be a fact of life for students in those settings. Entrance requirements for most colleges and universities include the Scholastic Aptitude Test (SAT) or the American College Test (ACT) scores. These scores have traditionally been used to assess and predict an applicant's success, thus are used as a screening tool for entrance into some colleges and universities. The value of these tests however, has come into question in recent years (Bracey, 2001).

Licensure Examinations in Non-Health Related Disciplines

Whether one goes to college or not, most individuals encounter some sort of competency evaluation once they enter the workforce. Nearly every profession requires competency examination for licensure. The purpose of such examination is to ensure

competence of those who provide services. Underlying this is the need to protect the public from harm caused by incompetence (Gross, 1984).

Most licenses are issued and regulated on the state government level. For some professions, licensure examinations vary from state to state to reflect unique codes and laws pertaining to the state. Graduates of law schools, for example, take a Bar Examination in the state they wish to practice; teachers take a state licensing examination in the state they wish to teach.

Although most professions are regulated by state government, some are regulated on the federal level. For instance, all aspects of aviation are regulated by the Federal Aviation Administration. To obtain a basic pilot license, individuals undergo a three-part examination process – written, oral, and flying examinations – at the completion of instruction. Additional instruction and a rigorous examination process is required for individuals who intend to obtain advanced certifications and ratings such as a commercial pilot license (United States Department of Transportation, 2001).

Professional Licensure Examinations in Health Care Disciplines

Individuals who are involved in health care are held accountable to practice according to standards of care. All health professionals must pass a licensure examination aimed at ensuring those who are issued a license have demonstrated a certain level of competence (Gross, 1984). Although licensure is typically regulated at the state level, most licensure examinations for health care professionals are national exams. Social workers, for example, take the American Association State Social Work Board (AASSWB). Pharmacists take the National Association of Boards of Pharmacy Licensure Examination (NABPLEX). Chiropractors take the National Chiropractic

Board of Examiners (NCBE) exam. Dentists take the Joint Commission on National Dental Examinations (JCNDE). Students of ostoepathic medicine take the Comprehensive Osteopathic Medical Licensing Examination (COMLEX) while students of allopathic medicine take the United States Medical Licensing Examination (USMLE).

Not surprisingly, there is wide diversity in the type and format of examination systems for various health care disciplines. Graduates of nursing programs sit for a single examination (the NCLEX-RN) to obtain licensure. In contrast, medical students (both allopathic and osteopathic) and dental students take a series of examinations at different points in the educational process (Osborn, Meoli, Buser, Clearfield, Bruno, & Sumner-Truax, 2000; Swanson, Ripkey, & Case, 1996). Students must pass each level to continue with their education. The dental literature reflects significant controversy associated with the licensure examination process. Candidates must successfully pass two written examinations as well as a clinical examination. The validity of the clinical examination has come under question, along with the ethical issues associated with conducting examinations using human subjects (Buchanan, 1991; Feil, Meeske, & Fortman, 1999; Formicola, Lichtenthal, Schmidt, & Meyers, 1998; Kalkwarf, 1999).

Variables Associated with Success on Licensure Examinations in Medicine

No health care discipline has researched variables associated with performance on licensure examinations to the extent that nursing has. For example, Pringle and Lee (1998) reported that prior to their study, no previous research had been done in predicting success or failure on the NCBE exam. Only the medicine literature comes close to nursing in its investigation of associated variables.

Allopathic Medicine. A number of articles appear in the medical literature related to predicting success on the various exams medical students must write. Since the USMLE is a series of three exams (Step 1, Step 2, and Step 3), predictors of success differ from exam to exam. Research has shown that the Medical College Admission Test (MCAT) alone and in combination with undergraduate grade point average (GPA) are good predictors of success in medical school and on the USMLE Step 1 (Koenig, Sireci, & Wiley, 1998; Mitchell, 1990). However, Veloski, Callahan, Xu, Hojat, and Nash (2000) found that MCAT scores were more valuable than undergraduate GPAs in predicting success in medical school. It should be no surprise that these variables are heavily weighted in the selection process for admission to most medical schools. Another examination, the Comprehensive Basic Science Subject Examination has also been shown to strongly correlate with USMLE Step 1 performance (Glew, Ripkey, & Swanson, 1997).

Nonacademic variables such as personality characteristics, leadership/decisiveness, confidence, motivation, external locus of control, and independence provide predictive power of medical student performance beyond that provided by academic measures alone (Markert, 1983; O'Donnell, 1982;Webb, et al., 1997). Strong correlation between performance on the MCAT and USMLE and parental income was found in a study conducted by Fadem, Schuchman, and Simring (1995). This correlation was particularly strong among minority women.

Case, Ripkey, and Swanson (1996), and Ripkey, Case, and Swanson (1999) report a strong relationship between performance in clinical clerkships and success on the USMLE Step 2 exam, although the authors point out that there is a great diversity in the

standards individual schools apply in rating student clinical performance. Furthermore, the length of clerkship and the time of the year the student is in the clerkship also affects performance. These authors also confirm scores on Step 1 exam and subject tests can be used to identify students at risk for poor performance on the Step 2 exam.

Ostoepathic Medicine. Several studies also report variables associated with COMLEX performance. Academic performance (as measured by GPA and grades during the first two years of medical school) is strongly associated with COMLEX Level 1 performance (Baker, Foster, et al., 2000, Hartman, Bates, & Sprafka, 2001). In one study, preadmission GPA and performance on the MCAT exam did not significantly relate to COMLEX Level 1 performance (Baker, Cope, Fisk, Gorby, & Foster, 2000). This contradicts the findings associated with USMLE performance.

Nursing Licensure Examination

Categories of Licensed Individuals Who Provide Nursing Care

There are several levels of licensed practitioners that provide nursing care. These include licensed practical nurse (LPN) (in some states, they are referred to as licensed vocational nurse), registered nurse (RN), and nurses who have advanced practice roles such as clinical specialist, nurse practitioner, and nurse mid-wife. Nurses in advanced practice roles are RNs who have undergone additional education and examination to meet advanced certification or licensure requirements.

Significant differences between LPNs and RNs exist regarding educational requirements as well as the role they play in the delivery of patient care. For this reason, the licensure examination also differs. Although the LPN is capable of providing basic nursing care, this is done under the supervision of the RN (ANA, 1998). The RN has a

sophisticated and dynamic role in the organization, coordination, and evaluation of care as it relates to the patient and family. Part of the role of the RN is the delegation of tasks (as defined by the state nurse practice act) to another designated caregiver. This includes delegating the delivery of basic nursing care to the LPN (ANA, 1998).

Graduates of LPN programs take the National Council Licensure Examination for Practical Nurses (NCLEX-PN). Like the NCLEX-RN, NCLEX-PN is developed and administered by National Council, however, it reflects entry level practice of the LPN.

The RN can be a graduate of a diploma program, associated degree program, or a baccalaureate degree program. Although the educational tracts are very different in philosophy and type course work covered, graduates from all types of RN programs take the same licensure examination.

Variables Associated with Success on Nursing Licensure Examinations

For years, nursing licensure examinations have been the focus of nursing research in attempts to identify variables associated with success. The focus of research related to nursing licensure examinations has primarily been associated with the RN examinations because this is considered entry into professional nursing practice. Research concerning variables associated with performance on the LPN examinations are limited. Ostrye (2000) suggests a major factor explaining this is the absence of LPN programs associated with research institutions. Since the nursing licensure examination has changed over time, discussion of the research conducted is organized by studies from each era. These eras include the State Board Test Pool Examination, and two generations of the NCLEX-RN.

Variables Associated with SBTPE Performance

The first national licensure examination for nurses was the State Board Test Pool Examination (SBTPE). This examination was in use from mid 1940s through 1982. This examination consisted of five distinct examinations from each of the following content areas: medical nursing, surgical nursing, obstetrical nursing, psychiatric nursing, and nursing of children. A separate performance score was reported for each of these areas thus, it was possible to research performance variables for individual sections as well as the examination as a whole (Yocom & Scherubel, 1985). Studies included in this section are those that involved research participants that wrote the licensure examination prior to 1982.

Several studies reported SAT scores to be a reasonable indicator of eventual success on SBTPE (Backman, 1971; Miller, Feldhusen, & Ashner, 1968; Reed & Feldhusen, 1972; Tillinghast & Norris, 1968). The National League for Nursing (NLN) Achievement Test was found to be a significant predictor in several studies as well (Brandt, Hastie, & Schumann, 1966; Melcom, Venn, & Bausell, 1981; Mueller & Lymann, 1969; Shelley, Kennamer, & Raile, 1976; Stronk, 1979). Muhlenkamp (1971) found the best predictors to be a combination of NLN scores and 7th semester GPA.

Academic success as measured by prerequisite nursing GPA, and grades in nursing theory courses was also reported as a reliable predictor of SBTPE success (Brandt, Hastie & Schumann, 1966; Muhlenkamp, 1971; Stronk, 1979). Yocom & Scherubel (1985) reported that cumulative nursing theory GPA was more highly correlated than cumulative nursing practicum GPAs.

Only a few studies were found that involved minority students. Boyle (1986) found that ACT scores were the most predictive of SBTPE performance in a study involving minority students. Dell & Halpin (1984) found that college GPA, SAT scores, and NLN Pre-Nursing Examination scores were significantly different between those who failed and passed the SBTPE in a predominately black nursing program.

Variables Associated with NCLEX-RN Performance

The NCLEX-RN exam was first implemented in 1982. Since then, several changes have occurred including the way in which performance is reported (from an actual score, to pass/fail), changes in test content, method of test administration (from a pencil and paper test to a computer adaptive testing format), and increases in passing standard. Wall, Miller, and Widerquist (1993) as well as Waterhouse, Carroll, and Beeman (1993) suggested that because of these changes, the variables associated with NCLEX-RN success might be different for the post-1988 examination. For this reason, a heavier emphasis of the literature review will involve studies done reflecting examination data after 1988.

Pre-1988 NCLEX-RN

Many studies were done following the introduction of NCLEX-RN in attempts to determine if variables associated with success were different with the new exam. The focus of these studies were similar to those reported for the SBTPE - academic predictor variables (both pre-admission and nursing school) such as SAT scores, ACT scores, GPA, success in pre-nursing courses, nursing theory courses, clinical courses, and demographic variables. Perhaps the best summarization of known predictor variables from early NCLEX-RN studies is reported by Campbell and Dickson (1996). Their

research involved an integrative review and meta-analysis of 47 studies performed between 1981 and 1990 that included candidates who took NCLEX-RN before 1988. According to this study, GPA in nursing and science courses were the strongest academic predictors of NCLEX-RN success, while age and parental education were the strongest demographic predictors of success.

Post-1988 NCLEX-RN Research

Since 1988, studies have continued to investigate multiple variables in two primary categories: academic variables and non-academic variables. Academic variables include cumulative GPA (CGPA), nursing school GPA (NGPA), standardized tests, performance in certain courses, and performance on assessment tests. Non-academic variables include the typical demographic variables (age, gender, and ethnicity) as well as variables associated with one's personality. The relationship between critical thinking and NCLEX-RN performance has been investigated in a few studies; these will be discussed in the sections that follow.

Academic variables. There has been great interest in identifying pre-admission academic variables, as these findings have influenced admission requirements for many nursing programs. Nursing programs also have been interested in identification of variables once students are in the nursing program. These become important in the identification of "high risk" students so that remedial work may be offered before graduation.

The most common pre-admission variables that have been investigated include SAT scores, ACT composite, mathematics and verbal scores, high school GPA, high-school rank, pre-nursing grade point average, and performance in prerequisite science

courses. Studies conducted by Waterhouse et al. (1993) and Alexander and Brophy (1997) found that the SAT verbal score was a reliable indicator of NCLEX-RN performance. Roye (1997) found that ACT and SAT composite scores, as well as GPA, were all higher for those students who passed NCLEX-RN as opposed to those students who failed the exam. Yellen and Geoffrion (2001) found differences an entrance reading exam score between those who passed and failed NCLEX-RN. While it was not clear what type of reading exam used, these researchers suggest that reading level was not only related to performance in various nursing courses, but also to NCLEX-RN performance. High school rank was the only significant pre-college indicator of NCLEX-RN success in a sample of baccalaureate nursing students (Wall et al., 1993). Beeson and Kissling (2001) found that those who successfully passed NCLEX-RN had significantly higher biology and sophomore GPAs than those who failed. Similarly, Wall et al. (1993) and Waterhouse et al. (1993) both found sophomore GPA to be predictive. Roncoli, Lisanti, and Falcone (2000), reported students with As or Bs in science prerequisites (anatomy, physiology, biology, inorganic and organic chemistry, and microbiology) were significantly more likely to pass NCLEX-RN than students who achieved C grades or repeated courses. In a study involving students from an associate degree program, Drake and Michael (1995) contradicted findings described above. These researchers found that achievement in high school or in college prior to admission to the nursing program has little validity in predicting which students ultimately pass the NCLEX-RN. It is possible these findings differ because of differences in the sampling process.

Nursing research has shown that once students are in a nursing program, there are variables associated with students who are more likely to successfully pass NCLEX-RN.

Although these variables are not useful from a program admission standpoint, they are useful in identifying "high risk" students for NCLEX-RN failure. Several studies identified poor achievement in courses within the nursing program as significant predictors. Although different studies investigated a different mix of courses, the commonality is that students who do poorly in one or more nursing courses are at increased risk for NCLEX-RN failure (Barkley, Rhodes, & Dufour, 1998; Beeson & Kissling, 2001; Endres, 1997). CGPA and NGPA have also been found to be significant variables associated with NCLEX-RN performance in a number of studies (Alexander & Brophy, 1997; Beeson & Kissling, 2001; Drake & Michael, 1995; Roncoli et al., 2000; Wall et al., 1993; Waterhouse et al., 1993).

Standardized assessment tests given to nursing students also have been shown to be significant predictors of NCLEX-RN success in a number of studies. Some studies found the National League for Nursing (NLN) Achievement Test was predictive (Alexander & Brophy, 1997; Barkley et al., 1998; Brisco & Anema, 1999; Schmidt, 2000; Wall, et al.1993). Beeson and Kissling (2001), and Endres (1997) found that the Mosby Assess Test was a significant predictor of NCLEX-RN success. Nurse researchers recently evaluated the predictability of a computerized comprehensive nursing exam, the Health Education Systems, Inc (HESI) Exit Exam on NCLEX success. In three separate studies, researchers found the HESI Exit Exam to be highly predictive of success on the NCLEX-RN and NCLEX-PN exams (Lauchner, Newman, & Britt, 1999; Newman, Britt, & Lauchner, 2000; Nibert, & Young, 2001). The value of this particular exit examination lies with the fact that the construction and presentation of questions are in a computerized format closely resembling the experience of taking the NCLEX.

Non-Academic variables. Demographic variables that have been explored in various studies include age, gender, and ethnicity. While none of the studies report gender to be a significant demographic variable, correlation with age and ethnicity have been reported by some studies and refuted by others.

Research conducted by Beeson and Kissling (2001), and Briscoe and Anema (1999) found age to be a significant variable. Both of these studies reported greater success on NCLEX-RN among older students. Alexander and Brophy (1997), and Roncoli et al. (2000) however, did not find age to be a significant variable.

Studies also have explored ethnicity as a variable. Briscoe and Anema (1999) found race to a significant variable associated with NCLEX-RN performance. They reported that students of African descent were most likely to perform poorly on the NCLEX-RN; for the other races (white-non-Hispanic, black non-Hispanic, and Hispanic) no significant correlation was demonstrated. Arathuzik and Aber (1998) found that students who do not speak English at home were less likely to be successful on the NCLEX-RN.

Ethnicity and NCLEX-RN success was a specific focus of a study conducted by Endres (1997). Results of this study found no significant differences between African American, foreign-born and white nursing graduates on NCLEX-RN. This study did find however, that there was a significant relationship between ethnicity and success on the NCLEX-RN with regard to the number of semesters needed to complete the nursing program. African American students who passed NCLEX-RN took significantly longer to complete the nursing program than foreign-born and white students who passed.

Variables associated with personal attributes have also been explored in a few studies. Arathuzik and Aber (1998) reported significant correlations between NCLEX-RN performance and several personal variables including English as primary language spoken at home, family responsibilities, emotional distress, and self-perceived competence in critical thinking. Poorman & Martin (1991) reported an inverse relationship between test anxiety and NCLEX-RN success. They also found that self-predicted performance was the best indicator of actual NCLEX-RN performance. In a qualitative study, Eddy and Epeneter (2002) found that participants who passed NCLEX-RN accepted responsibility for their own learning, were proactive in preparation for the exam, took the examination when they felt they were ready, and used stress management techniques to cope with this process. Participants who were unsuccessful perceived that their failure on NCLEX-RN was the responsibility of others, did not feel ready when they took the examination, and were less able to manage stress compared to those who passed.

