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A comparative analysis of demographic and academic characteristics

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**A comparative analysis of demographic and academic characteristics
and NCLEX-RN passing among urban and rural campus students
in a Midwest Associate Degree Nursing Program**

by

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A dissertation submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of
DOCTOR OF PHILOSOPHY

Major: Education (Educational Leadership)

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ABSTRACT

A retrospective study was initiated to determine: (1) the predictive relationship between demographic and academic variables and NCLEX-RN success; and (2) if there were significant differences between urban and rural nursing students that could account for an increased percentage of rural NCLEX-RN failures. A convenience sample was comprised of 398 graduates in 2005-2008, of an associate degree nursing program in the Midwest. Student age group, campus enrolled, Anatomy and Physiology GPA, number of practical nursing terms attempted, Practical Nursing GPA, and the number of associate degree nursing terms attempted were analyzed for predictive value of first-attempt NCLEX-RN success.

Descriptive analyses indicated urban and rural students were homogenous in nature. Means, standard deviations and the independent means *t*-test of significance determined there were no significant differences between urban and rural nursing students. A logistic regression analysis predicted 87.4% of the students who would pass the NCLEX-RN on the first attempt. Campus and the practical nursing core GPA were found to be significant predictors of NCLEX-RN success. Rural students were found to have less than a 30% chance of probability of passing the NCLEX-RN on the first attempt, compared to urban students, who had a 70% chance of passing the exam. Student age group, number of PN terms, Anatomy and Physiology GPA and the number of ADN terms were not significant predictors. The study supported the relationship between GPA and NCLEX-RN success, and the need to analyze environmental variables that influence success.

CHAPTER 1. INTRODUCTION

Skilled Healthcare Worker Shortage

The United States is approaching a severe shortage of health care workers. Currently, there is an 8.1% vacancy rate, with 135,000 open registered nurse positions across the United States (American Health Care Organization, 2007). Despite the current recession, the U.S. Department of Labor reported an increase of 27,000 positions in the healthcare sector in February 2009. Typically, registered nurses fill these positions, as they are the largest segment of the healthcare workforce (U.S. Bureau of Labor Statistics, 2009). By 2016, there will be a 23.5% increase in nursing positions, placing the nursing profession in the lead for employment opportunities (U.S. Bureau of Labor Statistics, 2007). If the current healthcare workforce trends continue, vacant registered nurse positions are expected to exceed one million by 2020 and, by 2015, all states are expected to experience the effects of a shortage of registered nurses (American Health Care Organization, 2007; Health Resources and Services Administration, 2006).

Iowa Demographics

An Iowa Nursing Task Force appointed by Governor Chet Culver predicted that 25% of the current workforce, or 9,000 nursing positions, will be vacant by 2020 (Iowa Nursing Task Force, 2008). The task force cited four main reasons the Iowa's nursing shortage will be critical: (a) an aging population; (b) 50% predicted retirement rate of Iowa's nurses within the next 15 years; (c) disparity in the distribution of nurses in urban and rural areas; and (d) a shortage of credentialed nurse educators. The 2010 projected census demographics indicate a 7.5% growth in the number of people between the ages of 65 and older, and a 2.7% growth in

the number of people between 20-24 years of age (U.S. Census Bureau, 2008). There is a projected need for 5,165 Registered Nurses (RN) and 1,895 Licensed Practical Nurses (LPN) in Iowa by 2014 to meet the needs of the aging population (Iowa Workforce Development, 2004). Currently, 59% of Registered Nurses and 32% of Licensed Practical Nurses are actively practicing (Iowa Board of Nursing, 2008). Statistics provided by the Iowa Board of Nursing anticipate 64% of the registered nurses in Iowa will be retired or over 65 years of age in 2009 (Iowa Nursing Task Force, 2008).

Relatively low wages and the increased physical and emotional demands within the health care work environment have been cited as the main factors for leaving the nursing profession (Iowa Council of Nurses [ICON], 2002). Iowa ranks last in the nation for Medicare reimbursement per beneficiary (Iowa Office of the Attorney General, 2003). Most hospitals rely on Medicare as a primary mechanism of reimbursement. As a result, Iowa's hospitals are not able to offer professional salaries that are competitive to the salaries in neighboring states.

The Iowa Board of Nursing, Trends in Nursing Report (June 30, 2008), identified 76 faculty vacancies (26 full-time and 50 part-time) in undergraduate RN programs and 36 faculty vacancies (13 full-time and 23 part-time) in LPN programs across the state. Forty-nine percent of nursing program faculty in Iowa plan to retire in 2010 (ICON, 2002). A shortage of nurse educators limits the ability of a nursing program to accept additional students, as the practice discipline requires ratios of one faculty member to no more than six to eight students. According to the Iowa Board of Nursing (IBON), approximately 2,000 qualified nursing applicants were unable to enter nursing programs in Iowa in 2008.

In addition to the projected shortages, there is a concern that incoming students are not academically prepared for the rigor of nursing programs. The Spellings Report (2006), indicated the United States is ranked 12th in the attainment of higher educational degrees as compared to other industrialized countries, and incoming college students are often inadequately prepared for the expectations of college (National Center for Public Policy and Higher Education [NCES], 2006; U.S. Department of Education, [U.S. DOE], 2006). National reports have also indicated that students in the United States score lower than their peers in science and mathematical literacy (Braswell, Lotus, Grigg, Santapau, & Johnson, 2001; Grigg, Daane, Ying, & Campbell, 2003; U.S. DOE, NCES, 2008). According to The National Assessment of Educational Progress report, only 36% of high school seniors are proficient in reading and 17% proficient in mathematics (U.S. DOE, 2006). The 2003 National Assessment of Adult Literacy findings indicated a 9% decline in prose literacy among college graduates, which is associated with critical thinking skills (U.S. DOE, NCES, 2003). The first-attempt pass rates for Iowa's nursing graduates who take the Registered Nurse licensing exam are lower than national standards (National Council State Boards of Nursing [NCSBN], NCLEX Statistics, 2010). In response, nursing programs are increasing program admission and progression requirements, widening the gap between high school student abilities and college entrance requirements.

A widening gap exists between the financial resources available to students and the cost of higher education. A 1.5% across-the-board budget cut in Iowa (2008), coupled with an additional 10% general aid reduction the following year (2009), have presented further challenges to many educational and services entities already facing economic hardship (Iowa Office of the Governor, 2010). In the majority of community colleges, where state aid and

student tuition and fees account for approximately 65% of the budget, these reductions are significant (Education Commission of the States, 2000).

Community College Challenge

Community colleges are in an optimal position to educate students to meet the healthcare worker shortage. More than 40% of the 14 million undergraduates in the United States attend two-year community colleges (American Association of Community Colleges [AACN], 2002; U. S. DOE, National Center for Education Statistics [NCES], 2008). Student enrollment in the community colleges has steadily increased over the last 30 years, and has surpassed the enrollment growth in four-year colleges and universities. The majority of this growth is attributed to nontraditional students (U.S. DOE, NCES, 2002). Non-traditional students are those who possess one or more of the following characteristics: delayed enrollment, part-time attendance, working full-time, financially independent, single parent or has dependents other than a spouse, and/or does not possess a high school diploma (U. S. DOE, NCES, 2002). These statistics indicate the need for all institutions of higher learning to focus on enrolling students of all ages, identify the factors that promote student retention and success, and create an environment conducive to meeting diverse student needs (Rendón, 2007).

Statement of the Problem

Midwest community college (MWCC) offers a Practical (PN) and Associate Degree Nursing (ADN) Program on two campuses; one urban and one rural. Commonly referred to as a ladder program, students can graduate from the PN program upon completion of one year of study and are eligible to take the NCLEX-PN exam (IBON, n.d., 655 Iowa

Administrative Code, Chapter 3). Students who choose not to exit the program after the first year proceed into the second year of study in order to complete the associate degree curriculum. Graduates from the Associate Degree Nursing Program must successfully pass the NCLEX-RN examination in order to enter the nursing workforce as a licensed Registered Nurse (National Council of State Boards of Nursing [NCSBN], NCLEX Overview, n.d.). The NCLEX is a standard benchmark for determining the success of the nursing program (Beeman & Waterhouse, 2001; Fowles, 1992; Griffiths, Bevil, O'Connor, & Weiland, 1995; Yin & Burger, 2003).

The Midwest Community College Nursing Program (MWCCNP) has experienced an annual 1% decline in NCLEX-RN pass rates since 2004. An internal analysis of NCLEX-RN results from 2002 to 2009 revealed that 81% of the students who failed the NCLEX-RN on the first attempt were graduates from the rural campus (NCSBN, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009).

Midwest Community College has the least restrictive nursing program entrance and re-entry policies of all statewide community college programs and surrounding baccalaureate schools of nursing. Students enter the program after meeting minimal standardized reading and math scores. A variety of entrance scores are accepted: Accuplacer, ASSET, Compass, ACT and SAT. Admission scores are waived upon completion of related coursework with a C- or above. Waivers have no time limits.

There are no selective progression requirements in place for advancement from the first to the second level of the nursing program. A student who completes first level nursing coursework with a minimal grade of C- may progress into the second level of the nursing program. Students are allowed to withdraw from nursing coursework and re-enter the

program an unlimited number of times. There is no time limit for program completion. Therefore, several faculty and program administrators have raised concerns regarding the rigor and relevancy of the nursing program admission and progression criteria.

Purpose and Significance

The primary purpose of this quantitative study was to analyze the predictive relationship between demographic information; student age group and campus enrolled, and academic program information: Anatomy and Physiology GPA, the number of terms the student attempted to complete PN core coursework, the core PN coursework GPA, the number of terms the student attempted to complete ADN coursework, and the core ADN coursework GPA, and first attempt NCLEX-RN success. A second purpose of the study was to determine if there were significant demographic and academic differences between urban and rural nursing students that could account for the higher percentage of rural NCLEX-RN failures.

This study increases the body of knowledge regarding the relationship between demographic and academic factors and NCLEX-RN success. The database utilized in this study provided a foundation for the ongoing collection and annual statistical analysis of variables related to program and NCLEX success.

The results of this study challenged the MWCC open-door program philosophy, resulting in changes in program admission, re-entry, and completion policies for the upcoming academic year. This study also identifies the need to explore the environmental nuances and non-cognitive factors related to program and licensure success.

Theoretical Framework

Astin's (1970, 1993) Input, Environment and Output (IEO) Framework was the framework for the development of the Demographic and Academic Variables and NCLEX-RN Success Model. This model depicts the relationship between the variables in this study (Figure 1, p. 9).

Student background and the institutional environment affect learning (Astin, 1970, 1993). Student development occurs as a result of the interaction between a student and the institutional environment. This interaction is influenced by the characteristics of the student and the nuances within the environment. Institutions of higher learning must recognize these characteristics, and work to assess the effect the institutional setting has on student learning. Through this process, institutions can modify the services and program experiences to promote student success (Astin, 1993).

There are three facets to a student's educational success: input, environmental, and output (Astin, 1993). Input variables, such as student characteristics, attributes, or past history, are unique to the individual and come with a student brings as he or she enters the educational setting. Input variables are previously determined and not changeable. They affect the way a student interacts within the environmental variables within the educational setting. For example, male students may interact differently than female students within the nursing program (gender is the input variable).

The second type of variable, environmental, is specific to each location or situation the student faces. Environmental variables are dynamic in nature. A rural campus environment may influence a student's experiences differently than an urban campus environment. The third types of variable, outputs, are similar to outcomes. Outcome variables

must be pre-determined and measurable. Nursing programs have several outcomes. The completion of the first level of the program is measured by a student's success on the NCLEX-PN exam. Completion of the second level of the program is measured by NCLEX-RN first-attempt success.

The MWCCNP Academic Model of NCLEX-RN Success is a conceptual model of the final variables used for the discriminate analysis in this study (Figure 1). Six independent variables were included in this model—two demographic variables, and four academic variables. The demographic variables are classified as *input* variables. These variables are unchangeable characteristics that may influence the interaction between the student and the educational environment.

The MWCCNP has two separate academic environments: Academic Environment 1, the first level practical nursing environment; and Academic Environment 2, the second level associate degree environment. The independent variables in Academic Environment 1 are: the number of terms a student attempted in order to complete the first level (PN) nursing coursework, the Anatomy and Physiology grade point average (GPA), and the GPA of the practical nursing theory coursework were. The number of terms a student attempts to complete the second level (RN) nursing coursework is the independent variable in Academic Environment 2. The extent to which these six independent variables (age group, campus enrolled, and variables within academic environments 1 and 2) predict the dependent variable, NCLEX-RN success is depicted by the model. A summary of the variables and the relationship to the Astin's IEO model can be found in Appendix A.

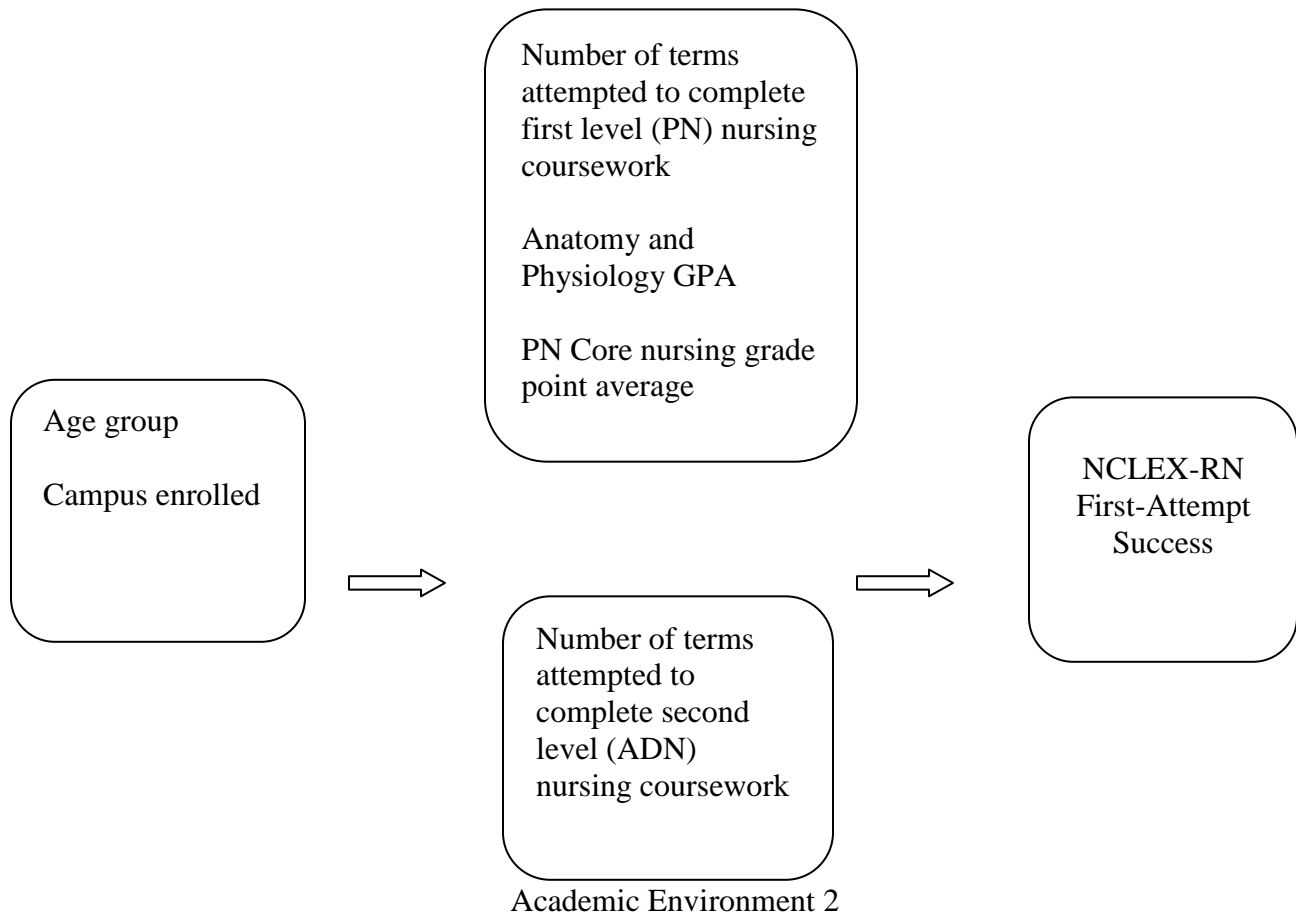


Figure 1. MWCCNP Academic Model of NCLEX-RN Success

Research Questions

The following research questions were identified based on the review of literature related to student and NCLEX-RN success:

1. What are the student demographics and program reading admission scores for the MWCC nursing students on the urban and rural campus?
2. What are the anatomy and physiology grade point average, the number of terms attempted for PN and ADN program completion, program outcomes and completion

- rates and cumulative and core program level grade point averages for the MWCC PN and ADN graduates on the urban and rural campus?
3. Is there a statistically significant difference in:
 - a. the anatomy and physiology grade point averages,
 - b. the number of terms attempted for PN and ADN program completion,
 - c. completion rates,
 - d. and core program grade point averages for the first year (practical level) and second year (associate degree) nursing students attending the urban versus rural campus?
 4. Is there a statistically significant difference in the second level nursing course grades on the urban and rural campus?
 5. Is there a statistically significant relationship between associate degree nursing course grades, and core PN and core ADN GPAs on the urban and the rural campus?
 6. To what extent do student demographics and academic performance data of PN and ADN levels predict the first time passing of the NCLEX-RN among the MWCC nursing students?

Definition of Terms

Several terms were defined for use in this study:

Accuplacer: A computer-adaptive, internet accessible, college advising and placement test often used in community and technical colleges. The Accuplacer test measures writing, numerical, reading skills, and math skills such as elementary, intermediate and college

algebra and geometry. Schools may add five additional testing areas to this exam (College Board Tests, n.d.).

ACT: A common standardized college entrance “tests of educational development are designed to determine how skillfully students solve problems, grasp implied meanings, draw inferences, evaluated ideas and make judgments in subject-matter areas important in success in college” (ACT Organization, 1997, ACT Technical Manual, p. 2).

Advanced Transfer ADN Student: A student who is a licensed practical nurse and has applied to complete the associate degree nursing requirements in order to become eligible to take the NCLEX-RN exam.

Age Group: An independent, demographic variable in this study referring to nontraditional and traditional age groupings.

Asset: A common standardized college entrance exam often used in the community or technical college setting. A product of the ACT organization, Asset tests measure writing, numerical and reading skills; elementary, intermediate and college algebra; and geometry. Schools may also add five additional tests to the Asset package (ACT organization, Asset, n.d.).

Associate Degree Nurse (ADN): “A program that has at least a two-academic-year course of study or its equivalent in theory and practice as described by the Iowa Board of Nursing that leads to a degree in nursing and to eligibility to apply for registered nurse licensure by examination” (IBON, n.d., 655 Iowa Administrative Code Nursing Board, Chapter 3, p. 1).

Associate Degree Nursing Student: a student who advances into registered nursing coursework and is awarded an associate degree upon program completion.

Astin's Input, Environment and Outcomes Framework (IEO): A framework which identifies student development as a process of interaction between an institution's environment and the characteristics a student brings with them (Astin, 1970).

Baccalaureate Program: "A course of study designed for registered nurses that leads to a baccalaureate degree with a major in nursing (IBON, n.d., 655 Iowa Administrative Code Nursing Board, Chapter 2, p. 1).

Clinical: "Hands-on learning situations in which students directly care for patients/clients within a relevant setting, under the supervision of a qualified faculty member, so program outcomes are met (IBON, n.d., 655 Iowa Administrative Code Nursing Board, Chapter 2, p. 1).

Compass: "Test designed to measure academic achievement and skills and competencies that have been identified by curriculum experts as essential for success in postsecondary education. Student performance is reported in terms of achievement on tests of writing skills, reading, prealgebra, algebra, college algebra, geometry, and trigonometry" (COMPASS Course Placement Service Interpretive Guide, n.d., Chapter 2, p. 3).

Content: "The subject matter in a given area of study" (IBON, n.d., 655 Iowa Administrative Code Nursing Board, Chapter 2, p. 1).

Core Nursing Courses: Nursing courses that consist of theory, lab and clinical activities, and must be taught by a qualified nursing faculty member. Core nursing courses are required courses for program completion and are often sequential in nature.

Core Nursing Grade Point Average (GPA): The grade point average of all nursing theory coursework (identified on the educational plan). The core nursing grade point average is calculated by the number of credit hours multiplied by the grade points for the grade

received, divided by the total number of credit hours attempted. In cases where a course was attempted more than once, all grades and course credits were included in the formula.