Summary of Variables Associated with NCLEX-RN

The nursing literature consistently reports a difference in certain academic variables (such as SAT, ACT, CGPA, NGPA), and success in nursing courses, between nursing graduates who pass and fail the NCLEX-RN. Assessment tests such as the NLN Achievement Tests, Mosby Assess Test, and the HESI Exit Exam have consistently been shown to be effective predictors of performance. Research studies have not consistently reported a relationship between demographic variables (such as gender, age, and ethnicity) and NCLEX-RN success. A variety of personal variables such as anxiety, self-perception, primary language, emotional distress, family responsibilities, assumed responsibility for learning, and stress management have also been identified as variables

associated with NCLEX-RN performance. Unfortunately, these are not as well defined or easily measured as academic and demographic variables.

Research findings evaluating variables associated with NCLEX-RN performance are similar for both the pre-1988 and post-1988 NCLEX-RN exam. Furthermore, these findings are consistent with those reported for the SBTPE and for those reported on the medicine counterparts, COMLEX and USMLE. One obvious forgone conclusion that can be drawn from this analysis is that students who are successful in the programs of study are most likely to pass the licensure examination. The potential benefit from these studies however, has been not only gaining an understanding of what variables are most likely associated with success, but also gaining an understanding of factors associated with failure. Evaluation of additional variables is needed to continue to add to this body of knowledge.

Critical Thinking – Theory as a Variable of NCLEX-RN Performance

The second major focus of this literature review involves CT. Because the purpose of this dissertation research is to investigate the relationship of CT on NCLEX-RN performance, it is necessary to justify CT as a variable and its potential relationship to NCLEX-RN performance. Despite the fact that CT is a concept well embedded in general and nursing pedagogy, very few research studies have investigated CT as a variable of NCLEX-RN performance. The focus of this section will include definitions of CT found in the literature, CT as a component of professional nursing practice, CT and NCLEX-RN success, and CT in nursing research.

Definitions of Critical Thinking

Critical thinking is a common term used by many disciplines yet it is a term that many do not fully understand. CT is a complex concept that cannot be explained with a single, simple definition. The numerous definitions and interpretations of CT that appear in the literature from multiple disciplines give evidence to the complexity of this concept. Definitions of CT represent multiple perspectives related to goals, process, methodology, essential characteristics, and scope (Bandman & Bandman, 1995). CT is not associated with every useful cognitive process, rather it is described as "one among a family of closely related forms of higher order thinking, along with, for example, problem solving, decision making, and creative thinking" (P.A. Facione, 1990, p. 13.)

Robert Ennis, one of the pioneers in the CT movement, offers the following definition of CT: "Critical thinking is reasonable reflective thinking that is focused on deciding what to believe or do" (Ennis, 1987, p 12). Ennis contends that belief and action are connected, but preceded by thinking through reflectively about what to do and what to believe.

Richard Paul, a recognized authority of CT from philosophy, describes two distinct aspects of critical thinking: a narrow, weak sense and a broad, strong sense. The narrow weak sense involves skills that are extrinsic or external to the character of the person, consisting of formal, inductive, and informal logic. In the broad, strong sense, Paul views critical thinking as a process that is integrated within the individual, consisting of social conscious effort that is considered essential to the "free, rational, autonomous mind" (Paul, 1984, p. 11.)

A cross-disciplinary panel of CT experts sponsored by the American Philosophical Association formed a working group to complete a two-year Delphi project resulting in the conceptualization of CT in two broad dimensions: critical thinking skills and critical thinking dispositions (P.A. Facione, 1990). The Delphi Project proposed the following definition of the ideal critical thinker:

> The ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit" (P.A. Facione, 1990, p.3).

Until recently, nursing has primarily relied on definitions of critical thinking from other disciplines. Bandman and Bandman (1995) authored a critical thinking text from the perspective of nursing. These authors define critical thinking as "the rational examination of ideas, inferences, assumptions, principles, arguments, conclusions, issues, statements, beliefs, and actions" (p. 7). Scheffer and Rubenfeld (2000) report the results of a consensus definition of CT specific to nursing. An international panel of expert nurses participated in a Delphi study from 1995 to 1998 to form the following consensus definition:

> "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, 2000, p. 357).

This definition affirms the importance of the affective domain associated with CT as described by the Delphi definition reported by P.A. Facione (1990). The nursing experts, however, included two additional affective components – creativity and intuition. A concern remains however, that based on the way CT is addressed in nursing, a limited understanding of its meaning continues to exist within the discipline (Cody, 2002; Simpson & Courtney, 2002).

Critical Thinking as a Component of Professional Nursing Practice

Critical thinking is a widely valued outcome of education in all disciplines, but particularly in professional and higher education. There is no question that CT is one of the expected outcomes in nursing education because it is considered an essential component of professional practice (Hicks, 2001). Daly (1998) contends the need for CT in nursing is "founded upon the perceived domain complexity of nurses' clinical reasoning" (p. 329). Cody (2002) describes CT as a cornerstone of nursing practice, and suggests it should be expanded.

CT has such an important presence in nursing that the evaluation of CT has become a required outcome for nursing education programs undergoing accreditation (CCNE, 1998; NLNAC, 2001). This is further emphasized by its prominent presence in nursing curricula. In a national survey conducted by McEwen and Brown (2002), the most commonly reported concept emphasized in nursing curricula was critical thinking. Because CT is considered an important aspect of successful nursing practice, and because the NCLEX-RN is reflective of "current entry-level nursing practice"(NCSBN, 2000, p. 1), it is logical to explore CT as a predictor variable for NCLEX-RN performance.

Relationship Between Critical Thinking and Multiple Choice Testing

Evidence suggesting a relationship between CT and the NCLEX-RN can be found in the nursing literature. Alfaro-LeFevre (1995) stresses one of the motivating factors for teaching and learning CT is because "Critical thinking will be essential to pass the National Council Licensure Examination (NCLEX)" (p. 4). Theoretical application of multiple choice test construction to cognitive domains provides a framework for this link.

Taxonomy of cognitive domains. Bloom's *Taxonomy of Educational Objectives* organizes thinking skills or cognitive domains into six levels: knowledge, comprehension, application, analysis, synthesis, and evaluation (Bloom, 1956). Multiple choice test items can be written at each of these various cognitive levels.

Knowledge, the lowest level of cognition, is associated with memorization. Test questions written at the knowledge level require recall of information and recognition of the correct choice. The second level, comprehension, is merely recognition of facts stated in another way. In other words, it tests whether a student understands given information. In the context of nursing, these types of questions usually involve the interpretation of data. Both of these only require habitual thinking.

Test questions written at the third cognitive level, application, require that students apply new information to a different situation. These questions look at the ability of the student to solve a problem using information presented. Analysis, the fourth level, involves the analysis or examination of information. Multiple choice questions written at this level requires breaking down information in order to gain clarification and meaning. Questions written at the synthesis level "require the student to combine, synthesize or assemble information from two or more sources in order to draw

a conclusion" (Wendt, Holz, & Worcester, 1996, p. 18). Evaluation, the sixth cognitive level, requires the student make an evaluative judgment about information presented. Although multiple choice items can be written at the synthesis and evaluation level, essay and case study questions may be more appropriate (Wendt, et al., 1996).

Multiple choice items and critical thinking skills. Morrison and Free (2001) propose that the development of highly discriminating multiple choice items is a valid method of evaluating and measuring CT. Morrison, Smith, and Britt (1996) identify several criteria for writing CT multiple-choice questions which include: writing questions at the application level or above, use of multilogical thinking (that is viewing problems from different perspectives), and requiring a high level of discrimination to choose from plausible alternatives. Ideally, writing test questions which require CT should involve the application of concepts (Morrison & Free, 2001).

According to NCSBN (2000), items on the NCLEX-RN exam are written at various cognitive levels, however, the majority of questions are at the application and analysis level of cognitive ability. Wendt and Brown (2000) contend that NCLEX questions written at the analysis level "involve the application of critical thinking in order to effectively select the best or most immediate course of action in caring for the client" (p 299). Although NCLEX-RN is not written for the purpose of measuring CT ability, it is evident that at least some degree of CT ability is necessary in order to succeed on this examination.

This strength of this association is further validated when considering the high correlation that is reported between the Health Education Systems, Inc. (HESI) Exit Exam and the NCLEX-RN exam (Lauchner, et al., 1999; Newman, et al., 2000; Nibert &

Young, 2001). According to Nibert and Young (2001), the writers of the HESI exam used the model described by Morrison, et al. (1996) and Morrison and Free (2001) to develop CT test items. Furthermore, the testplan for the HESI follows the test blueprint for NCLEX-RN developed by NCSBN (2000).

Critical Thinking and NCLEX-RN Success

There are only a few research studies reported in the nursing literature that investigate CT as a variable of NCLEX-RN performance. Gross, Takazawa, and Rose (1987) examined the relationships between of CT ability, GPA, NLN preadmission test scores, and NCLEX-RN in a sample of associate degree and baccalaureate degree nursing students. In this study, CT was measured using the Watson Glaser Critical Thinking Appraisal (WGCTA). The researchers measured CT abilities of both associate and baccalaureate students upon the beginning and completion of nursing program. Both groups were reported to show an improvement in CT abilities between entry and exit. The researchers also found that while the first WGCTA score was not related to NCLEX-RN score, the WGCTA score upon completion of the program was ($r = .24, p < .05$). These researchers found that the best predictor of NCLEX-RN performance however, was GPA ($r = .67$). To determine the variance contributed by the various independent variables, NCLEX-RN was regressed on the second WGCTA score, NLN score, and CGPA. Under this procedure, the best and only reliable predictor of NCLEX-RN performance was CPGA.

Another study investigating the relationship between CT and NCLEX-RN was conducted by Bauwens and Gerhard (1987). These researchers conducted a correlation study examining CT ability measured by WGCTA and NCLEX-RN scores. The

WGCTA was administered at the beginning of the nursing program, and again at the completion. Unlike the results reported by Gross, et al. (1987) these researchers found no significant difference in scores between the first and second administration of the WGCTA. These authors however, did report a low, positive correlation between the WGCTA score and NCLEX-RN score. It is important to note that both of these studies (Gross, et al., 1987 and Bauwens & Gerhard, 1987) were conducted prior to 1988, thus are not reflective of the current pass/fail scoring system, test plan or current CAT testing format.

Since 1988, research involving CT as a variable of NCLEX-RN success has been limited to two dissertation studies and a study reported by the authors of critical thinking instruments. Hall (1995) examined the CT ability of a sample of baccalaureate nursing students to determine if the students had adequate CT skills, and to determine the existence of relationships between the following variables: CT, age, gender, level of cognitive development, socioeconomic status (as determined by whether the student had been awarded a Pell or North Dakota grant), ACT score, college GPA, and NCLEX success. Hall used the California Critical Thinking Skills Test (CCTST) for the measurement of CT ability. Hall concluded that the sample of senior nursing students did not have adequate CT skills. Positive associations were reported between CT, cognitive development, financial status, ACT score, and GPA. Hall reported that CT ability was significantly different between those students who passed and those who failed NCLEX ($t = 3.36, p = .002$). Furthermore, using logistic regression, Hall found two variables that showed positive associations that were significant for NCLEX-RN success: socioeconomic status ($p < .05$) and CT ability ($p < .01$).

Morris (1999) examined the relationships among the variables academic achievement, clinical decision making, CT, work experience, and NCLEX success among senior level baccalaureate nursing students. Like Hall (1995), Morris used the CCTST to measure CT ability. In Morris's sample, males demonstrated higher CT ability than did female counterparts, however, only 14 of 83 participants were male. Morris reported five variables that were statistically significant with NCLEX pass status in her sample: the type of previous health care work experience ($r = .32, p = .003$), the amount of previous health care work experience ($r = .27, p = .01$), CGPA ($r = .24, p = .03$), NGPA ($r = .30, p = .0005$), and CT scores ($r = .22, p = .05$).

N.C. Facione and P.A. Facione (1997) examined the relationship between CCTST scores and NCELX-RN success in a sample of 163 nursing students. These researchers reported a difference in the mean score of those who passed (17.02) and those who failed (12.00); these differences are statistically significant ($t = 3.267, df = 162, p = .001$).

Measurement of Critical Thinking

Critical thinking has been a component of all education disciplines for a number of years yet, there is little consensus regarding its definition, application or measurement. Many contend that critical thinking proficiency is a generalized skill with applicability to a variety of situations, thus can be tested with general-content critical thinking instruments. Some individuals within nursing suggest that critical thinking should be defined and measured within the context of nursing (Hicks, 2001; Scheffer & Rubenfeld, 2000). Although a consensus statement on critical thinking in nursing has been proposed by Scheffer and Rubenfeld (2000), no measurement instruments specific to the nursing discipline currently exist.

The most frequently used instrument to measure critical thinking in nursing research studies has been the Watson Glaser Critical Thinking Appraisal (WGCTA). In recent years, however, this tool has fallen from favor for use in nursing studies because it has been found to yield inconsistent results. The WGCTA is not considered reliable when applied to the nursing discipline (Adams, Whitlow, Stover, & Johnson, 1996; Hicks, 2001; Vaughn-Wrobel, O'Sullivan, & Smith, 1997).

Two newer instruments that have gained popularity with nurse researchers are the California Critical Thinking Skills Test (CCTST) and the California Critical Thinking Dispositions Inventory (CCTDI) (N.C. Facione & P.A. Facione, 1997). These instruments were designed based on a consensus definition from 46 experts on critical thinking (P.A. Facione, 1990).

Use of the CCTST and CCTDI in Nursing Studies

There are not yet a large number of published nursing studies that have used the CCTST and CCTDI as these are still considered relatively new. Most nursing studies using CCTST and/or CCTDI have focused on critical thinking as program outcome objectives. These tools have also been used in studies focusing on critical thinking in clinical practice settings.

McCarthy, Schuster, Zehr, and McDougal (1999) compared critical thinking abilities in beginning and graduating nursing students using the CCTST and CCTDI. This study reported significant differences in critical thinking from the sophomore year to the senior year. Additionally, significant differences were found between sophomores and seniors on the CCTDI not only in total score, but also in sub-test differences in truth-seeking, analyticity, self-confidence, and inquisitiveness.

Bowles (2000) investigated the relationship between critical thinking and clinical-judgment skills using the CCTST. Findings reported from this study demonstrated a relationship between critical thinking and clinical-judgment abilities. The author supported use of CCTST as an effective measurement of critical thinking in the nursing discipline. In a similar type of study, May, Edell, Butell, Doughty, and Langford (1999) used the CCTST and the CCTDI to investigate the relationship between critical thinking and clinical competency. The researchers however, failed to find a correlation between these two variables.

The CCTST and CCTDI were used in a study by Colucciello (1997) to assess critical thinking skills and dispositions among baccalaureate nursing students. It was reported that CCTST and CCTDI scores were highest among first-semester junior students followed by first semester and second semester senior students. It was also noted that GPAs in these groups were considerably different.

In a study involving community college nursing students, Bachman (1998) investigated anxiety, CT (as measured by CCTST and CCTDI), and age as performance predictors in the nursing program. She found both the CCTST and CCTDI to correlate with academic and clinical performance. Based on these findings, it would seem reasonable to expect CCTST and CCTDI to be related to NCLEX performance as well.

Walsh and Hardy (1999) used the CCTDI to measure dispositional differences in critical thinking among academic majors finding that English majors had the highest dispositions scores followed by psychology, nursing, history, education, and business majors.

Not all studies are supportive of the use of CCTST and CCTDI for the nursing discipline. Leppa (1997) described mixed experiences using the CCTST and CCTDI in efforts to measure critical thinking as an educational outcome. The author suggests using CCTDI along with other non-standardized methods to effectively evaluate critical thinking. Hicks (2001) raises concern that the CCTDI and CCTST lack construct validity because "they do not show clear relationships to measures of nursing judgment or decision making, nor do they covary with one another as theoretically expected" (p.16). In an investigation of the psychometric properties of the CCTST and CCTDI, Bondy, Koenigseder, Ishee, and Williams (2001) reported that the CCTST lacks sufficient psychometric properties to assess individual abilities or stability reliability.

Facione however, defends the validity of CCTST and CCTDI for use in the nursing discipline in an aggregate data analysis using these tools within nursing education programs (N.C. Facione and P.A. Facione, 1997). It is evident that further nursing research using the CCTST and CCTDI is necessary. Although not discipline specific, these appear to have validation for use as quantitative standardized measurement of critical thinking skills and dispositions in nursing research.

Literature Review Summary

The primary purpose of this literature review was to present previous research on variables associated with licensure examination performance – particularly NCLEX-RN. Overall, studies consistently report a relationship between academic performance and NCLEX-RN success. Based on these studies, one can generally assume that those students who demonstrate strong academic performance are likely to pass the NCLEX-

RN. Critical thinking is an expectation of the nurse entering professional practice, and the NCLEX-RN is reflective of this expectation. Although a few studies have addressed CT as a possible variable related to NCLEX-RN performance, this relationship is not yet well established. Hall (1995) and Morris (1999) both found a relationship with CCTST and NCLEX-RN performance, but both were relatively weak indicators. Neither Hall or Morris used the CCTDI in their study. One of the difficulties in evaluating CT as a predictor lies with adequately capturing the essence of CT independent from other cognitive constructs. The literature generally supports use of the CCTST and CCTDI in the nursing discipline – particularly since no discipline specific tool currently exists. This study used both measurement tools along with other known academic variables to investigate relationships of these variables with NCLEX-RN performance.

CHAPTER 3

METHODS

This chapter presents an overview of the research approach and design. The population and process used to identify and access the sample is also described. Three instruments of measurement were used in the study: the California Critical Thinking Skills Test (CCTST), the California Critical Thinking Dispositions Inventory (CCTDI) and the National Council Licensure Examination for Registered Nurses (NCLEX-RN). A description of these instruments as well as their validity and reliability will be described. This chapter will also describe the procedure used for data collection and analyses.

Research Approach

The purpose of this study was to investigate the relationship between critical thinking skills, critical thinking dispositions, and NCLEX-RN performance. Additionally, this study investigated changes in critical thinking over time and the possibility that a combination of variables (including CGPA, NGPA, critical thinking skills, and critical thinking dispositions) adds to the prediction of NCLEX-RN performance. Based on the questions proposed for this dissertation research, a quantitative paradigm using a non-experimental approach was employed. This approach allows for the examination of relationships between attribute independent variables and a dependent variable (Gliner & Morgan, 2000).

The non-experimental research approach was selected for this study based on the types of variables under investigation. There was no manipulation of the variables in this

study as the independent variables are attribute variables, nor was there random assignment of participants into groups. The researcher used existing data that had been collected by one nursing program since 1998, thus the study can be further described as comparative or ex-post-facto.

The advantage of this design is that it is a practical approach, and feasible. When interpreting the results of this study, it must be remembered that the findings are a reflection of the sample for this study. The sample is similar to the theoretical population in many respects, therefore it has a medium to high external validity (Gliner & Morgan, 2000). Results from this study can help guide policy makers in decisions related to variables used in this study.

Participants

The theoretical population for this study was baccalaureate nursing students in the United States. The sampling design is best described as convenience sampling. Gliner and Morgan (2000) describe this as the selection of a sample on the basis of convenience. The selected sample (N=279) was from one baccalaureate nursing program in the Southwest and included the first and last semester generic nursing students enrolled between 1998 and 2001. The actual sample was reduced further to include those individuals from the selected sample that had completed the instruments and whose NCLEX results were on file (N=218).

The nursing program from which the sample was drawn had a NCLEX-RN pass rate of approximately 93% between 1998 and 2001. In the years 1998-2001, there were approximately 18 failures from that program. According to Gliner and Morgan (2000), the sample size should be large enough to detect significant differences or relationships.

Measurement

Three instruments were utilized in this study for measurement purposes. The California Critical Thinking Skills Test (CCTST), the California Critical Thinking Dispositions Inventory (CCTDI), and the National Council Licensing Examination for Registered Nurses (NCLEX). Additional variables used in this study included NGPA and CGPA. NCLEX-RN results and GPAs were available from student records at the College of Nursing.

CCTST

The CCTST is a 34-item multiple-choice instrument designed to measure critical thinking skills in college-aged individuals. The examination measures core critical thinking skills of analysis, interpretation, inference, evaluation, and explanation. Because each item is written using standard English with no technical vocabulary, it is considered a non-discipline specific (or discipline neutral) instrument. Two statistically equivalent forms of the CCTST (Form A and Form B) are available.

This 45-minute examination generates six different scores. A total score, three subset scores representing critical thinking (analysis, evaluation, and inference) and subset scores for inductive reasoning and deductive reasoning. P.A. Facione and N.C. Facione (1998) offer descriptions of these various sub-scales. The sub-scale *Analysis* evaluates the examination of ideas, and the ability to analyze and detect arguments. *Evaluation* sub-scale evaluates one's reasoning ability related to assessing arguments and claims. The *Inference* sub-scale evaluates one's ability to question evidence, conjecturing alternatives, and drawing conclusions. The last two sub-scales (*Deductive Reasoning* and *Inductive Reasoning*) are based on the "purported logical strength of the

inference" (p. 6). *Deductive Reasoning* as a sub-scale measure means "the assumed truth of the premises purportedly necessitates the truth of conclusion" while *Inductive Reasoning* sub-scale refers to "an argument's conclusion is purportedly warranted, but not necessitated by the assumed truth of its premises" (p. 6).

The total score is reflective of the number of correct items out of 34. Percentile norms were established for the total score by P.A. Facione (1991) based on a pilot study using 781 college students. The mean, median, and mode reported for the CCTST total score was 15.89, 16.00 and 16.00 respectively. Percentile norms for nursing students are reported by N.C. Facione & P.A. Facione (1997). Total mean scores for junior and senior level nursing students was 16.11 and 16.40 respectively. These data are presented in Table 2.

Table 2
National Mean Scores for Junior and Senior Nursing Students on the CCTST

CCTST	Junior level students			Senior level students		
Scales	*N*	*M*	*SD*	*N*	*M*	*SD*
Total	1618	16.11	3.74	2611	16.40	3.55
Analysis	1095	4.49	1.24	1772	4.59	1.32
Evaluation	1097	5.46	1.78	1772	5.72	1.87
Inference	1097	5.84	1.61	1770	5.71	1.67
Deductive Reasoning	1030	7.49	2.21	1725	7.25	2.12
Inductive Reasoning	1031	6.71	1.83	1726	6.93	1.99

(N.C. Facione & P.A. Facione, 1997)

A sub-scale score measures the number of correct items for the sub-scales. Each item on the CCTST is assigned to one of the first three sub-scales (Analysis, Evaluation, and Inference) (P.A. Facione & N.C. Facione, 1998). The number of items for the sub-scales Analysis, Evaluation and Inference are 9, 14, and 11 respectively. Thirty of the 34 items are reclassified as either inductive or deductive reasoning (P.A. Facione & N.C.

Facione, 1998). There are a total of 16 items representing the Deductive Reasoning sub-scale and a total of 14 items on the Inductive Reasoning sub-scale. National norms for nursing students on the CCTST are reported by N.C. Facione and P.A. Facione (1997) and are found in Table 2. Inter-correlations between CCTST sub-scale scores are presented in Appendix B.

CCTDI

The CCTDI is an instrument that is designed to assess the extent to which a person possesses the dispositions of the ideal critical thinker. It does not measure skill, rather the affective attitudinal dimensions of critical thinking. The CCTDI uses 75 statements related to critical thinking dispositions. The statements are based on a 6-point Likert rating scale with response options ranging from "strongly agree" to "strongly disagree." The statements all express familiar beliefs, opinions, expectations, values, and perceptions. This instrument takes between 15 and 20 minutes to complete.

The CCTDI generates a total score and seven subscale scores: Truth-seeking, Inquisitiveness, Open-mindedness, Confidence, Analyticity, Systematicity, and Maturity. P.A. Facione and N.C. Facione (2001) describe the *Truth-seeking* scale as the disposition to seek the truth, being courageous to ask questions, being objective even if findings do not support one's interest or opinions. The sub-scale of *Inquisitiveness* measures intellectual curiosity, or the degree one values being well-informed. *Open-mindedness* is described as tolerance of divergent views, and respecting "the rights of others to hold differing opinions" (p. 2). The *Confidence* scale describes the level of trust one has in their ability to make good judgments. The *Analyticity* scale refers to the ability to anticipate potential difficulties, and the anticipatory intervention of problems. P.A.

Facione and N.C. Facione (2001) describe *Systematicity* scale as "the disposition toward organized, orderly focused, and diligent inquiry" (p. 3). Finally, the *Maturity* scale evaluates cognitive maturity and the tendency for a person to make reflective judgments.

Total scores range from 70 to 420. According to P.A. Facione and N.C. Facione (2001), a total score above 350 can be interpreted as "across the board strength in the disposition toward CT" (p. 13). A total score less than 280 can be interpreted as an indication of "overall deficiency in the disposition toward CT" (p.13). Scores falling between 210 and 280 fall in the "ambivalent range" while scores below 210 indicate "significant opposition toward critical thinking" (p. 13).

Sub-scale scores range from 10 to 60. The interpretation of the sub-scale scores is that scores in the 40-60 range indicate "an increasingly positive disposition"; scores between 30-40 indicate "ambivalence toward the disposition"; and scores ranging from 10 to 30 are indicative of "more intensely negative disposition" (P.A. Facione & N.C. Facione, 2001, p. 13). National norms for nursing students on the CCTST are reported by N.C. Facione and P.A. Facione (1997) and are found in Table 3.

Table 3
National Mean Scores for Junior and Senior Nursing Students on the CCTDI

CCTDI	Junior level students			Senior level students		
scales	*N*	*M*	*SD*	*N*	*M*	*SD*
Total	817	308.0	27.8	1035	311.4	33.7
Truth-seeking	817	38.2	6.0	1041	38.7	4.8
Open-mindedness	817	44.7	5.0	1040	45.1	4.7
Analyticity	817	43.5	5.6	1039	44.0	4.4
Systematicity	817	43.7	5.6	1038	43.8	5.2
Confidence	817	43.3	5.9	1040	44.6	5.5
Inquisitiveness	817	48.4	5.6	1040	48.8	4.9
Maturity	817	46.0	5.7	1039	46.1	4.8

(N.C. Facione & P.A. Facione, 1997)

NCLEX-RN

The NCLEX-RN is a criterion-referenced, comprehensive examination based on the NCLEX-RN test plan which reflects current entry-level nursing practice. This includes knowledge, skills, and abilities essential for the nurse to meet the needs of clients requiring the promotion, maintenance, and restoration of health (NCSBN, 2000). The examination consists of questions written at the cognitive levels of knowledge, comprehension, application, and analysis, however, the majority of questions are written at the application and anlaysis level of cognitive ability.

The NCLEX-RN is administered using the computerized adaptive testing (CAT) method. The basis for CAT is item response theory. Each question has a measurable level of difficulty and each examinee has a measurable level of ability. NCSBN uses Rasch measurement theory (a type of item response theory) to produce a measure of a candidate's entry-level nursing competence. The Rasch model calibrates the difficulty of questions and an estimate of the examinee's ability, thus the difference between the difficulty of the test question and the ability of the examinee determines the probability of a correct response (Lunz & Bergstrom, 1991).

According to the NCLEX-RN Test Plan (NCSBN, 2000), all test questions are stored in a large test item pool and are classified by test plan area and level of difficulty. As the test progresses, the computer continually calculates a competence estimate. The computer selects each question based on the answers and the level of difficulty of previous questions. The process is repeated for each question creating an examination tailored to the candidate's ability. The examination continues until a pass or fail decision is made. For this reason, each candidate's examination is unique – furthermore the

number of questions a candidate answers varies from a minimum of 75 questions to a maximum of 265 questions during a five-hour maximum testing period. Because the NCLEX-RN is based on a calculated competency estimate, NCLEX performance is reported simply as pass or fail (NCSBN, 2000).

Measurement Reliability and Validity

Reliability of measurement refers to the degree that an instrument is consistent. Measurement validity on the other hand, refers to the quality of a measure. It is concerned with "how well an instrument measures a construct for a given purpose in a given population" (Gliner & Morgan, 2000, p. 416.) Measurement validity is further described by content validity, criterion validity, and construct validity. Content validity is described in terms of the content of instrument relative to the concept it is attempting to measure. Content validity can not be directly measured; rather it is based on judgment. Content validity can be established by basing the instrument on concept representation in the literature, or though a panel of experts in the content area (Gliner & Morgan, 2000). Criterion validity is the validation of an instrument against an external criterion. The instrument is said to have criterion-related validity if scores on the instrument correlate with the criterion (Polit & Hungler, 1999). Construct validity describes the measurement of a concept that cannot be directly observed. Construct validity is gained by finding evidence that the instrument is based on underlying theory.

CCTST

The Kuder Richardson-20 (KR-20) internal consistency reliability estimate for the CCTST is ranges between .68 and .70 (N.C. Facione, and P.A. Facione, 1997). According to P.A. Facione and N.C. Facione (1998), a KR-20 between .65 and .75 is

"desirable" for this type of instrument (p.15). Based on this information, the CCTST has an acceptable reliability.

The CCTST was developed out of the cross-disciplinary expert consensus definition of critical thinking (P.A. Facione, 1990), thus is supportive of both face validity and content validity. Evidence of discriminant construct validity is based on results of a validation study conducted by P.A. Facione (1991). Significant growth in CT skills was measured in groups of students who had completed approved CT instruction compared to control groups who had not received instruction. P.A. Facione concluded that the finding "supports the validity of the CCTST as a measure of CT skills, the targeted phenomenon" (p. 14). Another indication of construct validity is the significant, strong correlation between CCTST and ACT scores ($r = .402$, $p < .001$); GRE total scores ($r = .719$, $p < .001$); GRE analytic scores ($r = .708$, $p < .001$); GRE verbal scores ($r = .716$, $p < .001$); SAT verbal scores ($r = .545$, $p < .001$); and SAT math scores ($r = .422$, $p < .001$) (Facione P.A. & Facione, N.C., 1998).

CCTDI

A high degree of evidence of reliability of the CCTDI is reported based on a Cronbach's alpha for internal consistency of 0.91 for the total score and a range of 0.71 to 0.80 for the sub-scale scores (P.A. Facione & N.C. Facione, 2001). Like the CCTST, the CCTDI is conceptually grounded to the Dephi Report definition giving it content validity (P. Facione, 1990). Construct validity is demonstrated with relationships reported between several dispositions total and sub-scales and SAT verbal scores and ACT scores. SAT verbal scores correlate with the CCTDI Total Score ($r = .291$, $p<.002$), Open-mindedness sub-scale ($r = .325$, $p < .001$); Analyticity sub-scale ($r = .213$, $p < .026$), and

Maturity sub-scale ($r = .333, p < .001$). ACT scores correlate with the CCTDI Total Score ($r = .223, p < .001$); Open-mindedness sub-scale ($r = .198, p < .001$), Analyticity sub-scale ($r = .200, p < .001$), and Maturity sub-scale ($r = .200, p < .001$). (N.C. Facione & P.A. Facione, 1997).

NCLEX-RN

The reliability of the NCLEX-RN examination is based on a decision consistency statistic that generates two probabilities: the probability that the candidate's true ability is above passing, or the probability that the candidate's true ability is below passing. The NCSBN reports that the decision consistency statistic of the NCLEX is psychometrically sound and typically falls between .87 and .92. (NCSBN, 2001). NCSBN uses Rasch measurement theory to produce a measure of a candidate's entry-level nursing competence.

Content validity of the NCLEX-RN is ensured by inviting panels of qualified volunteers from around the country to serve as item writers. These individuals are from a wide variety of backgrounds covering the entire spectrum of different specialties and nursing practice settings. To determine the areas of questions to include on the exam, every three years an evaluation of entry level practice is conducted. This analysis is used to develop the NCLEX Test Plan, which is the basis for the development of the test (NCSBN, 2000). Face validity review is conducted by the NCSBN that involves periodic review of simulated examinations by experienced test developers to ensure that balance of content appears to represent the domain of nursing. Validity is further achieved by pre-testing examination items. During an examination, each candidate is given 15 items that are being tested as possible test items for future NCLEX-RN. These items are not

counted toward a total score, rather data are collected to determine the difficulty of each item.

Procedure

This ex-post-facto study involved the organization and analysis of data made available to the researcher by the nursing program. The nursing program has administered the CCTST and CCTDI to students at the beginning of the nursing program (entry scores) and again during the last semester of the nursing program (exit scores) since 1998. The first complete paired data for entry and exit scores were available for the nursing students who graduated in Spring 2000. Individual student scores on the CCTST and CCTDI were matched with NCLEX-RN performance (pass or fail), NGPA, and CGPA. Demographic data including gender, age at graduation, and ethnicity were also included. These data were available within the college of nursing. To maintain confidentiality of student records, data were matched by the university and then forwarded to the researcher with a numerical code eliminating identifiers.

Steps taken to gain access to these data included approval of the research proposal by the researcher's committee and approval from the Human Research Committee at Colorado State University as well as approval from the Human Subjects Review Board from the university affiliated with the nursing school. Furthermore, the researcher had meetings with the Associated Dean for Research and Clinical Scholarship at the nursing program, and with faculty involved with the administration of the CCTST and CCTDI at the nursing school.