Core Nursing Program: The required nursing courses as identified by the educational plan for the nursing program at MWCC.

Curriculum: “Content, lab/simulation, observation and clinical experiences developed, implemented, and evaluated by faculty to facilitate achievement of program outcomes and to meet the learning needs of students (IBON, n.d., 655 Iowa Administrative Code Nursing Board, Chapter 2, p. 1).

Day Program: A nursing program where the curriculum identified on the educational plan offered Monday through Friday prior to 5:00 p.m.

Dependents: People who rely on the student for support; includes children and elderly relatives. Dependents typically live in the same environment and are identified on federal financial documents.

Educational Plan: The formal document that outlines the core and support program coursework according in a sequential format; credit hours, semesters or terms, and the time of completion is identified.

Entrance Requirements: The identified requirements that must be met in order to be eligible to enter a designated program.

Evening/Weekend Program: A nursing program option where the theoretical classes identified on the educational plan are offered Monday through Friday after 4:00 p.m, and Saturday and Sunday.

Evolve Reach 'HESI Exam': Preparatory materials and tests designed to measure a student's knowledge related to subject areas on the NCLEX test. The Comprehensive Assessment Test is considered to be a "mock" NCLEX exam (Evolve Reach Brochure, 2009).

Faculty: "The individuals who teach nursing in a nursing education program or who are hired to teach in a program on the basis of education, licensure or practice as a registered nurse" (IBON, n.d., 655 Iowa Administrative Code Nursing Board, Chapter 2, p. 1).

Financial Status: The utilization of grants or loans to pay for college expenses.

Iowa Board of Nursing (IBON): Legal body responsible for regulating and enforcing regulations for nursing education, nursing practice and continuing education for nurses in Iowa (IBON, n.d., Home page).

Iowa Council of Nurses (ICON): "The forum for Iowa nursing organizations to communicate among the organizations and their members" (Iowa Nursing Association, n.d., ICON).

Lab/simulation: Activities that mimic the reality of a clinical environment and that are designed to demonstrate procedures, decision making and critical thinking through techniques such as role-playing and through the use of devices such as interactive videos or mannequins (IBON, n.d., 655 Iowa Administrative Code Nursing Board, Chapter 2, p. 1).

Ladder Program: A program in which the first level builds upon the second level of the curriculum; students are able to exit the program after the first year of studies and be eligible to take the NCLEX-PN exam for practical nursing, or may proceed into the second year of the program for completion of the registered nursing curriculum.

License: "A certificate issued to a person to practice as a registered nurse, or licensed practical nurse, or advanced registered nurse practitioner under the laws of this state (IBON, n.d., 655 Iowa Administrative Code Nursing Board, Chapter 1, p. 1).

Licensed Practical Nurse (LPN): A person who has been issued a license to practice as a Practical Nurse under those laws of the state (IBON, n.d., 655 Iowa Administrative Code Nursing Board, Chapter 3).

Licensed Registered Nurse (RN): A person who has been issued a license to practice as a Registered Nurse under the laws of the state (IBON, n.d., 655 Iowa Administrative Code Nursing Board, Chapter 3).

National Council of State Boards of Nursing (NCSBN): Comprised of member state nursing boards, “provides leadership to advance regulatory excellence for public protection.” (NCSBN, n.d., Mission and values).

NCLEX: National Council Licensure Examination, the examination currently used for initial licensure as a registered nurse or licensed practical nurse (IBON, n.d., 655 Iowa Administrative Code Nursing Board, Chapter 2, p. 1).

NCLEX Pass Rate: A percentage correlated from all first-attempt applicant scores who take the NCLEX exam within six months of graduating from a nursing program (NCSBN, n.d., NCLEX overview).

NCLEX-RN Success: The success of a student passing the National Council Licensure Examination for Registered Nurses on the first attempt. NCLEX-RN success is the dependent variable in this study.

Non-progression: A student who evidences a delay in moving on in sequence in the curriculum. This delay could be the result of needing to repeat a course, or a student request to take time off from the program as identified by the educational plan. Non-progression results in a delay in program completion.

Nontraditional Student: “A non-traditional student is one who has any of the following characteristics: delays enrollment; attends part time for at least part of the academic year; works full time; is considered financially independent for purposes of financial aid; had dependents other than spouse; is a single parent; does not have a high school diploma” (U.S. Department of Education, NCES, 2002, p. 3).

Persistence: Implied by a student who has repeated coursework, or returned to the program after a delay in progressing in the sequence of the core coursework identified on the educational plan.

Practical Nursing Program: “At least a one-academic-year course of study or its equivalent in theory and practice as described by the board that leads to a diploma in practical nursing and to eligibility to apply for practical nurse licensure by examination as described in 655 Iowa Administrative Code Nursing Board Chapter 3 (IBON, n.d., 655 Iowa Administrative Code Nursing Board Chapter 2, p. 1).

Practical Nursing Student: A student who exits the program upon completion of the core practical nursing coursework.

Program: “The course of study by any method of instruction or delivery that leads to a nursing diploma, degree or certificate. Multiple-site programs offered by one controlling institution shall be considered one program if the philosophy and curriculum of all sites are the same” (IBON, n.d., 655 Iowa Administrative Code Nursing Board, Chapter 2, p. 2).

Program Completion: The time it takes to complete all the required courses identified on the educational plan that enable one to become eligible for graduation from a program.

Program Performance Data: Academic reports that include course and comprehensive exam grades, and the number of semesters to complete the program.

Program Progression: Successful completion of sequential nursing coursework; advancing from the first level or the Practical Nursing curriculum into the second year of coursework in order to complete the Associate Degree nursing curriculum.

Qualified nursing faculty: “Individuals who meet Iowa Board of Nursing faculty qualifications as specified in Chapter 2 as well as the qualifications of the parent institution: (IBON, n.d., 655 Iowa Administrative Code Nursing Board, Chapter 2, p. 2).

Rural Campus: A campus situated in “a territory that is not classified as urban” (U.S. Census Bureau, n.d., American Fact Finder Glossary).

Scholastic Assessment Test (SAT): A standardized college entrance exam that measures critical thinking, mathematical reasoning, and writing skill proficiency (College Board Tests, n.d.)

Theory: The body of rules, ideas, principles, and techniques that applies to a subject; typically communicated through lecture or classroom activities.

Traditional Student: A student who “earns a high school diploma, enrolls full time immediately after finishing high school, depends on parents for financial support, and either does not work during the school year or works part time” (U.S. DOE, NCES, 2002, p. 1). Traditional students are typically between 18 to 24 years of age.

Urban Campus: A campus situated in “a territory with a general population density of at least 1,000 people per square mile of land area that together have a minimum residential population of at least 50,000 people” (U.S. Census Bureau, n.d., American Fact Finder Glossary).

CHAPTER 2. LITERATURE REVIEW

Overview

Numerous studies have been conducted to determine indicators related to successful completion of a nursing program and/or successful performance on the nursing licensure exam. The majority of research has focused on the relationship between academic admission and progression variables predictive of baccalaureate nursing student licensure success. Limited research has been conducted to determine the predictors of NCLEX-RN success in associate degree programs.

This chapter provides a brief review of past and present nursing testing formats, followed by research related to nursing program completion and licensure success. Research studies are presented in the periods of testing formats: SBTPE, NCLEX-RN Results (1982 to 1988), NCLEX-RN Results (1989 to 1994), and NCLEX-RN Results (1995 to Present). Research related to baccalaureate nursing student licensure success is presented, followed by research utilizing associate degree nursing students and mixed sample populations (BSN, ADN, Diploma, and/or PN). Nursing research related to traditional and non-traditional students, along with theories regarding student engagement in commuter and rural environments, is provided to strengthen the importance of including these variables in the study. A summary of the significant predictors of NCLEX-RN success is included in Appendix B.

Nursing Licensure

The first Registered Nurse (RN) licensure exam was administered in 1908. Comprised of 50 essay questions, this exam was divided into five sections and included an oral

component. In addition to the knowledge areas identified on the test plan, male applicants were required to answer 10 questions on diseases of men (IBON, n.d.; History of Nursing in Iowa, p. 1). The exam was comprised of essay questions until 1935, when the Board of Nursing constructed and initiated a 500 question, multiple-choice examination. This type of exam was used until 1946, when it was replaced with the first national State Board Test Pool Exam (SBTPE). In 1949, the SBTPE became the state exam standard (IBON, n.d., History of Nursing in Iowa, p. 1).

The National Council Licensure Examination (NCLEX) was adopted by the National Council of State Boards of Nursing (NCSBN) in 1982. The NCLEX results were reported as numerical scores (NCSBN, 1997). In 1988, the NCSBN made significant changes to the exam; the focus was changed from decision making to assessment of client's needs, the number of questions was reduced, and exam results were reported as pass/fail (Chornick & Yokum, 1995; Matassarini-Jacobs, 1989).

On April 1, 1994, the NCSBN converted to a Computerized Adaptive Testing method (CAT), enabling candidates to schedule their examination at board-approved testing centers. Temporary licensure for new graduates was terminated with this process (IBON, n.d.; History of Nursing in Iowa, p. 1).

From 1994 to October, 2002, the Educational Testing Services (ETS) and the Chauncey Group International in Princeton, New Jersey, were contracted to administer the state nursing board exams. On October 1, 2002, the National Council of State Boards of Nursing, Inc., awarded the testing contract to the National Computer Services (NCS Pearson). Candidates could apply over the Internet, web or email to take the exam at a national Pearson Professional Center, and communication with the State Boards of Nursing

became web-based and efficient. Licensure status was made available via telephone or the internet (IBON, n.d., History of Nursing in Iowa, p. 1). An overall decline in state board scores occurred following the implementation of these new testing centers. A governor-appointed Iowa Board of Nursing NLCEX-RN Task Force in 2006 was unable to reach conclusions regarding this occurrence (IBON, 2006). Today, NCS Pearson maintains the contract for all state nursing board exams.