Data Analysis

The analysis of data involved several statistical applications based on the research questions posed in Chapter 1. Descriptive statistics were used to illustrate demographic data and to compare data from this sample to established norms for nursing students. Comparative and association statistics were used to analyze the primary research questions. The following section is divided into sections based upon the type of research questions. After each section, the statistics used are explained.

Four questions examined differences in critical thinking scores between those who passed or failed the NCLEX-RN examination. These questions are:

1. Is there a difference in performance on the entry CCTST between individuals who pass or fail the NCLEX-RN examination?
2. Is there a difference in performance on the entry CCTDI between individuals who pass or fail the NCLEX-RN examination?
3. Is there a difference in performance on the exit CCTST between individuals who pass or fail the NCLEX-RN examination?
4. Is there a difference in performance on the exit CCTDI between individuals who pass or fail the NCLEX-RN examination?

An independent *t*-test was used to compare the performance of the two groups (those who passed, and those who failed) on the CCTST and CCTDI.

Two of the questions posed related to changes in critical thinking over time.

5. Is there a change in critical thinking scores for the whole sample between the entry and exit CCTST or CCTDI?

6. Is there a difference in change scores for the CCTDI or CCTST between individuals who pass or fail the NCLEX-RN examination?

For question five, a paired (dependent t-test) was used to determine if differences (improvements) were recognized between the first and last semester of nursing school for the entire sample. For question six, an independent *t*-test was used to compare gain scores of the two groups (those who passed and those who failed) to determine if significant differences existed between the groups.

The seventh question looked at associational (correlational) relationships between a variety of interval variables to see if CT added to the prediction of NCLEX-RN success provided by other variables.

7. Do the CT scores add to the prediction of NCLEX-RN performance based on NGPA, CGPA or ACT?

The statistical analysis employed for the final question was heirarctical multiple regression and discriminate analysis to predict the dependent variable from the independent variables. NGPA, and CGPA would be entered in the first step followed by CCTST and CCTDI scores. This analysis would determine whether CCTST or CCTDI added to the prediction of NCLEX-RN success.

CHAPTER 4

RESULTS

The purpose of this ex-post-facto research study was to investigate the relationship of critical thinking (CT) to NCLEX-RN performance in baccalaureate nursing students. The theoretical population for this study was baccalaureate nursing students in the United States. The selected sample included all generic nursing students (those students with no previous nursing degree) of one baccalaureate nursing program in the Southwest who graduated in 1998 through 2001. There were a total of 279 individuals in the selected sample. The actual sample was delimited to individuals from the selected sample that had completed the critical thinking instruments (CCTST and/or the CCTDI) and whose NCLEX-RN results were available. The actual sample consisted of 218 participants from the selected sample. A total of 61 individuals from the selected sample were not included due to lost, unidentifiable, or unattainable data.

Description of the Sample

Gender and Age

The gender and age of the sample was similar to demographic trends for newly licensed nurses at the national level. Table 4 shows that the gender distribution of the sample was 90% female and 10% male. By comparison, the gender distribution for newly licensed registered nurses in 1997 reported by the National Council of State Boards of Nursing (NCSBN) (2002) was 88% female and 12% male. The age of sample participants

ranged from 22 to 57 with a mean age of 30.3. The NCSBN (2002) reported an age range of 19 to 63 years of age and a mean age of 29.3 for newly licensed registered nurses in 1997.

Table 4

Demographics of the Sample Compared to Population of Newly Registered Nurses (N=218)

Attribute	Sample		Population of newly registered nurses
	n	Percent	Percent
Gender			
Male	22	10.1%	11.7%
Female	196	89.9%	87.9%
Ethnicity			
American Indian or Alaskan	4	1.8%	0.8%
Black non-Hispanic	5	2.3%	6.2%
Asian or Pacific Islander	12	5.5%	4.6%
Hispanic	55	25.2%	3.6%
White non-Hispanic	133	61.0%	80.4%
No Data Available	9	3.9%	3.4%

Ethnicity

The ethnic distribution of the sample was different compared to that seen on the national level. Table 4 shows that approximately 39% of the sample were minority (non-white) individuals, while the percent of minority individuals for newly registered nurses in the United States was approximately 20%. The most obvious difference is the percentage of individuals identified as Hispanic. These differences are most likely associated with regional population demographics from which the sample was drawn.

Critical Thinking Skills

The sample can be also compared to other groups of nursing students based on mean scores for the California Critical Thinking Skills Test (CCTST). A one-sample *t*-test was done to compare mean scores at both the junior and senior level. Table 5

presents the mean scores of the sample compared to national mean scores, as well as the results of the *t*-test comparing the two mean scores.

Table 5

Comparison of CCTST Performance of the Sample to Established National Nursing Student Norms (Junior Level Sample N=103; Senior Level Sample N=193)

CCTST scales	Sample scores		National scores		One-Sample *t*-test			Effect size
	M	*SD*	*M*	*SD*	*t*	*df*	*p*	*d*
Junior Level								
Total score	16.0	4.0	16.1	3.7	−.30	(102)	.76	
Analysis	4.3	1.7	4.5	1.2	−.88	(102)	.38	
Evaluation	5.6	5.2	5.5	1.8	.66	(102)	.51	
Inference	6.1	1.7	5.8	1.6	1.28	(102)	.20	
Inductive Reasoning	6.9	2.1	6.7	1.8	.95	(102)	.34	
Deductive Reasoning	7.4	2.4	7.5	2.2	−.37	(102)	.71	
Senior Level								
Total score	16.5	4.9	16.4	3.6	.26	(192)	.79	
Analysis	4.8	1.6	4.6	1.3	1.49	(192)	.14	
Evaluation	5.8	2.5	5.7	1.9	.14	(192)	.89	
Inference	5.9	2.1	5.7	1.7	1.77	(192)	.08	
Inductive Reasoning	6.8	2.5	6.9	2.0	−.62	(192)	.54	
Deductive Reasoning	7.7	2.8	7.3	2.1	2.32	(192)	.02*	.2

*$p < .05$.

The one-sample *t*-test revealed that the differences between the means were not statistically significant with the exception of senior level (exit) sub-scale Deduction. The effect size however, is small. These results indicate that the sample is similar to other nursing student groups in critical thinking skills both at the beginning and end of the nursing program. This is an important finding in terms of generalizing CCTST results from this study.

Critical Thinking Disposition

The mean scores for the sample group were also compared to national nursing student norms on the California Critical Thinking Disposition Inventory (CCTDI). The

sample scored somewhat higher (but not necessarily significantly higher) on the CCTDI total score and each of the sub-scale scores compared to the national mean scores at both the junior and senior level. These data are presented in Table 6.

Table 6

Comparison of CCTDI Performance by the Sample Group to Established National Nursing Student Norms (Junior n=103; Senior n=185)

CCTDI scales	Sample scores		National scores		One-Sample t-test		Effect size
	M	*SD*	*M*	*SD*	*t df*	*p*	*d*
Junior Level							
Total Score	317	24.3	308	27.8	3.8(102)	.001**	.32
Truth-seeking	40.1	5.6	38.2	6.0	3.3(102)	.001**	.32
Open-mindedness	45.9	5.3	44.7	5.0	2.3(102)	.027*	.24
Analyticity	44.4	4.9	43.5	5.6	1.9(102)	.062	
Systematicity	44.8	6.2	43.7	5.6	1.9(102)	.060	
Confidence	43.8	6.4	43.3	5.9	.83(102)	.410	
Inquisitiveness	50.5	5.8	48.4	5.6	3.7(100)	.001**	.37
Maturity	47.5	4.9	46.0	5.7	2.9(102)	.004**	.27
Senior Level							
Total Score	318	24.3	311	33.7	3.8(184)	.001**	.20
Truth-seeking	40.3	5.9	38.7	4.8	3.7(184)	.001**	.32
Open-mindedness	45.8	6.4	45.1	4.7	1.5(184)	.139	
Analyticity	44.7	6.3	44.0	4.4	1.6(184)	.122	
Systematicity	45.3	6.6	43.8	5.2	3.0(184)	.003**	.28
Confidence	45.2	6.7	44.6	5.5	1.2(184)	.244	
Inquisitiveness	49.6	5.9	48.8	4.9	1.9(184)	.050*	.16
Maturity	47.9	5.4	46.1	4.8	4.6(184)	.001**	.37

*p < .05. **p < .01.

A one-sample *t*-test was done to compare mean scores between the two groups. Table 6 presents results of the *t*-test between the sample and national student nurse mean scores. A difference in mean scores was identified in five of eight junior level (entry) CCTDI scores (Total Score, Truth-seeking, Open-mindedness, Inquisitiveness, and Maturity) and five of eight senior level (exit) CCTDI scores (Total Score, Truth-seeking, Systematicity, Inquisitiveness, and Maturity). The effect size for these varies from a

small effect to a small to medium effect. These results suggest that the sample had greater critical thinking disposition than typical nursing students did, both at program entry and at graduation.

NCLEX-RN Performance

The sample was further compared to national nursing student populations based on NCLEX-RN performance. The sample NCLEX-RN pass rate was 93% (200 passed, 16 failures) on the first attempt. The national pass rate for NCLEX-RN was 84.5% (approximately 253, 600 passed, 46, 480 failures) between 1998 and 2001. The difference between these two independent proportions was found to be significant ($z= 3.35$; $p< .001$) indicating that the sample had a higher degree of success on the NCLEX-RN compared to national averages.

Summary of Sample Description

In summary, the sample was similar to the national population of nursing graduates from an age, gender, and critical thinking skills perspective. Differences between the sample and national population were seen with ethnic distribution, critical thinking dispositions and NCLEX-RN performance. The sample had a much larger percent of minority (particularly Hispanic) individuals. Additionally, the sample demonstrated a higher CCTDI Total Score along with several subscale scores (both at entry and exit), and a higher NCLEX-RN pass rate compared to the national average.

Examination of the Research Questions

Differences in Entry Critical Thinking Skills and Dispositions Between Those Students Who Pass and Fail NCLEX-RN

The first two questions involve differences in performance on entry CCTST and

CCTDI scores between those who pass and fail NCLEX-RN.

1. Is there a difference in performance on the entry CCTST between individuals who pass or fail the NCLEX-RN examination?
2. Is there a difference in performance on the entry CCTDI between individuals who pass or fail the NCLEX-RN examination?

Because the nursing program began administering the CCTST and CCTDI in 1998, entry scores were not collected for the graduating classes in 1998 or 1999. These data were collected for the graduating classes of Spring and Fall 2000 and 2001. Unfortunately, usable data were available for only three of four graduating classes. For this reason, the number in the sample is smaller for these two questions than for other questions that follow.

Data were analyzed using an independent *t*-test, comparing means of the various entry CCTST and CCTDI scores between those who passed and failed the NCLEX-RN. The NCLEX-RN performance (pass/fail) was the independent variable while the total scores and sub-scale scores were the dependent variables. The pass and fail groups were also compared to national nursing student mean scores for junior level entry CCTST and CCTDI using a one-sample *t*-test to compare mean scores.

Entry CCTST. The CCTST generates a total score and five sub-scale scores. Table 7 shows that the pass group scored somewhat higher than the fail group on each of the six scores upon program entry. Table 7 also shows *t*-test results. The difference in means for three scores (Total Score, Analysis, and Deductive Reasoning) between those who passed and failed NCLEX-RN were statistically significant, each with a very large effect size. The sub-scale scores Evaluation, Inquisitiveness, and Inductive Reasoning were not found to be significant. These figures indicate that for this sample, those who

passed NCLEX-RN entered the nursing program with better CT skills in half of the sub-scale scores than those who failed NCLEX-RN.

Table 7

Comparison of Entry CCTST Scores Between Those Who Passed and Failed NCLEX-RN

CCTST scale	Group	*n*	Scores *M*	*SD*	*t*-test *t*	*df*	*p*	Effect size *d*
Total Score	Pass	96	16.3	4.0	2.5	(101)	.015*	1.0
	Fail	7	12.4	2.2				
Analysis	Pass	96	4.5	1.7	2.4	(101)	.017*	1.1
	Fail	7	2.9	1.1				
Evaluation	Pass	96	5.6	2.2	.39	(101)	.67	
	Fail	7	5.3	1.9				
Inference	Pass	96	6.2	1.5	2.2	(6.4)	.07	
	Fail	7	4.3	2.3				
Inductive	Pass	96	7.0	2.1	.29	(101)	.42	
Reasoning	Fail	7	6.3	1.4				
Deductive	Pass	96	7.6	2.4	3.0	(101)	.003**	1.2
Reasoning	Fail	7	4.9	1.7				

Note. For Inference sub-scale, the Levene test for assumption that variances of the two groups are equal was significant; therefore, equal variance not assumed.
*$p < .05$. **$p < .01$.

The sample pass and fail groups were also compared to national nursing student norms. Table 8 presents data for these comparisons. Results in Table 8 show that the pass group generally had slightly higher mean scores compared to national means scores. However, only the Inference sub-scale score was statistically significant with a small to medium effect size. Comparatively, all mean scores for those in the fail group were somewhat lower than national mean scores. Table 8 shows that three of six scores had statistically significant differences compared to national norms (Total Score, Analysis, and Deduction). The effect size calculations for these findings were very large. These findings show that while the pass group had similar critical thinking skills compared to national norms, the fail group demonstrated lower scores compared to national averages upon entry into the nursing program.

Table 8

Comparison of Entry CCTST Performance by the Pass and Fail Groups to Established National Nursing Student Norms at the Junior Level

CCTST		Sample scores		National scores		One-Sample *t*-test			Effect size
scale/group	*N*	*M*	*SD*	*M*	*SD*	*t*	*df*	*p*	*d*
Total Score									
Pass	96	16.3	4.0	16.1	3.7	0.3	(95)	.734	
Fail	7	12.4	2.2			–4.3	(6)	.005**	1.0
Analysis									
Pass	96	4.5	1.7	4.5	1.2	–0.2	(95)	.819	
Fail	7	2.9	1.1			–4.0	(6)	.007**	1.3
Evaluation									
Pass	96	5.6	2.2	5.5	1.8	0.7	(95)	.467	
Fail	7	5.3	1.9			–0.2	(6)	.817	
Inference									
Pass	96	6.2	1.5	5.8	1.6	2.2	(95)	.034*	0.3
Fail	7	4.3	2.3			–1.8	(6)	.122	
Inductive Reasoning									
Pass	96	6.9	2.1	6.7	1.8	1.1	(95)	.271	
Fail	7	6.3	1.4			–0.8	(6)	.451	
Deductive Reasoning									
Pass	96	7.6	2.4	7.5	2.2	0.4	(95)	.682	
Fail	7	4.9	1.7			–4.2	(6)	.006**	1.2

*$p < .05$. **$p < .01$.

Entry CCTDI. The CCDTI generates a total score and seven sub-scale scores. Table 9 presents data comparing entry group mean scores on the CCTDI between those who passed and failed NCLEX-RN . Those in the sample group who failed NCLEX-RN scored slightly higher than those who passed with the exception of Truth-Seeking sub-scale score. However, independent *t*-tests of these mean scores showed that these differences are not statistically significant. What this means is that on entry to the nursing program, individuals who passed and failed NCLEX-RN had similar critical thinking dispositions.

Table 9

Comparison of Entry CCTDI Scores Between Those Who Passed and Failed NCLEX-RN

CCTDI Scale	Group	*n*	Scores *M*	Scores *SD*	*t*-test results *t*	*df*	*p*
Total Score	Pass	96	316.8	24.4	–0.53	(7.0)	.61
	Fail	7	321.6	23.0			
Truth-seeking	Pass	97	40.1	5.6	0.17	(101)	.86
	Fail	7	39.7	6.6			
Inquisitiveness	Pass	96	50.5	5.9	–0.10	(101)	.92
	Fail	7	50.7	4.5			
Open-mindedness	Pass	96	45.8	5.3	–0.43	(101)	.62
	Fail	7	46.9	6.3			
Confidence	Pass	96	43.7	6.5	–0.91	(101)	.37
	Fail	7	46.0	6.0			
Analyticity	Pass	96	44.4	5.0	–0.63	(101)	.53
	Fail	7	45.6	3.8			
Systematicity	Pass	96	44.8	6.4	–0.14	(101)	.89
	Fail	7	45.1	3.5			
Maturity	Pass	96	47.5	5.2	–0.09	(101)	.97
	Fail	7	47.6	1.5			

Note. For the Total Score, the Levene test for assumption that variances of the two groups are equal was significant; therefore, equal variance not assumed.

The pass and fail groups also were compared to the national mean scores. Table 10 presents the comparisons of entry CCTDI performance by the sample pass and fail groups to established national nursing student norms at the Junior level. The pass group demonstrated statistically significant higher mean scores compared to the national mean scores in four of eight scores (Total Score, Truth-seeking, Inquisitiveness, and Maturity). The effect size for these ranged from small-medium to large. While the fail group also had slightly higher mean scores compared to national mean scores, a statistical significance was only found on the Maturity sub-scale score. The small number in the fail group may explain the lack of statistical significance for many of these other scores.