NCLEX-RN

The NCLEX-RN exam is a computer-adaptive examination administered to graduates of accredited schools of nursing. Graduates of baccalaureate and associate degree nursing programs take the same computerized NCLEX-RN exam to validate entry-level competence for RN licensure. The exam is comprised of 76-276 questions of varying difficulty (NCSBN, n.d., NCLEX Brochure). The NCLEX is administered using Computerized Adaptive Testing (CAT), or “a method for administering tests that merges existing computer technology with modern measurement theory to increase the efficiency of the testing process” (NCSBN, n.d., Computerized Adaptive Testing). Questions of increasing difficulty are presented until a test-taker misses a question. The computer then presents a similar question, or one that is of less difficulty. The computer is programmed to shut off “...when the confidence interval surrounding the candidate's ability level falls entirely above or below the passing standard. This confidence interval is the estimated region of a candidate's ability that could vary 95% of the time if the candidate answered more questions” (NCSBN, n.d., CAT).

The NCLEX-RN exam has a psychometrically established reliability between 0.87 and 0.92 (NCSBN, n.d., CAT). Content validity for the exam is established through test-item

development and a review process utilizing professional nurses with demonstrated knowledge and experience from the education, practice and administrative sectors. To maintain relevance of the NCLEX exam to the profession, the National Council State Board of Nursing conducts a RN and a LPN job analysis every three years. The results of these analyses are the basis for the NCLEX-RN and NCLEX-PN exams (NCSBN, n.d., NCLEX Overview). The NCSBN provides quarterly reports detailing first-attempt and retake passing percentages for individual nursing programs, and statewide aggregate comparisons.

Iowa NCLEX trends

In the 1970s, Iowa was within the top ten states for highest nursing licensure pass rates. Gradually, Iowa's pass rates have declined. In 2004, Iowa ranked 51 among the 55 states and countries reporting NCLEX-RN pass rates (NCSBN, 2004, NCLEX Statistics). An Iowa Board of Nursing Task Force (March, 2005) examined the variables related to NCLEX-RN scores, but was unable to identify specific reasons for the 2004 dramatic drop in the NCLEX-RN passing percentage. The task force generated ideas for further research and provided a summary of program recommendations that included: faculty recruitment, faculty test-writing, use of standardized testing for advising, progression and curriculum evaluation, and implementing plans to identify and assist at-risk students (IBON, 2006, NCLEX-RN Task Force Report). Since 2006, many Iowa nursing programs have raised admission and program progression standards to improve program pass rates (Community College Program Admission Requirements, 2009).

MWCC NCLEX statistics

Since 2005, there has been a slow decline in NCLEX-RN pass rates at MWCC; 89% in 2005; 88% in 2006; 86% in 2007; and 84% in 2008 (NCSBN, 2005-2009, NCLEX Statistics). In 2008, 84% of the students passed the NCLEX-RN exam with 94% of the failures occurring on the rural campus (NCSBN, 2008, NCLEX Statistics). An internal program analysis revealed 81% of the NCLEX-RN failures from 2002 through 2009 were students who had graduated from the rural campus (NCSBN, 2002-2009, NCLEX Statistics).

Academic Predictors of Nursing Licensure Success

State Board Testing Pool Examination (SBTPE)

Prior to the 1982 institution of the NCLEX exam, the association between academic variables, program completion, and success on the State Board Test Pool Examination (SBTPE) was identified. Taylor, Nahm, Loy, Harms, Berthod, and Wolfer's (1966) summative literature review identified high school grades were the best predictor of academic success in nursing in research conducted prior to 1965. Taylor et al. reported a limited ability to generalize these findings and concluded "the best combination of prediction variables be established in the local setting" (1966, p. 55). Schwirian, Baer, Basta, and Larabee (1978) used published data (1965 to 1975) to determine nursing theory course grades, GPA, and National League of Nursing (NLN) Achievement Test scores were the primary predictors of student success on the SBTPE.

NCLEX-RN results (1982 to 1988)

BSN students

One of the first comprehensive analyses, conducted by Campbell & Dickson (1996), involved the review of published and unpublished nursing research (1981 to 1990) related to the predictors of baccalaureate NCLEX-RN success. Out of the 47 studies included in the integrative review, 43 were descriptive in nature. Four studies were treated meta-analytically; three that were experimental designs, and one that was a quasi-experimental design. The majority of the studies used quantitative measures as predictor variables of retention, graduation and NCLEX-RN success. Grade point averages, theory grades and standardized test scores were most often studied. Five studies included demographic characteristics such as; student gender, student race, parent age, and parent's educational level. Convenience samples were primarily used, with the senior-level nursing students and recent graduates most commonly studied.

Among the demographic variables that were analyzed, parental age, financial status, and educational level were correlated with NCLEX-RN success. Academic variables—pre-nursing course grades, science course grades, nursing theory course grades, and cumulative program GPAs—were positively correlated to NCLEX-RN success. Standardized admission tests were significantly correlated with program success: ACT scores most often predicted NCLEX-RN success. The NLN pre-nursing examination was found to be 100% predictive of NCLEX-RN success in the one study that measured it (Campbell & Dickson, 1996, p. 56). These findings are consistent with those of Schwirian et al. (1978) who determined theory grades and program GPA were the most reliable predictors of nursing student success.

A meta-analysis of the program interventions identified computer-assisted instruction, support groups, and individualized remediation programs were significantly effective at a 95% confidence level. Support groups were the only intervention predictive of NCLEX-RN success (Campbell & Dickson, 1996, p. 56). In conclusion, Campbell and Dickson identified a need to work toward the identification of a common set of student characteristics predictive of licensure success.

Carpenter and Bailey (1999) conducted a third review of the literature (1976 to 1999) to update the findings of Taylor et al. (1966) and Schwirian et al. (1978). Academic variables were found to be most predictive of licensure success: High school ranking, grade point averages, ACT and SAT scores and nursing program grade point averages were positively correlated with NCLEX success in associate and baccalaureate programs, with theory course grades and NLN test scores most predictive of NCLEX success.

Feldt and Donahue (1989) initiated a study at a small, private college in the Midwest, to determine the best combination of routinely available academic variables predictive of nursing program success. Program success was measured by the cumulative nursing GPA and NCLEX-RN success. The independent variables included high school rank, ACT subtest and composite scores, and course grades; college psychology, sociology, general chemistry I and II, biology, zoology, microbiology, and anatomy. The random sample was made up of 189 subjects; 155 who completed the program between 1984 and 1986, and 34 program non-completers between 1978 and 1982.

The sample data were randomly divided in two approximately equal groups. A statistically significant *t*-Test of the regression coefficient identified potential predictors of program success. A multiple regression analysis incorporating the backward elimination

procedure determined ACT composite scores and first semester chemistry and anatomy grades were the best predictors of nursing program GPA. ACT composite scores and high school rank were the best predictors of a cumulative nursing GPA. The cumulative nursing GPA and first semester chemistry grades were the best combination of variables predictive of NCLEX-RN success, with the cumulative nursing GPA providing the greatest amount of discrimination between the NCLEX-RN pass/fail groups.

Quick, Krupa, and Whitley (1985) initiated a research study to determine the factors that influenced NCLEX-RN success, using a sample group of 138 non-transfer baccalaureate nursing students. Admission indicators predictive of NCLEX success were identified. A forced entry, discriminant analysis method was then used to determine the combination of admission variables most predictive of NCLEX-RN success. A classification procedure was then established to divide students into two groups; those predicted to pass the NCLEX, and those predicted to fail. The classification procedure utilized was determined to be 83.4% reliable for NCLEX-RN performance (p. 366).

The 1985 research study of Krupa, Quick, and Whitley (1988) analyzed the predictive validity of nursing course grades and performance on the NCLEX-RN. Utilizing a research design similar to the prior study, this study included the previously omitted transfer nursing students. Nursing course grade records and NCLEX-RN scores were analyzed for 352 BSN students who graduated between 1982 and 1985, with the intent of determining the factors that assist with early identification of the students at risk for NCLEX-RN failure. Through discriminant analysis, seven predictor variables correctly classified 86% of students at the completion of junior year, 88% during their senior year, and 91% at graduation. Out of the fifteen variables selected for analysis, grades in an introductory sophomore nursing course,

made the greatest contribution to the prediction of NCLEX-RN success. All nursing course theory grades and the cumulative program GPA were significantly correlated to NCLEX-RN success. These findings evidenced the ability to identify at-risk nursing students as early as their junior year, and validated the utilization of nursing theory grades to predict NCLEX-RN success.

Students enrolled in a 50-year-old Pacific Northwest nursing program that had experienced a sharp decline in the NCLEX-RN pass rates (1983), became the subjects in a study initiated by Whitley and Chadwick (1986). An analysis of the 1982 and 1983 BSN graduate records was conducted to identify the variables that contributed to the decline in NCLEX-RN pass rates from 94% in 1982, to 66% in 1983. No significant correlations were found between the twenty-three variables selected for analysis and the 1982 or 1983 graduate records.

The students who failed the NCLEX-RN had significantly lower SAT math scores, SAT verbal scores, entry level science GPAs, core nursing course grades, cumulative nursing GPAs, and cumulative program GPAs. The Pearson product-moment correlation ($p \leq .05$) determined science and prerequisite entry GPAs were the significantly correlated to NCLEX-RN success.

Payne and Duffey (1986) conducted a retrospective study utilizing the records of 283 BSN graduates (1983 and 1984) of the University of North Carolina, Chapel Hill School of Nursing. The purpose of this study was to determine if there were any predictor variables that could be used to identify students who would need additional assistance in order to pass the NCLEX-RN exam, and to identify the optimal point in which interventions would benefit at-risk students. The sample group was identified as the students who failed the NCLEX-RN

and the students who were “within chance level of failure...defined as approximately one standard error of estimate above the failure mark” (p. 377). The independent variables in the study included; GPA at start of the nursing curriculum, SAT math score, SAT verbal score, SAT total score, sequential nursing GPAs, and cumulative nursing GPA. NCLEX-RN success was the dependent variable in the study.

Descriptive and aggregate calculations of the two cohort groups determined the class distributions were normal. A sequence of stepwise regression analyses performed on the aggregate group determined the nursing program entrance GPA, and the SAT individual and total scores accounted for 33.3% of the variance in NCLEX-RN scores. The addition of the mid-junior GPA to the equation increased the explained variance to 48.3%, and the addition of the mid-senior year GPA, resulted in a total of 53% of the explained variance (Payne & Duffey, 1986).

Cross-validation was then employed to determine if the regression coefficients obtained from the 1983 graduate data was predictive of the NCLEX scores for the 1984 class. Similar results were identified. The final step, an examination of the data of the students who were correctly labeled as at-risk students, utilized the 1983 predictive coefficients. Fifty-five percent of the students at-risk for failing the NCLEX-RN exam were identified at the midpoint of junior year, and 65% were identified at the end of junior year. There was little change in results for the senior year. Payne and Duffey (1986) encouraged nursing programs to make predictions and implement interventions immediately following the first semester of junior year.