Table 10

Comparison of Entry CCTDI Performance by the Pass and Fail Groups to Established National Nursing Student Norms at the Junior Level (Pass Group n=96; Fail Group n=7)

CCTDI scale	Group	Sample scores *M*	*SD*	National scores *M*	*SD*	One-Sample *t*-test *t*	*df*	*p*	Effect size *d*
Total Score	Pass	316.8	24.4	308.0	27.8	3.5(95)		.001**	.29
	Fail	321.6	23.0			1.6(6)		.169	
Truth-seeking	Pass	40.1	5.6	38.2	6.0	3.3(95)		.001**	.32
	Fail	39.7	6.6			0.6(6)		.573	
Inquisitiveness	Pass	50.5	5.9	48.4	5.6	3.5(95)		.001**	1.1
	Fail	50.7	4.5			1.4(6)		.224	
Open-mindedness	Pass	45.8	5.3	44.7	5.0	2.1(95)		.042*	.43
	Fail	46.9	6.3			0.9(6)		.403	
Confidence	Pass	43.7	6.5	43.3	5.9	0.6(95)		.577	
	Fail	46.0	6.0			1.2(6)		.287	
Analyticity	Pass	44.4	5.0	43.5	5.6	1.6(95)		.106	
	Fail	45.6	3.8			1.4(6)		.201	
Systematicity	Pass	44.8	6.4	43.7	5.6	1.8(95)		.083	
	Fail	45.1	3.5			1.1(6)		.309	
Maturity	Pass	47.5	5.2	46.0	5.7	2.8(95)		.007**	.24
	Fail	47.6	1.5			2.7(6)		.037*	.28

*$p < .05$. **$p < .01$.

Differences in Exit Critical Thinking Skills and Dispositions Between Those Students Who Pass and Fail NCLEX-RN

Question three and four involve determining if performance on exit CCTST and CCTDI scores differ between those who pass and fail NCLEX-RN

3. Is there a difference in performance on the exit CCTST between individuals who pass or fail the NCLEX-RN examination?
4. Is there a difference in performance on the exit CCTDI between individuals who pass or fail the NCLEX-RN examination?

Exit CCTST and CCTDI scores were collected for all graduating classes 1998 through 2001, although data were not available for one of these graduating classes. A larger number of participants had exit data than entry data.

Data were analyzed using an independent *t*-test, comparing means of the various exit CCTST and CCTDI scores between those who pass and failed the NCLEX-RN. The NCLEX performance (pass/fail) was the independent variable while the total scores and sub-scale scores were the dependent variables.

Exit CCTST. Table 11 presents a comparison of exit mean scores for the CCTST between the pass and fail group. Scores for the pass group are somewhat higher than the fail group in each scale. The table also shows results from independent *t*-tests for significance. All six scores have a statistically significant difference between group means with a medium to large effect size. These results indicate that for this sample, students who pass NCLEX-RN are more likely to have higher exit CCTST scores than those who fail NCLEX-RN. It is reasonable to conclude that critical thinking may be, at least in part, an indication of NCLEX-RN success.

Table 11

Comparison of Exit CCTST Scores Between Those who Passed and Failed NCLEX-RN

CCTST			Scores		*t*-test			Effect size
scale	Group	*n*	*M*	*SD*	*t*	*df*	*p*	*d*
Total Score	Pass	178	16.8	4.9	3.0	(191)	.003**	.81
	Fail	15	12.9	3.6				
Analysis	Pass	178	4.8	1.7	2.2	(191)	.026*	.60
	Fail	15	3.9	1.3				
Evaluation	Pass	178	5.7	2.5	2.2	(191)	.030*	.59
	Fail	15	4.4	1.9				
Inference	Pass	178	6.1	2.1	2.6	(191)	.011*	.69
	Fail	15	4.7	1.9				
Inductive	Pass	178	7.0	2.5	2.7	(191)	.008**	.72
Reasoning	Fail	15	5.2	1.8				
Deductive	Pass	178	7.8	2.8	2.1	(191)	.035*	.69
Reasoning	Fail	15	6.3	2.6				

Note. For all t-test results, the Levene test for assumption that variances of the two groups are equal is not significant; therefore, equal variance assumed.
*$p < .05$. **$p < .01$.

As mentioned previously, exit CCTST scores for the entire sample slightly exceeded national percentile scores at the senior level, although these differences were

not statistically significant. The pass and fail groups were compared to the national mean scores. Table 12 presents results of a one-sample *t*-test to determine if differences exist between pass or fail groups. The pass group had higher mean scores that proved to be statistically significant in only two sub-scale scores (Inference and Deduction) compared to the national mean scores. The effect size for these two variables was low-medium. More interestingly, the fail group had lower mean scores that were statistically significant compared to national mean scores for Total Score, Analysis, Evaluation, and Induction. The calculated effect size for each of these were medium to high.

Table 12

Comparison of Exit CCTST Performance by the Pass and Fail Groups to Established National Nursing Student Norms at the Senior Level

CCTST scale/group	*n*	Sample scores *M*	*SD*	National scores *M*	*SD*	One-Sample *t*-test *t*	*df*	*p*	Effect size *d*
Total Score									
Pass	178	16.8	4.9	16.4	3.6	1.1	(177)	.285	
Fail	15	12.9	3.6			−3.8	(14)	.002**	.97
Analysis									
Pass	178	4.8	1.7	4.6	1.3	2.0	(177)	.042	
Fail	15	3.9	1.3			−2.2	(14)	.049*	.54
Evaluation									
Pass	178	5.8	2.5	5.7	1.9	0.7	(177)	.463	
Fail	15	4.4	1.9			−2.7	(14)	.017*	.68
Inference									
Pass	178	6.1	2.1	5.7	1.7	2.4	(177)	.016*	.23
Fail	15	4.7	1.9			−2.1	(6)	.053	
Inductive Reasoning									
Pass	178	7.0	2.5	6.9	2.0	0.1	(177)	.894	
Fail	15	5.0	1.8			−3.7	(14)	.002**	.95
Deductive Reasoning									
Pass	178	7.8	2.8	7.3	2.1	2.8	(177)	.005**	.23
Fail	15	6.3	2.6			−1.5	(14)	.162	

*$p < .05$. **$p < .01$.

Exit CCTDI. A comparison of exit mean scores for the CCTDI between those who passed and failed NCLEX-RN are shown in Table 13. An independent sample *t*-test

revealed statistically significant differences for five of eight scores (Total Score, Truth-seeking, Open-mindedness, Synthesis, and Maturity). The effect sizes are medium to large. While the mean scores for Inquisitiveness and Analyticity were higher among those who passed the NCLEX-RN, the differences in means were not found to be statistically significant. The Confidence mean score was slightly higher among those who failed NCLEX-RN, but this was not found to be statistically different. These results indicate that in this sample group, those who passed the NCLEX-RN had higher CCTDI scores at the completion of the nursing program than those who failed. Maturity had the largest effect size, perhaps an indication of the seriousness that those students who scored highly took their education compared to less mature, less serious counterparts.

Table 13

Comparison of Exit CCTDI Scores Between Those Who Passed and Failed NCLEX-RN

CCTDI			Scores		*t*-test			Effect size
scale	Group	*n*	*M*	*SD*	*t*	*df*	*p*	*d*
Total Score	Pass	171	320.4	27.5	2.6	183	.010*	.72
	Fail	14	300.3	29.8				
Truth-seeking	Pass	171	40.7	5.7	2.7	183	.007**	.75
	Fail	14	36.3	7.5				
Inquisitiveness	Pass	171	49.8	6.1	0.7	183	.477	
	Fail	14	48.6	3.3				
Open-Mindedness	Pass	171	46.1	6.3	2.4	183	.015*	.64
	Fail	14	41.9	6.0				
Confidence	Pass	171	45.1	6.8	-0.2	183	.812	
	Fail	14	45.6	4.1				
Analyticity	Pass	171	44.9	6.2	0.8	183	.415	
	Fail	14	43.4	6.9				
Systematicity	Pass	171	45.6	6.5	2.2	183	.030*	.60
	Fail	14	41.6	7.5				
Maturity	Pass	171	48.3	5.0	3.6	183	<.001**	.96
	Fail	14	43.0	7.9				

Note. For all t-test results, the Levene test for assumption that variances of the two groups are equal is not significant; therefore, equal variance assumed.
*$p < .05$. **$p < .01$.

Exit CCTDI scores for the pass and fail groups of the sample were compared to national mean scores. Table 14 presents results of a one-sample *t*-test to determine if

differences exist by pass or fail group. When compared to national mean scores, the pass group had higher mean scores for all eight scores. All but two (Confidence and Analyticity) were statistically significant with a small to medium effect size. The fail group generally had slightly lower mean scores compared to national norms however, the differences were not statistically significant.

Table 14

Comparison of Exit CCTDI Performance by the Pass and Fail Groups to Established National Nursing Student Norms at the Senior Level (Pass Group n=171; Fail Group n=14)

CCTDI	Sample scores		National scores		One-Sample *t*-test			Effect size
scale/group	*M*	*SD*	*M*	*SD*	*t*	*df*	*p*	*d*
Total Score								
Pass	320.4	27.5	311	23.7	4.2	(170)	<.001**	.37
Fail	300.3	29.8			-1.4	(13)	.186	
Truth-seeking								
Pass	40.7	5.7	38.7	4.8	4.5	(170)	<.001**	.41
Fail	36.3	7.5			-1.2	(13)	.247	
Inquisitiveness								
Pass	49.8	6.1	48.8	4.9	2.0	(170)	.043*	.19
Fail	48.6	3.3			-0.3	(13)	.801	
Open-mindedness								
Pass	46.1	6.3	45.1	4.7	2.1	(170)	.036*	.24
Fail	41.9	6.0			-2.0	(13)	.062	
Confidence								
Pass	45.1	6.8	44.6	5.5	1.0	(170)	.304	
Fail	45.6	4.1			0.9	(13)	.388	
Analyticity								
Pass	44.9	6.2	44.0	4.4	1.7	(170)	.085	
Fail	43.4	6.9			-0.3	(13)	.750	
Systematicity								
Pass	45.6	6.5	43.8	5.2	3.6	(170)	<.001**	.33
Fail	41.6	7.5			-1.1	(13)	.292	
Maturity								
Pass	48.3	5.0	46.1	4.8	5.8	(170)	<.001**	.45
Fail	43.0	7.9			-1.5	(13)	.165	

*p < .05. **p< .01.

Differences in Change of Critical Thinking Skills and Dispositions Over Time

The fifth question posed involves looking at changes in CCTST and CCTDI between entry and exit of the nursing program:

5. Is there a change in critical thinking scores for the whole sample between the entry and exit CCTST or CCTDI?

A paired *t*-test was done to determine if there was a change in mean scores over time, and if any changes were significant. All paired sample correlations for both the CCTST and CCTDI scores were found to be significant ($p < .001$), indicating that the pairs of tests (entry and exit) highly correlate to one another.

CCTST. Table15 presents mean scores at entry and exit, as well as the mean gain scores and *t*-test results for the CCTST. In general, small increases in mean scores were demonstrated on CCTST scores, however, only the Deductive Reasoning score was statistically significant. The small effect size suggests this difference probably lacks importance. These findings generally indicate that critical thinking skills of this sample did not change as a result of the nursing program, rather these skills remained constant.

Table 15

Mean Gain Scores on the CCTST Over Time Between Entry and Exit (N=85)

CCTST Scores	Time Frame	Score *M*	Gain score *M*	*SD*	Paired *t*-test *t*	*df*	*p*	Effect size *d*
Total Score	Entry	16.1	0.85	4.0	1.9	(84)	.055	
	Exit	17.0						
Analysis	Entry	4.4	0.39	1.9	1.8	(84)	.069	
	Exit	4.8						
Evaluation	Entry	5.7	0.22	2.5	0.8	(84)	.409	
	Exit	5.9						
Inference	Entry	6.1	0.24	1.9	1.2	(84)	.246	
	Exit	6.3						
Inductive Reasoning	Entry	7.0	0.05	2.4	0.2	(84)	.820	
	Exit	7.0						
Deductive Reasoning	Entry	7.5	0.62	2.4	2.4	(84)	.020*	.26
	Exit	8.1						

*$p < .05$. **$p < .01$

CCTDI. Table16 presents mean scores at entry and exit, as well as the mean gain score and *t*-test results for the CCTDI scores. While small positive mean gain scores

occurred in all CCTDI scores with the exception of Inquisitiveness, only the Confidence sub-scale score was statistically significant. The calculated effect size for this finding, however, is small.

Table 16

Mean Gain Scores on the CCTDI Over Time Between Entry and Exit (N=85)

CCTDI Scale	Time Frame	Score *M*	Gain score *M*	*SD*	Paired *t*-test *t*	*df*	*p*	Effect size *d*
Total Score	Entry	316	3.9	20.7	1.73	(84)	.086	
	Exit	320						
Truth-seeking	Entry	39.9	0.1	5.8	.11	(84)	.912	
	Exit	39.8						
Inquisitiveness	Entry	50.5	-0.2	5.0	.35	(84)	.731	
	Exit	50.3						
Open-mindedness	Entry	45.6	0.4	4.9	.77	(84)	.443	
	Exit	46.0						
Confidence	Entry	43.6	2.1	5.6	3.47	(84)	.001**	.3
	Exit	45.7						
Analyticity	Entry	44.5	1.1	5.2	1.92	(84)	.058	
	Exit	45.6						
Systematicity	Entry	44.9	0.6	5.1	1.03	(84)	.310	
	Exit	45.4						
Maturity	Entry	47.3	0.3	4.8	0.591	(84)	.556	
	Exit	47.6						

*$p < .05$. **$p < .01$.

Differences in Change of Critical Thinking Skills and Dispositions Over Time Between Students Who Pass and Fail NCLEX-RN

While the results in the previous section indicated that as a group, the sample did not demonstrate statistically significant changes in critical thinking ability, the next question involves comparing differences in change of CCTST and CCTDI between entry and exit between those who pass and fail NCLEX-RN.

6. Is there a difference in change scores for the CCTST and CCTDI between individuals who pass and fail NCLEX-RN?

A gain score was calculated on all scores for the CCTST and CCTDI. An independent *t*-test was then done to determine if there was a statistical difference in the mean gain scores between the pass and fail group.

CCTST. The mean gain score for each CCTST scores and *t*-test results are presented in Table 17. While both the pass and fail groups had small positive gains in nearly all sub-scale scores, none of these differences were statistically significant. Therefore, students who failed NCLEX-RN were no more likely than students who passed NCLEX-RN to improve on critical thinking ability while in nursing school. In other words, the gap between the critical thinking skills of those who passed or failed NCLEX-RN did not change as a result of the educational process, and there seems to be no relationship between the change in critical thinking skills over time and NCLEX-RN performance.

Table17

A Comparison of Mean Gain Scores on the CCTST Between Those who Passed and Failed NCLEX-RN

CCTST			Gain score	*t*-test		
Scale	Group	*n*	*M* *SD*	*t*	*df*	*p*
Total Score	Pass	79	0.8 (*SD* 4.1)	-0.41	(83)	.68
	Fail	6	1.5 (*SD* 3.3)			
Analysis	Pass	79	0.4 (*SD* 2.0)	-0.36	(83)	.72
	Fail	6	0.7 (*SD* 1.8)			
Evaluation	Pass	79	0.3 (*SD* 2.5)	0.57	(83)	.57
	Fail	6	-0.3 (*SD* 2.7)			
Inference	Pass	79	0.2 (*SD* 1.9)	-1.3	(83)	.20
	Fail	6	1.2 (*SD* 1.7)			
Inductive	Pass	79	0.1 (*SD* 2.4)	0.06	(83)	.95
Reasoning	Fail	6	0.0 (*SD* 1.4)			
Deductive	Pass	79	0.6 (*SD* 2.4)	-0.92	(83)	.36
Reasoning	Fail	6	1.5 (*SD* 3.3)			

Note. For all t-test results, the Levene test for assumption that variances of the two groups are equal is not significant; therefore, equal variance assumed.

CCTDI. The mean gain scores for the CCTDI as well as the independent *t*-test comparing mean differences of these means are presented in Table 18. This table shows

that those who passed NCLEX-RN generally demonstrated small positive gains while those who failed NCLEX-RN had a mix of positive and negative gain scores. More importantly, the *t*-test results showed no statistically significant difference in the mean gain scores for CCTDI between those who passed and failed NCLEX-RN. These results indicate that students who failed NCLEX-RN were no more likely to experience change in critical thinking disposition while in nursing school than students who passed.

Table 18

A Comparison of Mean Gain Scores on the CCTDI Between Those Who Passed and Failed NCLEX-RN

CCTDI			Gain score		*t*-test	
Scales	Group	*n*	M	*SD*	*t* *df*	*p*
Total Score	Pass	79	4.2	21	0.50(83)	.62
	Fail	6	-0.2	14		
Truth-Seeking	Pass	79	0.6	6.0	0.77(83)	.45
	Fail	6	-1.8	4.9		
Inquisitiveness	Pass	79	-0.3	5.2	-0.68(83)	.50
	Fail	6	1.2	2.4		
Open-Mindedness	Pass	79	0.6	4.8	0.99(83)	.33
	Fail	6	-1.5	7.0		
Confidence	Pass	79	2.1	5.8	-0.04(83)	.97
	Fail	6	2.2	3.3		
Analyticity	Pass	79	1.1	5.2	-0.20(83)	.85
	Fail	6	1.5	5.7		
Systematicity	Pass	79	0.6	5.2	-0.05(83)	.96
	Fail	6	0.7	3.1		
Maturity	Pass	79	0.5	4.8	1.42(83)	.16
	Fail	6	-2.3	4.6		

Note. For all t-test results, the Levene test for assumption that variances of the two groups are equal is not significant; therefore, equal variance assumed.

Prediction of NCLEX-RN Performance

The last question posed looks at the prediction of NCLEX-RN performance using critical thinking skills and disposition scores along with other known predictor variables.

7. Do the CT scores add to the prediction of NCLEX-RN performance based on NGPA, CGPA or ACT scores?

While previous research studies have identified NGPA, CGPA, and ACT to be significant variables associated with NCLEX-RN performance, confirmation that these variables were significant for the sample was needed. Three *t*-tests on these variables were run to determine if statistical differences existed in mean scores between those who pass and those who fail NCLEX-RN. Group means comparing pass and fail groups on NGPA, CGPA, and ACT, as well as *t*-test results are presented in Table 19. Statistically significant mean differences in NGPA, CGPA, and ACT exist between those who passed and failed NCLEX-RN. The effect size is large to very large for all three variables.

Table 19

A Comparison of Nursing Grade Point Average (NGPA), Cumulative Grade Point Average (CGPA), and ACT Scores Between Those Who Passed and Failed NCLEX

					t-test			Effect size
Variable	Group	*n*	M	*SD*	*t*	*df*	*p*	*d*
NGPA	Pass	195	3.36	.34	5.3	(209)	<.001**	1.38
	Fail	16	2.89	.29				
CGPA	Pass	202	3.33	.32	4.1	(216)	< .001**	1.10
	Fail	16	2.99	.22				
ACT	Pass	99	21.6	3.7	2.7	(107)	< .001**	.89
	Fail	10	18.3	3.5				

*$p < .05$. **$p < .01$

Correlations between these three variables were also done to determine how much each correlated to NCLEX performance. NGPA correlated the highest $r = .29$, $p = .001$ with a medium effect size. ACT also correlated highly $r = .25$, $p = .005$ with a small to medium effect size. Correlation for CGPA was $r = .153$; $p = 0.6$, indicating this was not a statistically significant correlation variable.

The next step was to run a multiple regression with critical thinking scores as additional variables. Because CGPA does not contribute to NGPA, and because there were a small number in the sample with ACT scores, it was decided to run the multiple regression with NGPA and the CCTST and CCTDI Total Scores. Sub-scale scores were not included in the multiple regression because these are components of the total score, and because of the high degree of correlation with the Total Score.

Table 20 presents the correlation matrix and descriptive statistics for the variables for the regression of NCLEX-RN performance on NGPA, Exit CCTST (Total Score), and Exit CCTDI (Total Score). Note that the greatest correlation is between NGPA and NCELX-RN performance. Thus as NGPA, Exit CCTST, and Exit CCTDI scores go up, the more likely the participant is to pass NCLEX-RN.

Table 20

Correlation Matrix and Descriptive Statistics for NGPA, Exit CCTST Total Score, and Exit CCTDI Total Score, and NCLEX-RN Performance (N-173)

	NCLEX	NGPA	Exit CCTST	Exit CCTDI
NCLEX	1.0			
NGPA	.336	1.0		
Exit CCTST	.203	.273	1.0	
Exit CCTDI	.194	.281	.143	1.0
Mean	1.08	3.31	16.46	318.51
SD	.27	.356	4.76	28.02

Note. NCLEX-RN performance (pass or fail) is the dependent variable. All correlations are statistically significant at $p<.005$.

Table 21 presents the results of the multiple regression analysis. This multiple regression statistic (R=.368) is a medium effect size. Although the only variable in this combination of variables that was statistically significant in predicting NCLEX-RN

performance was NGPA, 12% of the variability in NCLEX-RN performance can be explained by a combination of these variables.

Table 21

Multiple Regression Analysis of NCLEX-RN Performance on NGPA, Exit CCTST and Exit CCTDI

Independent Variable	Unstandardized Coefficients	Standardized Coefficients	*t*-test	
	B	*B*	*t*	*p*
NGPA	.213	.277	3.60	.000
Exit CCTST	.06	.113	1.52	.130
Exit CCTDI	.097	.099	1.33	.185

Note: R=.368; Adjusted R Square = .120. F (3, 169) = 8.18, p<.001.

Discriminant analysis was also used to evaluate the predictive value or the ability to correctly classify students into pass and fail groups based on CCTST, CCTDI scores as well as NGPA.

The Wilk's Lambda test of equality for group means (between the pass and fail groups) showed that those who passed and those who failed had significantly different means for each of the variables. For the NGPA the Wilks Lambda was .887, F 21.76 (*df*, 1, 171), p <.001. For the Exit CCTST, the Wilks Lambda was .959, F 7.37 (*df*, 1, 171), p =.007. For the Exit CCTDI the Wilks Lambda was .963, F 6.65 (df, 1, 171), p =.011.

Results of the discriminant analysis are presented in Table 22. Overall, 92% of the students were correctly categorized. In other words, based on the three predictor variables used, the discriminant analysis correctly identified the performance (pass or fail) of 92% of the sample.

Table 22

Classification Summary for Discriminant Function

Actual group	Predicted group		Total (%)
	Pass (%)	Fail (%)	
Pass	156 (98.1%)	3 (1.9%)	159 (100%)
Fail	11 (78.6%)	3 (21.4%)	14 (100%)

Note: 91.9% of original grouped cases correctly classified

While the discriminant analysis correctly classified 98% of students who passed NCLEX-RN, it incorrectly classified nearly 79% of those who failed. Even though the group that passed NCLEX-RN did significantly better on all three of these predictors, there were 11 students who failed that did better on the combination of these variables than three students who passed. What this indicates is that using the variables NGPA, Exit CCTST, and Exit CCTDI, it is possible to predict with high degree of accuracy those who are likely to pass NCLEX-RN, but is not accurate in predicting who is likely to fail. Thus, this mix of variables does not seem to be very useful in predicting who will fail NCLEX-RN.

Examination of Other Questions

Critical Thinking and Scholastic Achievement

An argument that could be made is that CT is a component of general intelligence, thus the fact that CT ability is related to NCLEX-RN performance should not be all that surprising. For this reason, an additional question is raised and looked at with these data: What is the association between CT and scholastic ability?

The ACT score has long been recognized as a valid measurement of scholastic ability, thus it will be the variable used to answer this question. A relatively weak

positive correlation between ACT scores and the Exit CCTST Total Score using the Pearson product-moment correlation test was found ($r = .32$, $df = 90$, $p = .001$). The effect size is medium, and the coefficient of determination ($r^2 = .096$) means that approximately 10% of the variance between ACT and Exit CCTST Total Score is common to both.

One weakness in the interpretation of the findings above is the small number of participants with ACT scores. A larger number of participants in the sample have Nursing Grade Point Average (NGPA), another indication of scholastic ability. However, findings for a correlation between NGPA and Exit CCTST Total Score were similar to the correlation previously discussed above. The Pearson product-moment correlation test between the two variables found weak positive correlation ($r = .30$, $df = 186$, $p = .001$) with a medium effect size. The coefficient of determination ($r^2 = .09$) means that approximately 9% of the variance between NGPA and Exit CCTST Total Score is common to both.

The correlation of CCTST Total score to ACT scores and CCTST Total Sccore to NGPA reflects that while CT is positively influenced by academic ability, there are other components to it, giving rise to justification to consider these two variables separately.

Age/Gender and NCLEX-RN Performance

Another area explored with this sample was to determine if differences in age or gender existed between the pass and fail groups. The following question was posed: Is there a difference in age or gender between individuals who pass or fail the NCLEX-RN?

These variables were evaluated in order to compare findings from this sample with other reported research findings. A *t*-test analysis showed that age at graduation was not found to be statistically significant ($t<.000$, df 16.8; $p=1.0$). Results for chi-square

analysis of gender and NCLEX-RN performance (X^2 = 1.43, *df* 1, p= .232) indicated that gender was not a statistically significant variable associated with NCLEX-RN performance.

Ethnicity and NCLEX-RN Performance

Because the nursing program had a culturally diverse student population, an additional question posed had to do with differences in NCLEX-RN performance based on ethnicity. Ethnicity as a variable of NCLEX-RN performance has been addressed by other research studies, with varied findings.

Table 23 presents statistical analysis using chi square and phi. The attribute independent variable is ethnicity on two levels; minority (includes Indian, Black, non-Hispanic, Hispanic, and Asian or Pacific Islander) and non-minority (White non-Hispanic). The dependent variable is NCLEX-RN success on two levels; pass and fail.

Table 23

Cross Tabulation for NCLEX-RN Performance (pass/fail) and Ethnicity (minority/non-minority) (N=209)

	NCLEX Pass	NCLEX fail	Total
Minority			
Count	65	11	76
Expected count	70.5	5.5	76
Percent within	85.5%	14.5%	100%
Percent of total	31.1%	5.3%	36.4%
Non-Minority			
Count	129	4	133
Expected count	123.5	9.5	133
Percent within	97.0%	3.0%	100%
Percent total	61.7%	1.9%	63.6%
Total			
Count	194	15	209
Expected Count	194	15	209
Percent of total	92.8%	7.2%	100%

Table 23 shows that a larger number of minority students failed NCLEX-RN than was expected; likewise, fewer non-minority students failed NCLEX-RN than was expected. It is important to note, however, that while the pass rate for the minority students was lower compared to non-minority students in this sample, the pass rate for minority students was comparable to the national NCLEX-RN pass rate (85%).

Chi-square and phi was used to determine if such differences occurred by chance, or if the relationship is statistically significant. Chi-square tests results were $X^2 = 9.54$, $df=1$, $p=.002$; phi = -.214, $p=.002$, with a small to medium effect size. This indicates that a difference in NCLEX-RN performance based on ethnicity was greater than what could be expected by chance.

CHAPTER 5

DISCUSSION

Overview of the Study

Pass rates for the National Council Licensure Examination for Registered Nurses (NCLEX-RN) have declined in recent years stimulating renewed interest to identify variables associated with NCLEX-RN performance. Critical thinking (CT) is considered an important component of professional nursing (Cody, 2002; Daly, 1998; Hicks, 2001), and thus is reflected in nursing education curricula and in the development of the NCLEX-RN examination (Alfaro-LeFevre, 1995; Wendt & Brown, 2000). For this reason, CT as a variable associated with NCLEX-RN performance became a logical variable to investigate.

This ex-post-facto research study involved 218 baccalaureate nursing students who graduated between 1998 and 2001 from a university-based nursing program located in the Southwest. The participants completed two critical thinking instruments, the California Critical Thinking Skills Test (CCTST) and the California Critical Thinking Disposition Inventory (CCTDI) as part of a part of a program evaluation process for the nursing school. These instruments were administered to students upon entry into the nursing program, and again during their final semester. Because administration of these instruments did not begin until 1998, both entry and exit data were available for only part of the sample. Data from these two instruments along with other student data (including

gender, age, nursing grade point average, cumulative grade point average, and ACT scores) were used to look for relationships associated with NCLEX-RN performance. The data analyses included descriptive statistical methods, *t*-test analysis, Pearson product-moment correlation, multiple regression, discriminant analysis, and chi-square.

Overview of Findings and Relationship to the Literature

The data analyses of this study was based on ten research questions; seven questions identified prior to the collection of data, and three additional questions posed after the data had been collected.

The seven original questions primarily focused on the relationship between critical thinking and NCLEX-RN performance. Four questions looked at differences in CT skills and disposition at entry and at exit between students who passed and failed NCLEX-RN. Two questions looked at changes in CT skills and disposition over time; one looking at the entire sample, the other comparing such changes between the pass and fail groups. One question evaluated CT skill and dispositions along with other variables as effective predictors of NCLEX-RN performance.

One additional question focused on differentiating CT skills and disposition from general scholastic ability. Other questions explored the relationship of other variables (age, gender, and ethnicity) to NCLEX-RN performance.

Differences in CT Between Pass and Fail Groups

The major focus of this study was to determine if a relationship exists between CT and NCLEX-RN performance. Results from this study found several differences between the pass and fail groups related to CT skills and disposition that would tend to support

such a theory. Although statistically significant differences were found between the pass and fail groups on only 3 of 14 CCTST and CCTDI scales upon entrance into the nursing program, the differences between these two groups were much more pronounced at the completion of the nursing program. The pass group had significantly different mean scores on 11 of 14 exit CCTST and CCTDI scales.

CCTST. As a group, participants who passed NCLEX-RN had statistically significantly higher exit CCTST scores (on all scales) than those who failed, and the effect sizes were medium to large. These findings are similar to those reported by Hall (1995) and Facione and Facione (1997). A comparison of the exit CCTST scores to national nursing student norms emphasized the deficiencies of the fail group further. The fail group had statistically significant lower mean scores in four of six scales compared to national mean scores. In both the entry and exit tests, the fail group was statistically significantly lower in both the Total Score and Analysis. While the fail group mean scores were comparable to the national mean scores for Inference and Deductive Reasoning, the pass group exceeded national mean scores on these two scales. Comparisons between pass and fail groups from a sample to national mean scores have not been reported in other studies.

CCTDI. Interpretation of the CCTDI data analysis is somewhat more difficult. Keeping in mind that this instrument measures a person's attitudinal disposition as opposed to actual critical thinking skill, makes this variable more nebulous. There was no statistically significant difference in mean scores on the entry CCTDI between those who passed and failed NCLEX. On the exit CCTDI, however, participants who passed NCLEX-RN had statistically significantly higher mean scores in five of eight scales

compared to those who failed. While these results may seem impressive, comparisons to national nursing student norms tell a different story.

Comparisons of exit CCTDI scores to national nursing student mean scores showed that as a group, the sample generally had higher mean scores. The pass group exceeded national mean scores in five of eight scales (both at entry and exit) with a small to medium effect size, and the fail group scores were actually consistent with national mean scores. Because the scores of the fail group were consistent with national mean scores, it would be illogical to suggest these scores are associated with NCLEX-RN failure, especially considering the small number in the fail group.

No other studies have reported a statistically significant relationship between CCTDI and NCLEX-RN success. Facione and Facione (1997) reported an inability to examine this relationship due to the size in their sample. May, Edell, Doughty & Langford (1999) looked at a correlation between CCTDI scores and clinical competency, but were unable to find statistical differences.

Although the statistical analysis shows mathematical differences between the pass and fail groups in this sample, the general interpretation guidelines for the CCTDI describe the performance for both groups similarly. A Total Score below 280 is considered weak; a score above 350 is an indication of across the board strength in the disposition toward critical thinking. The mean exit CCTDI Total Score for the pass and fail group was 320 and 300 respectively, yet both groups lie between "weakness" and "across the board strength". A sub-scale score below 40 is considered weak with an ambivalence toward critical thinking, while scores between 40 to 60 indicate an increasingly positive disposition. All mean sub-scale scores for both sample groups fell

between 40 and 50 with the exception of Truth-Seeking, in which the fail group had a mean score of 38.

Overall, results from this study show statistically significant differences in several CCTST and CCTDI subscale scores between the pass and fail group. Differences were noted on the CCTST both at entry and exit, however, the differences were far more pronounced with exit scores than with entry scores. Comparisons of the sample scores to national mean scores highlight these differences further.

There were no statistically significant differences on entry CCTDI mean scores between pass and fail groups within the sample. While statistically significant differences were noted with exit CCTDI scores, the fail group performance was actually comparable to national mean scores. Furthermore, the interpretation of the CCTDI scores for the pass and fail groups were very similar. Such findings point to the caution one must take in the interpretation of these data. Based on findings from this study, the relationship of CCTDI to NCLEX-RN performance remains unclear.