Glick, McClelland, and Yang (1986) conducted a research study utilizing data from 51 BSN graduates of a large Midwestern university. The purpose of this study was to identify

the relationship between admission variables; high school rank, cumulative high school GPA, ACT individuals scores, and ACT composite score, pre-nursing course grades, nursing course grades, and program achievement. Program achievement was measured by clinical nursing course grades, cumulative nursing GPA, and NCLEX-RN success. No statistically significant correlations were found between high school rank, high school GPA, clinical nursing grades, cumulative nursing GPA and NCLEX-RN success. Rather, the biology GPA contributed 26% to the variance when the pre-nursing grade point average was used as the criterion variable ($p \leq .001$) in the stepwise multiple regression analysis. Statistically significant correlations were found between six of the seven clinical nursing courses and NCLEX-RN success. The pathology class was found to be highly correlated with NCLEX-RN success.

Yang, Glick and McClelland (1987) repeated the previous study with a larger and broader sample population. Using the academic records of 210 BSN graduates (1983 to 1985) from a large Midwestern university, Yang and associates set out to investigate the relationship between admission variables and program achievement. Admission variables included; high school rank, ACT subtest and composite scores, and the cumulative GPAs for chemistry, biological sciences, social sciences, and pre-nursing courses. Program outcome was measured by the grades earned in clinical nursing courses, cumulative nursing GPA, and NCLEX-RN performance. Consistent with prior studies, the majority of the subjects were female (94.76%) with a mean age of 23.63. The percentage of students who transferred in pre-nursing courses from another institution was 18.57%.

Many statistically significant correlations between the predictor variables and nursing program achievement were found: The ACT social science sub score was the highest

predictor ($r = .48$) of NCLEX-RN success; The pre-nursing GPA ($r = .64$), social science GPA ($r = .58$), and biological sciences GPA ($r = .54$) were the strongest predictors of the clinical grade point average; and The pre-nursing GPA ($r = .65$), social science GPA ($r = .57$), and biological science GPA ($r = .56$) were the strongest predictors of the cumulative nursing GPA (Yang, Glick & McClelland, 1987, p. 301).

The cumulative nursing GPA and NCLEX-RN scores were then used as dependent variables in two stepwise multiple regressions. When the cumulative nursing GPA was the dependent variable, the ACT composite score accounted for 4% of the variance ($p \leq .0001$), the pre-nursing GPA accounted for 3% of the variance, and the chemistry GPA accounted for 0.8% of the variance. When the NCLEX-RN was used as the dependent variable in the second regression, the ACT composite score accounted for 14% of the variance, high school rank 3%, and chemistry GPA 3%. The pre-nursing GPA added 2% of explained variance. The biology and social science grade points averages did not contribute to either multiple regression equation. Yang et al. (1987) concluded, "...success in a baccalaureate nursing program and NCLEX-RN licensure examination may be predicted on the basis of performance in high school, on college entrance tests, and pre-nursing grade point averages" (p. 305).

A student's Type A behaviors, measured by Jenkin's Activity Survey, was included as an independent variable in a study by McKinney, Small, O'Dell, and Coonrod (1988). McKinney et al. initiated a study to determine which variables were predictive of NCLEX-RN success in a study of 136 baccalaureate students from a church affiliated, Liberal Arts College in the eastern United States. Graduate data from 1983 to 1985 were used to ensure an adequate sample size. The independent variables included pre-entrance, progression and

program outcome data. Pre-entrance data included; SAT verbal scores, SAT math scores, SAT total scores, and pre-nursing GPA. Academic progression data included; repeated coursework, Mosby Assess Test results, nursing clinical GPA, and Type A behavior, measured by the Jenkin's Activity Survey. Program outcome data included the subject's age at graduation, cumulative college GPA and nursing GPA.

Significant positive correlations were found between pre-entrance test scores, nursing theory GPA, clinical GPA, Mosby Assess Test scores, cumulative GPA, and NCLEX-RN scores. There was little evidence to suggest an association between student age, gender, and/or Type A personality and nursing abilities. Multiple regression analyses and Pearson's product-moment correlation analyses determined pre-entrance test scores, cumulative college GPA, Mosby Assess Test scores, and the number of nursing courses repeated, were significant predictors of NCLEX success. The researchers concluded early academic program predictors would assist with the identification and remediation of at-risk students.

The main objective of a study conducted by Younger and Grap (1992) was to develop a regression equation representative of the best predictors of NCLEX-RN scores. The sample group consisted of the data of 388 upper-division baccalaureate graduates who took the NCLEX-RN exam between 1984 and 1987. A stepwise regression analysis was used to identify the combination of courses with the highest predictive value of NCLEX-RN success. Four courses; Pediatric Nursing, Health Needs of Women, Medical-Surgical Nursing I, and Medical-Surgical Nursing II, were combined to make up a new variable, CORE, utilized in a second stepwise regression analysis. The second step-wise regression analysis was run with variables known at four distinct points in a student's education; pre-admission, at the end of sophomore year, at the end of the nursing program, and after completion of a NCLEX-RN

review course. SAT verbal, SAT quantitative, and SAT combined scores, along with high school rank were the pre-admission variables in the analysis. College GPA was the variable identified for the end of sophomore year, with averages adjusted to control for differences in grading between previous colleges attended. The end of nursing program variables included specific nursing course grades and the CORE variable. The composite NLN exam score and the NCLEX-RN review test score were the variables entered at the fourth point.

The CORE variable explained 55% of the variance in the NCLEX-RN with the combined SAT verbal and SAT quantitative scores increasing the prediction to 59%. The composite NLN score raised the explained variance to 62%. Younger and Grap (1992) concluded that interventions initiated as a result of low SAT scores or junior course grades could improve performance on the NCLEX-RN exam. Attendance at the NCLEX-RN review course did not contribute to the predictive validity of the equation.

Jenks, Seleman, Bross, and Paquet (1989), used a convenience sample of 407 baccalaureate students from an eastern university nursing program, to determine the significant predictors of NCLEX-RN success and identify the earliest point of intervention for students at risk for NCLEX failure. Data related to three points in time; pre-admission, end of junior year, and at graduation, was introduced into the regression and discriminate analysis equations. Pre-admission data included: transfer institution GPA, the total number of credits earned at time of transfer, transfer college science GPA, and the type of university the student previously attended. Age and individual grades in the first three nursing courses were the variables introduced as the variables at the second data point. Student gender, individual senior level nursing course grades, and the Mosby Assess Test score were the variables introduced at the third data point.

The junior and senior course grades and the Mosby Assess Test scores were found to be strongly correlated with NCLEX-RN performance ($p = .0001$). Upon program admission, 62% of the sample group was correctly classified; at the end of the junior year, 81%; and at the end of the senior year, 86%. These findings are consistent with Yang et al. (1987) and Younger and Grap (1992), who concluded nursing students at risk for NCLEX-RN failure, could be identified early in the program.

Prior to 1988, other researchers identified relationships between academic variables and NCLEX-RN success. Horns, O'Sullivan, and Goodman (1991) examined the records of 394 BSN graduates from a Southern university and used regression analysis to determine that 67% of the variance in NCLEX-RN scores could be accounted for by admission GPA. The variance decreased to 14% a student's sophomore year, and 11% the junior year. Student race accounted for 33% of the variance. Horns et al. also concluded early identification of students at risk for NCLEX failure was possible.

Foti and DeYoung (1991) used the data of 298 graduates (1985 to 1988) from a state-supported, baccalaureate program in the Northeast, to explore a variety of pre-admission and progression variables. Through multivariate analyses, Foti and DeYoung found the Mosby Assess Test, SAT verbal score, and cumulative GPA to be the best predictors of NLCEX-RN success ($R^2 = 0.49$, $p = .001$). These results supported the program efforts to increase student's verbal abilities in order to improve NCLEX success.

McClelland, Yang, and Glick (1992) conducted a statewide analysis of 1,069 baccalaureate graduates from nine nursing programs to determine pre-nursing GPA and the ACT composite score, which are the best predictors of nursing program achievement. In a study of baccalaureate data (1985 through 1987), Huepell (1994) identified a positive

correlation between science and nursing course grades and NCLEX-RN success, but failed to provide information regarding early predictors of NCLEX-RN success.

One of the first studies to address the relationship between nonacademic variables and NCLEX-RN success was conducted by Dell and Valine (1990). Using 78 senior, nursing student volunteers, Dell and Valine ascertained the relationship between age, self-esteem, college GPA, SAT scores, ACT scores, and NCLEX-RN success. Three instruments were used to measure self-esteem: the Tennessee Self-Concept Scale (TSCS), the Gergen-Morse Self-Consistency Measure, and the D-A-P Test.

Multiple regression analysis determined that 58% of the variance in NCLEX-RN scores could be accounted for by college GPA. When SAT scores, ACT scores, self-esteem, and age were added to the equation, the variance increased to 64%. The R^2 change was minimal with the addition of the self-esteem measures, $R^2 = .02$, $F(3,44) = .66$. Dell and Valine (1990) concluded, "Thus, the question of whether students see themselves negatively because of their poor performance, or whether they perform poorly because they see themselves negatively remains unresolved" (p. 161).

A second study, conducted by Poorman and Martin (1991), addressed the relationship between nonacademic variables and NLCEX-RN success. The sample group was made up of 102 second-semester senior nursing students. The students were 25 years of age or younger and enrolled in one of two baccalaureate nursing programs in western Pennsylvania. The subjects were interviewed and asked to complete a Test Anxiety Inventory (TAI) and a Cognitive Assessment Tool. Subjects were also required to take the NCLEX-RN within three months of graduation.

Using Pearson's product-moment correlation, Poorman and Martin (1991) found a student's test anxiety to be inversely related to a passing score on the NCLEX-RN. A step-wise regression analysis revealed self-predicted nursing course grades were the best predictors of the actual NCLEX-RN score, with anxiety index scores the next best predictor. The findings of Poorman and Martin support the need for further research regarding non-academic variables and NCLEX success.

ADN students

Only two studies related to the variables predictive of associate degree NCLEX-RN success were found during this time period. Oliver (1985) published one of the first studies utilizing a mixed methodology method to analyze a data set of 67 ADN students who graduated from a southeastern community college. The quantitative variables examined included; high school rank, 11th and 12th grade English grades, grades in high school biology courses, and Algebra 1 grades. Demographic variables included; race, gender, age, marital status at time of program admission, and enrollment status. Qualitative data—the applicant's previous experience in college, previous experience as a licensed practical nurse and a nursing faculty member's prediction of student academic success and program completion—were included as variables in the study.

Through a set of analyses, Oliver (1985) identified the individual and cluster variables predictive of a student's first quarter grade point average, and those that were predictive of successful nursing program completion. Pre-admission variables—high school rank, biology and English grades—were individually correlated with academic success in the nursing program. A multiple regression analysis determined that a student's biology grade,

age and the faculty prediction of student academic success was predictive of first-quarter GPA. The 12th grade English grade, enrollment status, and faculty prediction of student academic success were determined to be the strongest predictors of program completion. The most successful ADN student, according to Oliver, was one who was "...older, attending school part-time, and had previously attended college" (p. 205). A disproportionate percentage of Black students compared to White students did not complete the program.

Lengacher and Keller (1990) examined the predictive relationship between selected admission, program and outcome variables. The records of 146 associate degree graduates from a public community college were examined. Entrance GPA, ACT English scores, ACT math scores, ACT composite score, and age were the admission variables selected for analysis. Program variables included; grades in nursing theory and clinical courses, NLN test scores, and a student perception of role strain (as measured by the Lengacher Role Strain Inventory). Program outcome variables included cumulative program GPA and NCLEX-RN performance.

Pearson product-moment correlations and stepwise multiple regression analyses were run to identify the relationships between the independent variables and the dependent variable, NCLEX-RN success. The first stepwise linear regression analysis identified the cumulative program GPA ($r = .71$) and ACT composite scores ($r = .75$) were the best predictors of NCLEX-RN success. A second regression analysis determined two nursing theory courses (medical/surgical and maternal/child) accounted for 59% of the variance in the prediction of NCLEX-RN success. Student age, entrance GPA, ACT sub-scores and perception of role strain had no predictive value for NCLEX success.

NCLEX-RN results (1989-1994)

The implementation of a higher passing standard on the NCLEX-RN along with the change to reporting NCLEX results as pass/fail resulted in a national decline in NCLEX success (Chornick & Yokum, 1995; Matassarini-Jacobs, 1989). A 16.4% failure rate was reported in the initial testing group under the new standards, although the test plan is designed to elicit a 10% failure rate (Dell & Valine, 1990; Poorman & Martin, 1991). The pass/fail reporting of the NCLEX results presented a new challenge to nursing researchers, as there is greater difficulty in determining correlations and making predictions using a dichotomous variable (Tabachnick & Fidell, 2007). These changes led nursing researchers to suggest the predictors for the new NCLEX-RN test plan, would differ from the predictors identified in past research studies (Wall, Miller, & Widerquist, 1993, Waterhouse, Carroll, & Beeman, 1993).

BSN students

Mills, Sample, Pohlman, and Becker (1992) initiated a research study to address the challenges of measuring a dependent variable, NCLEX-RN success that changes within the time frame of study. A review of 543 first-attempt NCLEX-RN candidates, who took the exam between 1982 and 1990, was initiated to identify the academic predictors of NCLEX-RN success. The sample group was affiliated with a university that did not experience a decline in NCLEX-RN pass rates when the scoring method changed. Therefore, an independent dummy variable was created as a control for this anomaly. Two time frames were represented in the study—1982 to 1987 and 1988 to 1990. Preadmission, program and outcome variables included: gender, high school GPA, ACT subtest scores, transfer status,

and yearly nursing GPAs. Variable interaction effects were determined prior to running the multivariate analyses. A series of five logistic regression models were then carried out to determine the variables predictive of first-attempt NCLEX-RN success. NCLEX-RN success was the dependent variable in all of the logistic regressions.

The first logistic regression model was run using the independent variables of: age at time of NCLEX exam, gender, high school GPA, ACT sub scores, transfer status, the dummy year variable, and the interactions between high school GPA, sex, and age. In the model, age and the ACT social science subscore appeared to be significant. Further analysis determined the ACT subscore had little practical application.

The second model was run with the independent variables related to freshman year academic performance: age, gender, cumulative freshman GPA, dummy variable for the year, and the interaction effect between the cumulative GPA, age and sex. The third model was run to determine the end of the sophomore year predictors. The freshman GPA was replaced with the sophomore GPA, and the interaction effects were revised. The third model correctly identified 77.6% of the graduates who passed the NCLEX-RN exam, and 68.4% of those who failed.

The fourth model, run with data pertinent to the junior year, correctly classified 74.7% of the students who passed the NCLEX-RN and 75.4% of those who failed. These results led the researchers to conclude, the end of junior year was the critical point for identifying at-risk students. In the fifth and final model, "...the sensitivity and overall correct classification decreased slightly" (Mills et al., 1992, p. 406). Age was inversely related to NCLEX-RN performance in the first three models. By the fourth model, age was not significant. Pre-admission variables were found to be weak indicators of NCLEX-RN

performance. The researchers encouraged the exploration of the relationship of attitude and motivation to NCLEX-RN success.

A retrospective study by Fowles (1992) utilizing a mixed set of data comprised of numerical and categorical NCLEX-RN scores (1985 to 1989), revealed a significant decrease in the amount of explained variance using NCLEX-RN pass/fail results. Fowles was able to determine NCLEX-RN success could be predicted by the ACT social science scores, ACT composite scores, Anatomy and Physiology I grades, Mosby Assess Test scores, and GPA at the end of the first level of the program.

Wall, Miller, and Widerquist (1993) initiated a retrospective study to identify the academic variables predictive of NCLEX-RN success in students who sat for the exam between 1988 and 1991. The pre-nursing variables selected for analysis included; high school rank, SAT verbal scores, SAT math scores, sophomore GPA, and science GPA. The program variables included; GPA in junior year coursework, GPA in senior year coursework, Mosby Assess Test scores, NLN test scores, and cumulative program GPA.

The sample population consisted of 92 baccalaureate graduates from a small, Midwest liberal arts college. The graduate records were first divided into two groups: the students who passed NCLEX-RN, and the students who failed. An independent means *t*-test of significance determined the independent variable means were higher, with the exception of high school rank, in the group who passed the NCLEX-RN. The SAT math and SAT verbal scores were not significant at the .05 level and were eliminated from the discriminate analysis. A stepwise logistic regression was able to classify 88% of the total graduates correctly by the end of their senior year: 94% who passed the NCLEX-RN, 53.3% who failed. High school rank, sophomore GPA, and science GPA were identified as significant

preadmission predictors. Further research was encouraged to identify the effectiveness of early interventions for at-risk students.

Waterhouse, Carroll and Beeman (1993) initiated a study at the University of Delaware “to identify the variables that might be used as predictors for success on the post 1988 version of the National Council Licensure Exam, NCLEX-RN, and to identify those students at risk of failing the examination” (p. 278). Out of a convenience sample of 313 baccalaureate nursing graduates enrolled in the nursing program from 1988 through 1990, 257 student cases were classified according to pass/fail on the NCLEX-RN. Three discriminate analyses were run to determine the influence of fifteen independent variables at three points in time; at the end of the junior year, between fall and spring semester senior year, and at graduation. Seven significant predictor variables were used to successfully classify 86% of the students at the end of the junior year, 88% of the students during their senior year, and 91% at graduation. The grades in first senior level nursing course and graduation GPA were the best indicators of NCLEX-RN success. The researchers identified the importance of early identification and remediation for students at risk of failing the NCLEX-RN.

Waterhouse, Bucher & Beeman (1994) conducted a study of 142, 1991 or 1992 nursing graduates, from the University of Delaware in an attempt to evaluate the reliability of the classification procedure used in the 1993 study. The subjects in this study had significantly lower SAT verbal and math scores, physiology grades, high school rank and nursing course grades, than their counterpart in the previous study. They were also more likely to have changed majors, been placed on academic probation, or have participated in an American Nursing Review course.

The 1993 classification procedure was applied to both graduating classes. A discriminant function analysis, using the 15 variables in the 1993 study, resulted in the correct classification of 87% of the students who passed the NCLEX-RN, and 62% of the students who failed the NCLEX-RN. Waterhouse et al. (1994) concluded it was statistically and ethically sound to utilize the discriminate function in order to identify at-risk students for failing the NCLEX-RN.

Griffiths, Bevil, O'Connor, and Wieland (1995) initiated a two-part study to investigate the relationship between Anatomy and Physiology (A & P) grades and academic success in a BSN program. The first part of the study was undertaken to determine the relationship between six Anatomy and Physiology variables (type of A & P course, focus of course, type of institution taken, credits earned, mean final grade, and time between course completion and nursing program entrance) and predicted success on an A & P exam used as a screening instrument. The second part of the study was done to determine the relationship between the A & P screening exam and the final grade earned in the first nursing course, which required a sound knowledge base of anatomy and physiology. The sample group consisted of 98 students who transferred into a 2-year, upper divisional nursing program junior year.

Using a stepwise multiple regression model, two of the six A & P variables accounted for 18% of the variance in the screening exam score: the type of institution the A & P course(s) were taken, and the mean final A & P course score(s). A simple regression analysis then determined that 9% of the relationship between the A & P screening exam scores and the identified nursing course could be explained. Further regression analyses, utilizing the six pre-admission and progression variables along with the A & P screening exam scores,

determined "...the mean final grade in prerequisite A & P course(s), type of college in which these courses were taken, and the number of credits earned in A & P explained 39% of the variance in the final" (Griffiths et al., 1995, p. 64) nursing course grade.

BSN and ADN students

Alexander and Brophy (1997) conducted a five-year study to determine graduate performance on the "new" NCLEX-RN test plan. Using a quota sampling technique of graduate data from 1988 to 1994, the relationship between selected admission and academic variables and NCLEX-RN success was analyzed for two groups of students: associate degree students who were able to exit the program after two years and take the NCLEX-RN, and four-year baccalaureate students. The admission variables included: student age, admission status, and a number of academic variables (number of credits earned, high school rank, high school GPA, number of years of high school chemistry and math, SAT scores, high school rank, and college GPA). The academic variables in the study included: nursing course grades, the grades from nine support courses, first year program GPA, second year program GPA, and the NLN Comprehensive Achievement Test score. NCLEX-RN success was the dependent variable in the study.