Critical Thinking Over Time

Because the sample attended a nursing program that placed a heavy emphasis on CT in the curriculum, one might expect to see changes in CT as a result of such exposure. The sample was evaluated for changes in CT skills and disposition between program entry and exit. Furthermore, comparisons were made of changes in CT over time between the pass and fail groups.

Despite efforts to enhance critical thinking and dispositions through curricular exposure, very little change occurred in the sample as a group on either CCTST or CCTDI. Only one CCTST sub-scale (Deductive Reasoning) and one CCTDI sub-scale

(Confidence) showed statistically significant moderate gains. Facione and Facione (1997) reported statistically significant gains in two scales (Evaluation and Induction) on the CCTST and on three scales on the CCTDI (Truth-seeking, Analyticity and Confidence) between sophomore and senior years. The inability of detecting CT over time brings to question the variable of CT as a natural trait as opposed to a learned trait.

The analyses of data also failed to show any difference in gains made between the pass and fail group on either the CCTST or CCTDI. One might expect that improvements would be seen, particularly in students with CT deficiencies, but for this sample, this does not appear to be the case. It is possible that changes over time were not recognized in this sample due to the small sample size (particularly in the fail group), and possibly due to the rather short time frame (less than two years) in which repeat testing occurred. Additionally, the sample as a group had higher entry CCTDI scores compared to national norms; thus the potential for growth in the sample might have been less than the sample described by Facione and Facione (1997).

Prediction of NCLEX-RN Performance with Critical Thinking Variables

Another focus of this study was to determine if the prediction of NCLEX-RN performance could be improved upon by using critical thinking as a variable. Previous research has consistently identified several academic variables associated with NCLEX-RN performance including cumulative grade point average (CGPA), nursing grade point average (NGPA), SAT scores, and ACT scores. Standardized NCLEX-RN assessment tests such as the Mosby Assess Test, National League of Nursing (NLN) Assess Test, and the Health Education Systems, Inc (HESI) Exit Examination are also associated with NCLEX-RN performance.

In this study, multiple regression was done using NGPA and the CCTST and CCTDI Total Scores. While CCTST and CCTDI each had a statistically significant positive correlation with NCLEX-RN performance, neither of these variables added to the predictive ability of NGPA. Discriminant analysis was also used to evaluate the predictive value or the ability to correctly classify students into pass and fail groups based on CCTST scores, CCTDI scores, and NGPA. This analysis showed that while this combination of variables was very good at predicting who passed NCLEX-RN, it proved to be a poor predictor of those who failed in this sample group.

No other studies have reported using CCTST or CCTDI to predict NCLEX-RN performance. Studies that have reported success at predicting NCLEX-RN performance have done so using academic variables such as performance in specific nursing courses, and various standardized NCLEX-RN assessment tests. (Barkley, et al., 1998; Beeson & Kissling, 2001; Lauchner, et al., 1999, Nibert & Young, 2001).

Despite the fact that CT did not add to the predictive ability of NGPA, the researcher does not recommend abandoning this as a possible predictor variable, particularly considering the relationship found between exit CCTST and NCLEX-RN. One must keep in mind that CT skills and dispositions for this study were measured by the CCTST and CCTDI; it is quite possible that other instruments designed to measure CT will be developed that are more sensitive to NCLEX-RN performance. Furthermore, it is possible the small sample size of the fail group limited this statistical analysis.

Critical Thinking and Scholastic Performance

The relationship between critical thinking and scholastic ability was examined in order to gain insight regarding additional explanations for CT ability and NCLEX-RN

performance. Because the pass group generally had higher CT scores, it could be assumed this was related to intelligence; those who are intelligent are more apt to think critically. If indeed CT is just another measure of scholastic ability in disguise, it brings to question the appropriateness of considering CT independently as a variable associated with NCLEX-RN performance.

Facione and Facione (1997) reported a strong correlation (r=.596) between NGPA and Exit CCTST scores, however, this finding was based on a sample size of only 26. For this sample, analysis of CCTST total score to ACT and NGPA showed a positive correlation for each, with a shared variance of 10% and 9% respectively. This means that 90% of the variance between CCTST and ACT is unexplained; likewise, 91% of the variance between CCTST and NGPA is unexplained. These findings are important because they show that while critical thinking skills (as measured by the CCTST) are related to scholastic ability, it is also measuring something else as well. This provides additional justification to investigate critical thinking as a variable especially in light of differences found between pass and fail groups.

NCLEX-RN Performance and Ethnicity

NCLEX-RN pass rates by ethnicity are not reported by NCSBN or the individual state boards of nursing. Ethnicity as a variable of NCLEX-RN performance has been reported in only a few studies (Arathuzik & Aber 1998; Briscoe & Anema 1999; Endres, 1997) however, findings have been inconsistent, possibly because of small sample sizes and attempts to look at specific ethnic groups. The culturally diverse population of the sample provided an excellent opportunity to explore ethnicity as a variable.

Chi-square analysis revealed a statistically significant difference in NCLEX-RN performance between minority and non-minority students. A higher number of minority students failed NCLEX-RN than would be expected; the effect size, however is small to medium. This is particularly interesting given the strong performance of the sample as a group on NCLEX-RN.

Other Findings of Associated with Existing Research

Previous studies examining variables associated with NCLEX-RN performance have consistently reported differences in various academic variables such as SAT, ACT, CGPA, NGPA, and success in various nursing courses between those who pass and fail the NCLEX-RN. Differences in some of these academic variables (ACT, NGPA, and CGPA) between those who passed and failed NCLEX-RN were also found with this sample group. Previous research has also focused on non-academic variables including age, gender, and ethnicity. As mentioned previously, this study found differences between minority and non-minority students and NCLEX-RN performance. No differences in pass and fail groups were found with regard to age and gender.

Limitations

There are several inherent limitations associated with this study. First of all, this was a convenience sample from one baccalaureate nursing program, thus it may not be representative of nursing students from other nursing programs. While many aspects of the sample were similar to national nursing statistics such as age, gender distribution, and CCTST mean scores, significant dissimilarities were noted in ethnic distribution, CCTDI mean scores, and NCLEX-RN pass rates. These factors limit generalizability.

There are a couple of possible explanations for the difference in NCLEX-RN pass rates. The national pass rates include all types of educational programs for nursing (baccalaureate, associate degree, and diploma). The nursing program from which the sample was taken is one of only two university-based programs in the state, and in the eyes of many, is considered the state's "crown jewel" nursing school. Because of this, one could expect a larger draw of the academically strong students compared to other programs within the state. Additionally the quality of instruction and curriculum of this nursing school may be stronger compared to the average nursing program, thus resulting in a higher pass rate.

Another limitation is noted in the sample size. Although there were 218 in the sample, there were only a total of 16 in the fail group. The small number in the fail group limits power and interpretation of results. Entry scores were only available for approximately half of the sample. For this reason, comparisons between entry and exit group scores are limited.

The author also recognizes that differences may exist between the pass and fail groups above and beyond their NCLEX-RN performance (such as ethnicity) that may have affected internal validity. For this reason, caution must be taken when interpreting results from this study.

Finally, limitations to this study include omissions and potential error in data collection process. First of all, some of the CT data (CCTST and CCTDI) lacked proper identification resulting in the loss of potential participants. Secondly, the organization of the CCTST and CCTDI data made completion of a database challenging. Finally, because the researcher was dependent upon the nursing school to compile the database,

direct supervision and control over this process was not possible. For these reasons, the researcher acknowledges that omissions in data and potential errors in the database may have affected results.

Conclusions

The search for variables associated with NCLEX-RN performance continues as nursing programs struggle to adequately prepare students for successful nursing careers. Critical thinking is a component of professional nursing practice reflected in the educational process, evaluation process, research, and clinical practice of nursing. While CT is difficult to define and measure, it is clear that a relationship exists between CT and success in the nursing. A positive correlation between scholastic ability and critical thinking exists; however, CT possesses independent elements that can not be explained by scholastic ability alone.

This study has shown that for this sample, significant differences exist in CT skill and disposition between those who pass and fail NCLEX-RN. The relationship between CT skills (as measured by the CCTST) at the completion of the nursing program and NCLEX-RN performance is especially noteworthy. These findings suggest that critical thinking is a crucial element for NCLEX-RN success. It is quite possible that students with low CCTST scores (especially when compared to national averages) could benefit from remedial efforts aimed at NCLEX-RN preparation.

Gains in CT skills and disposition during the course of nursing education were limited despite curricular attention to this construct; moreover students who failed NCLEX-RN were no more likely to improve these skills than students who passed. However, these instruments may not be sensitive to gains made in the relatively short

time frame between entry and exit testing, therefore nursing academia should not expect significant changes in CT skills and dispositions as a result of the educational process. Even though there is a clear relationship between CT skills and dispositions and NCLEX-RN performance in this sample, these variables do not add to the predictive ability of NGPA to NCLEX-RN performance.

Finally, this study has shown a statistically significant difference in NCLEX-RN performance between students who are minority and those who are non-minority. The ability to draw firm conclusions from this finding is limited, however, it adds support to existing research that have also found such differences.

Recommendations for Practice

On the basis of findings from this study, nursing programs might consider using the CCTST as part of an admission profile. The researcher does not recommend the selection of students solely based on CCTST scores, but it is possible that these scores might be useful as an element in the admission selection process.

The identification of students at risk of NCLEX-RN failure may be possible considering some of the findings reported in this study. Nursing programs could consider using the CCTST and CCTDI along with other variables such as NGPA, CGPA, and ACT or SAT scores to develop a tool that identifies "at risk" students already enrolled in a nursing program. It is also suggested that scores should be compared to national student scores as well as comparing scores within a given group, particularly if the number of students is small. The early identification of the "at risk" student would provide an opportunity to offer strategies designed to improve their chances of NCLEX-RN success.

Program administrators and faculty would need to plan and implement such strategies based on the unique aspects of their curriculum and the perceived needs of the students.

Recommendations for Research

Confirmation that another variable is associated with NCLEX-RN performance opens the door for many additional studies. There is a need for continued research to further understand the relationship between critical thinking and professional nursing practice (Cody, 2002; Daly, 1998; Hicks, 2001), as well as its role in NCLEX-RN performance (Facione & Facione, 1997). Replication of this study in multiple types of nursing programs, with various curricula and student populations would add to this understanding. It would be particularly helpful to conduct this study with a sample that has a lower NCLEX-RN pass rate, thus providing a larger number in the fail group in which to make comparisons to a passing group.

Additional research should be conducted to determine if CT adds to the predictive ability of standardized NCLEX-RN examination tests to NCLEX-RN performance (Beeson & Kissling 2001; Lauchner, et al., 1999; Nibert & Young, 2001). Furthermore, a research study investigating the use of CCTST and CCTDI as a part of admission profile for a nursing program might provide insight to the selection of candidates who are most likely to be successful not only in the nursing program, but also with the NCLEX-RN. Research investigating the practicality and benefit of early identification of "at risk" students along with the success of remedial strategies would also be interesting. Further research related to change in CT over time, with a longer time frame would also be of benefit (Facione & Facione, 1997).

The question of ethnicity and NCLEX-RN performance should be investigated further. While ethnicity was not the focus of this study, findings from this study suggest differences in NCLEX-RN performance between minority students and non-minority students may exist. The fact that this variable has not been researched extensively provides additional incentive for investigation.

On a final note, another direction for research should be considered. Most NCLEX-RN related research studies have looked for variables associated with NCLEX-RN performance. A different approach could be an investigation of factors associated with the decline of NCLEX-RN pass rates. The recent nursing shortage has in part, been a result of declining enrollment in nursing programs throughout the country over the last several years. With less competition for admission into nursing programs, less qualified applicants may be admitted and eventually graduate. It is possible that the national decline in NCLEX-RN pass rates may be partially explained by this trend.

REFERENCES

Adams, M.H., Whitlow, J.F., Stover, L.M., & Johnson, K.W. (1996). Critical thinking as an educational outcome. An evaluation of current tools of measurement. *Nurse Educator, 21*(3), 23-32.

American Nurses Association. (1998). *Standards of clinical nursing practice* (2nd ed.). Washington, DC: Author.

Alexander, J.E., & Brophy, G.H. (1997). A five-year study of graduates' performance on NCLEX-RN. *Journal of Nursing Education, 36*, 443-445.

Alfaro-LeFevre, R. (1995). *Critical thinking in nursing*. Philadelphia: Saunders.

Arathuzik, D., & Aber, C. (1998). Factors associated with national council licensure examination-registered nurse success. *Journal of Professional Nursing, 14*, 199-126.

Bachman, M.L. (1998). *Anxiety, critical thinking and age as performance predictors of community college nursing students*. Unpublished doctoral dissertation, Colorado State University.

Backman, M.E. (1971). Prediction of achievement in a collegiate nursing program and performance on state board examinations. *Nursing Outlook, 19*, 487.

Baker, C.M. (2000). Problem-based learning for nursing: integrating lessons from other disciplines with nursing experiences. *Journal of Professional Nursing, 16*, 258-266.

Baker, H.H., Cope, M.K., Fisk, R., Gorby, J.N., & Foster, R.W. (2000). Relationship of preadmission variables and first-and second-year course performance to performance on the National Board of Osteopathic Medical Examiners' COMLEX-USA Level 1 examination. *The Journal of the American Osteopathic Association, 100*, 153,161.

Baker, H.H., Foster, R.W., Bates, B.P., Cope, M.K., McWilliams, T.E., Musser, A., et al., (2000). Relationship between academic achievement and COMPEX-USA Level 1 performance: A multisite study. *The Journal of the American Osteopathic Association, 100*, 238-242.

Bandman, E.L., & Bandman, B. (1995). *Critical thinking in nursing* (2nd ed.). Norwalk, CT: Appleton & Lange.

Barkley, T.W., Rhodes, R.S., & Dufour, C.A. (1998). Predictors of success on the NLCEX-RN among baccalaureate nursing students. *Nursing and Health Care Perspectives, 19*, 132-137.

Bauwens, E.E., & Gerhard, G.G. (1987). The use of the Watson-Glaser Critical Thinking Appraisal to predict success in a baccalaureate nursing program. *Journal of Nursing Education, 26*, 278-281.

Beeson, S.A., & Kissling, G. (2001). Predicting success for baccalaureate graduates on the NCLEX-RN. *Journal of Professional Nursing, 17*, 121-127.

Bloom, B.S. (1956). *Taxonomy of educational objectives.* New York: Longmans, Green.

Bondy, K.N., Koenigseder, L.A., Ishee, J.H., & Williams, B.G. (2001). Psychometric properties of the California Critical Thinking tests. *Journal of Nursing Measurement, 9*, 309-327.

Bowles, K. (2000). The relationship of critical-thinking skills and the clinical judgement skills of baccalaureate nursing students. *Journal of Nursing Education, 39*, 373-376.

Boyle, K.K. (1986). Predicting the success of minority students in a baccalaureate nursing program. *Journal of Nursing Education, 25*, 186-192.

Brandt, E.M., Hastie, B., & Schumann, D. (1966). Predicting success on state board examinations. *Nursing Research, 15*, 62-69.

Bracey, G.W. (2001). Test scores in the long run. *Phi Delta Kappan, 82*, 637-8.

Briscoe, V.J., & Anema, M.G. (1999). The relationship of academic variables as predictors of success on the National Council Licensure Examination for Registered Nurses (NCLEX-RN) in a selected associated degree program. *The ABNF Journal, 10*, 80-83.

Buchanan, R.N. (1991). Problems related to the use of human subjects in clinical evaluation/responsibility for follow-up care. *Journal of Dental Education, 55*, 797-801.

Campbell, A.R., & Dickson, C.J. (1996). Predicting student success: a 10-year review using integrative review and meta-analysis. *Journal of Professional Nursing, 12*, 47-59.

Case, S.M., Ripkey, D.R., & Swanson, D.B. (1996). The relationship between clinical science performance in 20 medical schools and performance on step 2 of the USMLE licensing examination. *Academic Medicine, 71* (supplement), S31-33.

Cody, W.K. (2002). Critical thinking and nursing science: judgement, or vision? *Nursing Science Quarterly, 15*, 184-189.

Colucciello, M.L. (1997). Critical thinking skills and dispositions of baccalaureate nursing students: A conceptual model for evaluation. *Journal of Professional Nursing, 13*, 236-245.

Commission on Collegiate Nursing Education. (1998). *Standards for accreditation of baccalaureate and graduate nursing education programs.* Retrieved October 1, 2001, from http://www.aacn.nche.edu/accreditation/standards.htm.

Daly, W.M. (1998). Critical thinking as an outcome of nursing education. What is it? Why is it important to nursing practice? *Journal of Advanced Nursing, 28*, 323-331.

Dell, M.A., & Halpin, G. (1984). Predictors of success in nursing school and on state board examinations in a predominantly black baccalaureate nursing program. *Journal of Nursing Education, 23*, 147-150.