In the study (Alexander & Brophy, 1997), descriptive and inferential analyses were performed to determine differences between the associate degree and baccalaureate groups. Multi-collinearity among the predictor variables was attributed to the interconnectedness of the nursing curriculum. Statistically significant differences were found between the two groups in five out of six nursing courses, and first and second level GPAs. A comparison of the groups using the independents means *t*-test of significance, determined the groups were

statistically different in 18 of 19 variables, with the greatest difference on the NLN Comprehensive Achievement Test. An alpha level of .003 was established to address potential multiplicity problems. The two groups were significantly different in the proportion of courses passed and failed.

Three logistic regression models were tested in this study. The first model employed forward step-wise regression that utilized 22 selected admission, progression, and exit variables. Using the grades in two courses—Nursing Adult I and Introductory Sociology—the finished model was able to identify 88.24% of the students who would pass the NCLEX-RN. The fit of the SAT verbal test and the SAT math test was tested in the second model. Only 68.22% of the students were correctly predicted in this model, with the SAT verbal score carried on to the third model. Using the SAT verbal score, six course grades, and the NLN Comprehensive Achievement Test, the third model was able to classify 80.63% of the subjects who passed the NCLEX-RN. This study supported the strong correlation between SAT verbal test score, program GPA, NLN Comprehensive Achievement Test scores, and NCLEX-RN success. Alexander and Brophy (1977) reiterated the need for early intervention for at-risk associate degree students. Course grades in Nursing Adult I and Sociology were identified as reliable identifiers of at-risk students. These findings were not considered applicable to other programs.

NCLEX-RN results (1995-2009)

The conversion to a Computerized Adaptive Testing (CAT) in 1994 required researchers to take into account the relationship between students' computerized test-taking skills and exam success (Beeman & Waterhouse, 2001; Lauchner, Newman & Britt, 1999).

BSN students

Arathuzik and Aber (1998) conducted one of the first studies to identify the relationship between academic and nonacademic barriers to success in a diverse student group who were enrolled in an urban, public institution. Using a descriptive, correlational design, a convenience sample of 79 senior nursing students was selected to complete a demographic data sheet, internal and external block scales, and the Study Skills Self-Efficacy Instrument (SSSE). The Internal Block was comprised of eight variables: multiple role strain, self-doubt and lack of confidence, disorganization and ineffective use of time, poor study habits and lack of self-discipline, low motivation and low perseverance, emotion (anxiety, anger, and guilt), fatigue, and self-induced stress and overreacting. The External Block included: finances, family demands and responsibilities, family health problems, lack of support, demands of work, living arrangements, and strains in relationships. Low, but significant correlations, was found between academic and nonacademic factors and NCLEX-RN success. Family demands and responsibilities, financial difficulties, and work responsibilities were inversely related to NCLEX-RN success. A student's sense of confidence in test-taking abilities, lack of family responsibilities, along with lack of emotions (anxiety, anger, guilt and loneliness), was positively correlated with NCLEX-RN success. The researchers encouraged programs to develop a comprehensive student database in order to identify a student's internal and external blocks in order to enhance the effectiveness of interventions.

The contribution of the basic sciences to success in nursing education was the focus of a study by Wong and Wong (1999). Situated in Canada, Wong and Wong utilized a sample population ($N = 258$) of graduates from a generic nursing degree program who wrote the

Canadian Nurses Association Testing Services (CNATS) examination. The independent variables identified in this study included: high school chemistry grades, high school biology grades, grades in each of the basic science courses (introductory anatomy, physiology, chemistry and microbiology), program level GPAs, cumulative nursing course GPA, cumulative basic science course GPA, and cumulative nursing program GPA. The CNATS exam was the dependent variable in the study, and utilized as a proxy variable for professional success.

The researchers reported, "...multiple regression analyses were performed using the PROC REG procedure. The PROC REG analysis procedure produces the coefficients labeled 'standardized estimates' which are the estimates that would be obtained if all the variables were standardized to a zero mean and unit variance prior to performing the regression computations" (Wong & Wong, 1999, p. 349). Bonferroni correction was then used to determine the level of significance.

A weak, but significant correlation was found between high school science grades and the nursing program GPA. The grade point average of four combined science courses (Physiology, Anatomy, Microbiology, and Chemistry) was significantly correlated to the program GPA ($r = .75, p < .0005$), but moderately correlated to the CNATS exam score ($r = .46, p < .0005$). Age was inversely related to high school science grades, but significantly correlated with program GPA. A weak, but significant correlation was found between age, program GPA, and the CNATS exam score ($r < .20, p < .05$).

Utilizing a regression analysis equation, Wong and Wong (1999) then determined a student's cumulative GPA could be predicted by high school science grades and age. Age exerted the greatest influence on academic success ($SE = .2977$), followed by the high school

chemistry grade. Students' third and fourth year basic science and nursing course grades were significantly related to successful program completion. The high school GPA and nursing program science GPA were not significantly predictive of CNATS success.

Beeson and Kissling (2001) conducted another study to determine the predictors of NCLEX-RN success using 505 records of 1993 to 1998 baccalaureate graduates from a nursing program in the Southeastern United States. Entrance and program predictors were the independent variables, and included: age, gender, admission classification, number of degrees, age at time of NCLEX-RN exam, nursing course performance, cumulative program GPA, and Mosby Assess Test score. Significant inverse correlations were found between the number of C- or below course grades and Mosby Assess Test scores. The Mosby Assess Test scores were positively correlated to NCLEX-RN success. The students who had one C by the end of sophomore year were more likely to fail the NCLEX-RN exam. The logistic regression model was able to predict 84% of the students who passed the NCLEX-RN and 76% of the students who failed based on information that was available one semester prior to graduation. Non-traditional students (23 years or older) had a higher NCLEX-RN pass rate (95.7%) than traditional students (88.3%).

Similar results were identified in a study conducted by Beeman and Waterhouse (2001) to determine the predictors of NCLEX-RN success. Using discriminant analysis, Beeman and Waterhouse determined the number of C+ or higher nursing theory grades was the best predictor of NCLEX-RN success, followed by a variety of nursing course grades. More than 93% of all students were correctly classified according to the discriminant analysis: 94% who passed the NCLEX-RN, and 92% who failed. These results strongly

promoted the use of discriminant analysis in the identification of students at risk to fail the NLCEX-RN exam.

Recognizing the complexity and time involved in multivariate analysis, Barkley, Rhodes, and Dufour (1998) developed a Risk Appraisal Instrument (RAI) to identify students at risk for NCLEX-RN failure. The RAI was found to highly correlate with NCLEX-RN failure ($r = .7827$; $p = .001$) and able to explain more than 61% variance in predictive test scores. The RAI correctly classified 95.5% of the students who passed the NCLEX-RN and 76.92% of those who failed. The researchers recommended that the RAI instrument be adopted by nursing programs for assessment and remediation, as it was easy to use and efficient.

In conjunction with the research conducted at the University of Delaware, Waterhouse and Beeman (2003) compared the reliability of a modified version of the RAI, the DRAI, to a statistically complex method for assessing NCLEX-RN risk status. The RAI instrument was modified by replacing variables with related coursework and grades from the University of Delaware nursing program. Transcripts from 538 past graduates were analyzed, with correlations, frequencies and Chi-squared analyses conducted. Weights for each item were calculated duplicating the methodology employed by Barkley et al. (1998). The formula utilized in the 1996 study was then applied, and the results were analyzed using similar procedures as the previous study. A much lower correlation ($r = -.315$) was found between the DRAI and NCLEX-RN failure than the previous study ($r = -.783$). In addition, 71.1% of the subjects were correctly classified versus the 95.6% correct classification in the original study, which was considered a minor improvement over the 69.9% subjects who could have been classified by chance alone.

The modified Delaware RAI was 60.8% predictive of NCLEX-RN failures, but less useful in predicting NCLEX-RN success; 74.1%, compared to an 81.6% prediction by chance alone. Beeman and Waterhouse (2003) concluded that the DRAI was not as useful as the discriminant function formula developed and applied in their 1994 research, or as effective as the logistic regression model used by Beeson and Kissling (2001). However, the DRAI may be useful as a rough estimate of high-risk students for NCLEX-RN failure in cases where time or resources are limited. This study supported the correlations between the number of C or lower grades earned in nursing courses and NCLEX-RN failure also found in the preceding studies (Barkley et al., 1998; Beeman & Waterhouse, 2001; Beeson & Kissling, 2001).

Campus location was a unique variable included in a retrospective study conducted by Haas, Nugent, and Rule (2003). Initiated with a similar purpose of determining the variables predictive of NCLEX-RN success, Haas et al. analyzed the data of 351 graduates (1991 to 2001) from a nursing school in Southeastern United States. The sample population was comprised primarily of Caucasian females who were 20 to 48 years of age.

A Chi-square analysis that was used to determine the relationship between student gender, race and campus location and NCLEX-RN success, revealed female students passed the NCLEX-RN at a significantly higher rate than male students. Fisher's exact test (two-sided) was then used to diminish the effect of small racial sample groups. The results indicated Caucasian students had a significantly higher pass rate among all groups, followed by African American, Asian, and Hispanic nursing students.

Academic data: program merit scores, SAT verbal scores, and SAT quantitative scores, transfer undergraduate GPA, program GPA, nursing GPA, and age were analyzed

using interval data comparisons. The students who passed the NCLEX-RN had significantly higher SAT verbal scores, SAT quantitative scores, nursing GPAs, and were older. A stepwise logistic regression, utilizing SAT scores, nursing GPA, age, campus location, gender and race (converted to two categories) was able to identify 71% of the successful NCLEX-RN testers, and 61.2% of those who failed on the first attempt. Haas et al. (2003) concluded that early intervention was important to assist programs with low NCLEX-RN pass rates.

The predictive validity of science course grades, first semester nursing performance, and the effect of tutorial services, was the focus of a study conducted by Potolsky, Cohen, and Saylor (2003). First-semester baccalaureate nursing students ($n = 37$) who were enrolled in the pathophysiology or pharmacology course were invited to participate in weekly tutorial sessions. At the end of the term, a transcript analysis was conducted of past science course grades and the grades earned in the pathophysiology and pharmacology courses. A two-tailed Pearson correlation coefficient identified a high positive correlation between mean science grades and the mean pathophysiology grade ($r = .77$; $p = .01$). A moderate positive correlation was found between mean science grades and Pharmacology ($r = .60$; $p = .01$). Course grades were not significantly different between the student group who attended five or more tutorial sessions and the group who attended less than five sessions. The students who attended minimal tutorial sessions had a higher mean average in pre-requisite nursing courses. The researchers concluded pre-requisite science course grades were reliable indicators of nursing performance.