Drake, C.C., & Michael, W.B. (1995). Criterion-related validity of selected achievement measures in the prediction of a passing or failing criterion on the National Council Licensure Examination (NCLEX) for nursing students in a two-year associate degree program. *Educational and Psychological Measurement, 55*, 675-83.

Eddy, L.L., & Epeneter, B.J. (2002). The NCLEX-RN experience: Qualitative interviews with graduates of a baccalaureate nursing program. *Journal of Nursing Education, 41*, 273-78.

Endres, D. (1997). A comparison of predictors of success on NCLEX-RN for African American, foreign-born, and white baccalaureate graduates. *Journal of Nursing Education, 36*, 365-71.

Ennis, R. (1987). A taxonomy of critical thinking dispositions and abilities. In J.B. Barton & R.J. Sternberg (Eds.), *Teaching thinking skills: Theory and practice.* New York: Freeman.

Facione, N.C. & Facione, P.A. (1997). *Critical thinking assessment in nursing education programs: An aggregate data analysis.* Millbrae, CA: California Academic Press.

Facione, P.A. (1990). *The Delphi report: Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction.* Millbrae, CA: California Academic Press.

Facione, P.A. (1991). *Using the California Critical Thinking Skills Test in research, evaluation, and assessment.* Milbrae, CA: California Academic Press. (ERIC Document Service No. ED 337 498)

Facione, P.A. & Facione, N.C. (2001). *California Critical Thinking Disposition Inventory test manual.* Millbrae, CA: California Academic Press.

Facione, P.A. & Facione, N.C. (1998). *California Critical Thinking Skills Test, Form A and Form B, test manual.* Millbrae, CA: California Academic Press.

Fadem, B., Schuchman, M., & Simring, S.S. (1995). The relationship between parental income and academic performance of medical students. *Academic Medicine, 70,* 1142-4.

Feil, P., Meeske, J., & Fortman, J. (1999). Knowledge of ethical lapses and other experiences on clinical licensure examinations. *Journal of Dental Education, 63,* 453-8.

Formicola, A.J., Lichtenthal, R., Schmidt, H.J, & Meyers, R. (1998). Evaluating clinical licensing examinations to professional testing standards. *New York State Dental Journal, 64,* 38-44.

Glew, R.H., Ripkey, D.R., & Swanson, D.B. (1997). Relationship between students' performances on NBME Comprehensive Basic Science Examination and the USMLE Step 1. *Academic Medicine, 72,* 1097-102.

Gliner, J.A., & Morgan, G.A. (2000). *Research methods in applied settings. An integrated approach to design and analysis.* Mahwah, NJ: Lawrence Erlbaum Associates.

Greenlaw, J. (1985). Definition and regulation of nursing practice: An historical survey. *Law medicine and health care, 13,* 177-21.

Gross, SJ. (1984). *Of foxes and hen houses. Licensing and the health professions.* Westport, CT: Quorum.

Gross, Y.T., Takazawa, E.S., & Rose, C.L. (1987). Critical thinking and nursing education. *Journal of Nursing Education, 26,* 317-323.

Guido, GW. (2001). *Legal and ethical issues in nursing.* Upper Saddle River, NJ: Prentice Hall.

Hall, G.H. (1995). *Critical thinking in nursing education.* Unpublished doctoral dissertation, University of Minnesota.

Hartman, S.E., Bates, B.P., & Sprafka, S.A. (2001). Correlation of scores for the Comprehensive Osteopathic Medical Licensing Examination with osteopathic medical school grades. *The Journal of the American Osteopathic Association, 101*, 347-9.

Hicks, F.D. (2001). Critical thinking: Toward a nursing science perspective. *Nursing Science Quarterly, 14*, 14-21.

James, J.C., & Tanner, C.K. (1993). Standardized testing of young children. *Journal of Research and Development in Education, 26*, 143-152.

Kalkwarf, K.L. (1999). How the licensure process will evolve. *Journal of the American Dental Association, 130*, 1737-1742.

Koenig, J.A., Sireci, S.G., & Wiley, A. (1998). Evaluating the predictive validity of MCAT scores across diverse applicant groups. *Academic Medicine, 73*, 1095-106.

Lauchner, K.A., Newman, M., & Britt, R.B. (1999). Predicting licensure success with a computerized comprehensive nursing exam. The HESI Exit Exam. *Computers in Nursing, 17*, 120-125.

Leppa, C.J. (1997). Standardized measures of critical thinking. *Nurse Educator, 22*, 29-33.

Lunz, M.E., & Bergstrom, B.A. (1991). Comparability of decisions for computer adaptive and written examinations. *Journal of Allied Health, 20*, 15-23.

Markert, R. (1983). The relationship of noncognitive characteristics to performance on NBME Part I. *Res Med Edu, 27*, 72-77.

Matassarin-Jacobs, E. (1989). The nursing licensure process and the NCLEX-RN. *Nurse Educator, 14*(6), 32-35.

May, B.A., Edell, V., Butell, S., Doughty, J., & Langford, C. (1999). Critical thinking and clinical competence: A study of their relationship in BSN seniors. *Journal of Nursing Education, 38*, 100-110.

McCarty, P., Schuster, P., Zehr, P., & McDougal, D. (1999). Evaluation of critical thinking in a baccalaureate nursing program. *Journal of Nursing Education, 38*, 142-144.

McEwen, M., & Brown, S.C. (2002). Conceptual frameworks in undergraudate nursing curricula: report of a national survey. *Journal of Nursing Education, 41*, 5-14.

Miller, C.L., Feldhusen, J.F., & Asher, J.W. (1968). The prediction of state board examination scores of graduates of an associated degree program. *Nursing Research, 17*, 555-558.

Miller, D.W. (2001). Scholars say high-stakes tests deserve a failing grade. *The Chronicle of Higher Education*, 47(25), A14-A16.

Mitchell, K. (1990). Traditional predictors of performance in medical school. *Academic Medicine, 65*, 161-65.

Melcolm, N., Venn, R., & Bausell, R.B. (1981). The prediction of state board test pool examinations scores within an integrated curriculum. *Journal of Nursing Education, 20*(5), 24-28.

Morris, B.C. (1999). *Relationships among academic achievement, clinical decision making, critical thinking, work experience and NCLEX-RN pass status.* Unpublished doctoral dissertation, Arizona State University.

Morrison, S., & Free, K.W. (2001). Writing multiple-choice test items that promote and measure critical thinking. *Journal of Nursing Education, 40*, 17-24.

Morrison, S., Smith, P., & Britt, R. (1996). *Critical thinking and test item writing.* Houston: Health Education Systems, Inc.

Mueller, E.J., & Lymann, H.B. (1969). The predication of scores on the state board test pool examination. *Nursing Research, 18*, 263-267.

Muhlenkamp, A.F. (1971). Prediction of state board scores in a baccalaureate program. *Nursing Outlook, 19*, 57.

National Council of State Boards of Nursing. (2000). *Test plan for the National Council Licensure Examination for Registered Nurses.* Chicago:Author. Accessed, September 10, 2001, from http://www.ncsbn.org

National Council of State Boards of Nursing. (2001). *Reliability and validity of NCLEX.* Accessed, September 10, 2001, from http://www.ncsbn.org

National Council of State Boards of Nursing. (2002). *NCLEX-RN examination statistics.* Accessed, August 15, 2002, from http://www.ncsbn.org

National League for Nursing Accrediting Commission. (2001). *Interpretive guidelines for standards and criteria: 2001.* Accessed October 1, 2001, from http://www.nlnac.org

Newman, M., Britt, R.B., & Lauchner, K.A. (2000). Predictive accuracy of the HESI Exit Exam: A follow up study. *Computers in Nursing, 18*, 132-136.

Nibert, A.T., & Young, A. (2001). A third study on predicting NCLEX success with the HESI Exit Exam. *Computers in Nursing, 19*, 172-177.

O'Donnell, M. (1982). NBME Part I Examination: Possible explanations for performance based on personality type. *Journal of Medical Education, 57*, 868-870.

Osborn, G.G., Meoli, F.G., Buser, B.R., Clearfield, M.B., Bruno, J.P., & Sumner-Truax, L. (2000). The Comprehensive Osteopathic Medical Licensing Examination, COMLEX-USA: A new paradigm in testing and evaluation. *Journal of the American Osteopathic Association, 100*, 105-111.

Ostrye, M.E. (2000). *Predictors of NCLEX-PN success for practical nursing students in an open access technical college*. Unpublished Dissertation, Indiana State University.

Paul, R.W. (1984). Critical thinking fundamental to education for a free society. *Educational Leadership, 5*, 11.

Peters, M. (2000). Does constructivist epistemology have a place in nurse education? *Journal of Nursing Education, 39*, 166-172.

Polit, D.F., & Hungler, B.P. (1999). *Nursing research: Principles and methods.* Philadelphia: Lippincott.

Poorman, S.G., & Martin, E.J. (1991). The role of nonacademic variables in passing the National Council Licensure Examination. *Journal of Professional Nursing, 7*, 25-32.

Pringle, R.K., & Lee, J. (1998). The use of learning and study strategies inventory as a predictor for success or failure on Part I of the National Board of Chiropractic Examiners test. *Journal of Manipulative Physiological Therapy, 21*, 164-6.

Reed, C.L., & Feldhusen, J.F. (1972). State board examination score prediction for associate degree nursing program graduates. *Nursing Research, 21*, 149-153.

Ripkey, D.R., Case, S.M., & Swanson, D.B. (1999). Identifying students at risk for poor performance on the USMLE Step 2. *Academic Medicine, 74* (supplement), S45-48

Robey, M. (1979). *Examining the validity of the State Board Test Pool Examination for registered nurse licensure*. Kansas City: American Nurses' Association.

Roncoli, M., Lisanti, P., & Falcone, A. (2000). Characteristics of baccalaureate graduates and NCLEX-RN performance. *Journal of the New York State Nurses Association, 31*, 17-19.

Roye, T.V. (1997). *Predictors of performance on the National Council Licensure Examination for Registered Nurses by associated degree graduates.* Unpublished doctoral dissertation, University of Houston.

Schmidt, A.E. (2000). An approximation of a hierarchical logistic regression model used to establish the predictive validity of scores on a nursing licensure exam. *Educational and Psychological Measurement, 60,* 463-478.

Schaeffer, B.K. & Rubenfeld, M.G. (2000). A consensus statement on critical thinking in nursing. *Journal of Nursing Education, 39,* 352-359.

Shannon, M.L. (1975). Nurses in American history. Our first four licensure laws. *American Journal of Nursing, 75,* 1327-1329.

Shelley, B., Kennamer, D., & Raile, M. (1976). Correlation of NLN achievement test scores with state board test pool examination scores. *Nursing Outlook, 24,* 52-57.

Simpson, E., & Courtney, M. (2002). Critical thinking in nursing education: literature review. *International Journal of Nursing Practice, 8,* 89-98.

Smeltzer, S.O. (1982). The new state board exam. *Nursing Outlook, 30,* 312-313.

Stronk, D.R. (1979). Predicting student performance from college admission criteria. *Nursing Outlook, 27,* 604-607.

Swanson, D.B., Ripkey, D.R., & Case, S.M. (1996). Relationship between achievement in basic science coursework and performance on 1994 USMLE Step 1 Test administration. *Academic Medicine, 71* Supplement, S28-S30.

Tillinghast, B.S., & Norris, B.N. (1968). The relation of selected admission variables to student achievement. *Nursing Outlook, 16,* 58.

Thompson, S. (2001). The authentic standards movement and its evil twin. *Phi Delta Kappan, 82,* 358-62.

United States Department of Transportation (2001). Part 61: Certification: Pilots and instructors. *Federal Aviation Regulations.* Washington, D.C.: Author

Vaughan-Wrobel, B.C., O'Sullivan, P., & Smith, L. (1997). Evaluating critical thinking skills of baccalaureate nursing students. *Journal of Nursing Education, 36,* 485-488.

Veloski, J.J., Callahan, C.A., Xu, G., Hojat, M., & Nash, D.B. (2000). Prediction of students' performances on licensing examinations using age, race, sex, undergraduate GPA, and MCAT scores. *Academic Medicine, 75,* S28-S30.

Wall, B.M., Miller, D.E., & Widerquist, J.G. (1993). Predictors of success on the newest NCLEX-RN. *Western Journal of Nursing Research, 15*, 628-643.

Walsh, C.M., & Hardy, R.C. (1999). Dispositional differences in critical thinking related to gender and academic major. *Journal of Nursing Education, 38*,149-155.

Waterhouse, J.K., Caroll, M.C., & Beeman, P.B. (1993). National council licensure examination success: Accurate prediction of student performance of the post-1988 examination. *Journal of Professional Nursing, 9*, 278-283.

Webb, C.T., Sedlacek, W., Cohen, D., Shields, P., Gracely, E., Hawkins, M., et al, (1997). The impact of nonacademic variables on performance at two medical schools. *Journal of the National Medical Association, 89*, 173-180.

Wendt A., & Brown, P. (2000). The NCLEX examination. Preparing for future nursing practice. *Nurse Educator, 25*, 297-300

Wendt, A., Holz, R., & Worcester, P. (1996). *Test development and item writing manual.* Chicago: National Council of State Boards of Nursing.

Yellen, E., & Geoffrion, A. (2001). Associated degree nurse success in NCLEX-RN, predictors and implications. *Nurse Educator, 26*, 208-211.

Yocom, C.J., & Scherubel, J.C. (1985). Selected pre-admission and academic correlates of success on state board examinations. *Journal of Nursing Education, 24*, 244-249.

APPENDIX A

IRB APPROVAL

Colorado State University

Office of Regulatory Compliance
Office of Vice President for Research
and Information Technology
Fort Collins, CO 80523-2046
(970) 491-1563
FAX: (970) 491-2293

MEMORANDUM

TO: Gene Gloeckner, School of Education, 1588
FROM: Celia Walker, Administrator for the Human Research Committee
SUBJECT: **PROJECT APPROVAL**
Title: Critical Thinking as a Predictor of Performance on the National Council Licensure Examination for Registered Nurses (NCLEX-RN).
Protocol No.:02-032H
Funding Agency: N/A
Funding Agency Deadline: N/A
DATE: February 13, 2002

I am pleased to inform you that the above-referenced project was approved by the Human Research Committee on February 12, 2002 for the period February 12, 2002 to February 12, 2003. Because of the nature of this research, it will not be necessary to obtain a signed consent form. Consent is waived under § _ _.116 (d) as secondary data. **Approval is for 400 records.**

As a condition of approval, a copy of the IRB approval from must be received prior to initiation of the research.

A status report of this project will be required within a 12-month period from the date of approval. You will be sent a reminder approximately two months before the protocol expires. The Principal Investigator will report on the numbers of subjects who have participated this year and project-to-date, about problems encountered, and provide a verifying copy of the consent form or cover letter used. The necessary form (H-101) is available from the Regulatory Compliance web page (see below). Should the protocol not be renewed before expiration, all activities must cease until the protocol has been re-reviewed.

It is the responsibility of the investigator to immediately inform the Committee of any serious complications, unexpected risks, or injuries resulting from this research. It is also the investigator's responsibility to notify the Committee of any changes in experimental design, participant population, or consent procedures or documents. This can be done with a memo which completely describes the changes and their consequences (new consent form or cover letter, or altered survey instrument, for example). Students serving as Co-Principal Investigators may not alter projects without first obtaining PI approval. The PI is ultimately responsible for the conduct of the project.

This approval is issued under Colorado State University's OHRP Federal Wide Assurance 00000647 issued July 1, 2001. If approval did not accompany a proposal when it was submitted to a sponsor, it is the researcher's responsibility to provide the sponsor with the approval notice.

Please direct any questions about the Committee's action on this project to me for routing to the Committee.

Additional information is available from the Regulatory Compliance web site at www.research.colostate.edu/regulatory/

xc: Jean Giddens

APPENDIX B

CCTST SUB-SCALE CORRELATIONS

APPENDIX B
CCTST SUB-SCALE CORRELATIONS

Inter Corrrelations Between Core CCTST Sub-Scales

		Analysis	Evaluation	Inference
Pearson	Analysis	1.0		
Correlation	Evaluation	.262	1.0	
	Inference	.300	.35	1.0
N	Analysis	2924		
	Evaluation	2923	2926	
	Inference	2924	2926	2927

Note: All correlations are statistically signficiant p<.001.
From Facioine, NC & Facione, PA, 1997

Inter Corrrelations Between CCTST Deductive and Inductive Sub-scales to Core CCTST Sub-Scales

		Analysis	Evaluation	Inference
Pearson	Deduction	.490	.559	.670
Correlation	Induction	.339	.717	.539
N		2663	2662	2663

Note: All correlations are statistically signficiant p<.001.
From Facioine, NC & Facione, PA, 1997