Daley, Kirkpatrick, Frazier, Chung, and Moser (2003) initiated one of the first studies to compare the predictive accuracy of the Mosby Assess Test and the Health Education

Systems Incorporated (HESI) Exit Examination on NCLEX-RN success. Demographic and academic variables were analyzed to determine if significant differences existed between the students who passed the NCLEX-RN, and those who failed on the first attempt. The sample population was comprised of two cohorts of senior nursing students (1999 cohort, $N = 121$; 2000 cohort, $N = 103$) from a generic baccalaureate program. The population was comprised primarily of White females in their early twenties who graduated with a B+ average. The 1999 cohort was required to take the Mosby Assess Test prior to graduation. The 2000 cohort was strongly encouraged to take the HESI Exit Examination, but not required to do so. Eighty of the 103 (77.67%) students in the 2000 cohort took the exam. Both exams were administered in the final quarter prior to graduation. All students then attempted the NCLEX-RN examination after graduation.

A comparison of the demographic and academic characteristics of the cohorts revealed there were no significant differences in preadmission, program progression, and standardized test scores. Preadmission variables included: age, gender, ethnic group, ACT scores, and prerequisite GPA. Program progression variables included: pre-requisite science course grades, nursing course grades, pathophysiology grade, and medical-surgical theory course grades. Independent t -tests and Chi-square tests determined $p > .05$ on all the variables.

Significant differences were found between the students who passed the NCLEX-RN on the first attempt and those who failed. Among the Mosby Assess Test cohort, the 1999 graduates who successfully passed the NCLEX-RN were older, and had significantly higher ACT and pre-admission GPAs than their cohort counterparts who failed the NCLEX-RN on the first attempt. The successful testers also demonstrated higher academic abilities in the

program as evident by higher grades in: anatomy, physiology, medical-surgical clinical courses, and medical-surgical theory courses, and a higher cumulative program GPA. The successful NCLEX-RN testers in the 2000 cohort who had the option of taking the HESI Exit Examination had higher grades in the medical-surgical theory courses and higher cumulative program GPAs. Regardless of the standardized exam test taken, the successful NCLEX-RN students had significantly higher exit exam scores than the students who were not successful. Further comparison between the Mosby Assess Test and HESI Exit Examination determined the HESI “provided greater sensitivity, specificity, positive and negative predictive value, and test efficiency” (Daley, Kirkpatrick, Frazier, Chung, & Moser, 2003, p. 394).

In order to address a gap in the nursing literature related to NCLEX-RN success, Crow, Handley, Morrison and Shelton (2004) initiated a national study to identify the 1999 program requirements and interventions used to promote NCLEX-RN success in BSN programs. The purpose of the study was to identify the best predictors of NCLEX-RN success in baccalaureate programs in order to provide a foundation for nursing educators on which to base program decisions. Out of the 513 generic BSN programs recruited to participate, 160 programs returned usable responses (31.2%). Returned data represented 38 states and the District of Columbia. Program enrollments in the nursing major varied from 15 to 485 students ($M = 145.93$, $Mdn = 124$, $SD = 91.46$, $n = 143$), with 68% of the programs located in urban areas. Females comprised 91.34% of the total enrollment, and 25.47 was the mean graduate age. The ethnic majority of the students in the respondent data were White (81%), followed by African American (10.7%). Hispanic (5.28%), Asian (5.7%), and Native American (2.11%) who represented the minority ethnic groups. The first-attempt NCLEX-RN pass rate for the sample group was 87.37%.

The common criteria for nursing program admission included: ACT scores ($M = 20.11$), SAT scores ($M = 939.41$), high school GPA ($M = 2.59$), cumulative pre-program GPA ($M = 2.6$), and recommendation letters. The most common progression requirements were: course grades (98.10%), clinical performance (89.4%), and the college cumulative GPA (66.30%). The NLN predictor tests were used by 16.25% as criteria for progression. The range of credits required for graduation was 120 to 144 (Mode = 128; $M = 127.34$). A minimal GPA of 2.0 was required by most programs to graduate. Program completion requirements included completion of an exit exam (36.9%), a clinical proficiency demonstration (46.3%), and participation in a NCLEX-RN review course (26.9%). Kaplan and Educational Resources, Inc. were the most commonly used courses.

The programs used a variety of data to determine NCLEX-RN success. Ninety percent of the programs used a comprehensive examination, with the Mosby Assess Test most frequently used (31.9%). A 2.5 GPA was used by 29.4% of the programs with 36.3% applying specific course grades. Academic referrals (82.5%), commercial review courses (53.8%), social support referrals (56.7%) and computerized reviews (53.8%) were the most common interventions reported. Faculty led review courses were used by 26.3% of the programs.

Measurements of association were used to determine the relationship between pre-admission, progression, graduation requirements, and NCLEX-RN first-attempt success. Standardized entrance exam scores and SAT scores were the only admission criteria correlated to NCLEX-RN success. Significant correlations were found between NLN specialty exams (Mental Health Nursing and Community Health Nursing), clinical proficiency, and program exit exams and NCLEX-RN success. A significant correlation was

found between ethnicity and NCLEX-RN success; the percentage of White students was positively correlated ($r = .19$; $p = .02$; $n = 143$), and the percentage of Hispanic students, negatively correlated ($r = -.25$; $p = .01$; $n = 105$). The use of a commercial review course was the only program intervention significantly correlated to NCLEX-RN success. The inability to determine the effect of specific interventions for at-risk students was a limitation of this study.

In an attempt to find the best model to predict NCLEX-RN success and failure, Seldomridge and DiBartolo (2004) initiated a retrospective study, utilizing 186 baccalaureate graduates (1998 to 2002) from a rural, mid-Atlantic public nursing program. Fifty-one percent of the graduates were native to the program whereas 49% transferred into the program. At the time of the study, the program had an 80.6% NCLEX-RN pass rate. Program pre-admission and progression variables were the independent variables in this study, and NCLEX-RN first-attempt success was the dependent variable. The pre-admission variables included: pre-nursing course grades (anatomy and physiology I, chemistry, pathophysiology, statistics), cumulative pre-program GPA, and the total number of C or lower grades in prerequisite courses. Progression variables included: core nursing course grades, program level GPAs, the number of C grades in level coursework, and percentile scores on the NLN Comprehensive Achievement Test for Baccalaureate Students (NLN-CATBS).

Pearson product-moment correlation coefficients revealed the NLN percentile scores had the highest correlation with NCLEX-RN success ($r = .452$; $p = .000$), followed by the pathophysiology grades ($r = .337$; $p = .000$), and test averages in the advanced medical-surgical course ($r = .303$; $p = .000$). A negative correlation was found between the number of C or below grades in prerequisite courses ($r = -.245$; $p = .002$) and nursing course grades ($r =$

-.342; $p \leq .000$). Low grades in prerequisite and nursing courses were negatively correlated with NCLEX-RN success.

Two-sample *t*-tests and the nonparametric Mann-Whitney test were used to examine the differences between the successful and unsuccessful testers. The successful testers had significantly higher pre-program GPAs, medical-surgical nursing course grades, program level GPAs, and NLN-CATBS scores.

A series of stepwise logistic regressions were performed utilizing preadmission, progression, and program level variables. A significance level of 0.15 was used to determine whether to include or exclude variables in the model. Utilizing preadmission variables, the first logistic regression model identified a student's grade in pathophysiology as statistically significant. This model was able to correctly classify 100% of the successful NCLEX-RN testers, and the unsuccessful testers 2.8% of the time. Pathophysiology course grades provided an 81.2% overall accuracy in predication. A second logistic regression, using progression data available at the end of a student's junior year, determined medical-surgical nursing test scores were 98.7% predictive of NCLEX-RN success, and 5.6% of the failures. Students who failed the NCLEX-RN had 50% more C's in junior courses. One hundred percent of the students who had minimal grades of B or above junior year passed the NCLEX-RN exam. However, only 50% of the students who had five or more C's in junior courses passed the exam. The third logistic regression used program variables available at the end of senior year. The NLN-CATBS exam score correctly predicted successful testers 94.7% of the time, and 25% of those who failed. A students' grade in the Adult II course was significant, predicting 94% of the students who would pass, and 33% of those who would fail the NCLEX-RN exam.

A final regression model was then run utilizing all of the independent variables in the previous models. In step one of the model, the NLN-CATBS exam score correctly predicted 94.7% of the successful testers, and 25% of those who would fail. The pathophysiology grade introduced in step 2 of the model raised the prediction of testers who would fail 50%, but lowered the prediction of passers to 93.3%. The overall predication rate of the final model was 84.9%. As a result of the findings of this research, the institution revised program admission criteria placing more emphasis on prerequisite course grades. Computerized intervention tools were also integrated into the curriculum.

A longitudinal study to determine the effects of new curriculum implementation was conducted at the University of Hawaii at Manoa School of Nursing by Uyehara, Magnussen, Itano, and Zhang (2007). The nursing program introduced a new curriculum to improve program completion rates and NCLEX-RN success. The purpose of the study was to identify program admission, progression and completion predictors of program completion and NCLEX-RN success. Students were considered successful in the program if they completed coursework in the recommended period of time.

Data were collected over a five-year period on all students who enrolled in the nursing program. The sample group consisted of 280 enrollees, 224 of whom completed the program and graduated, and 56 who withdrew from the program. Descriptive statistics determined 82.1% of the sample was female, with a mean age of 24.63. Nine ethnic categories were identified: Filipino descent (31.43%), Japanese descent (20%), and Caucasian (17.5%). The remaining sample was mixed, and comprised of Chinese, other Asian, part Hawaiian, Hispanic, or African American descent.

Program success, withdrawal, and NCLEX-RN passing were the dependent variables in the study. The independent variables were comprised of preadmission, progression, and outcome predictors. The preadmission variables were: prerequisite GPA, cumulative GPA, NLN composite and subtest (verbal, math, and science) scores, and ethnicity. Program variables included: nursing course grades, NLN achievement test scores, and the Watson Glaser Critical Thinking Appraisal score. The Mosby Assess Test score and nursing GPA were the program outcome variables.

A comparison of the successful versus unsuccessful students on the NCLEX-RN identified significant correlations between the Fundamentals course ($N = 217$; $r = .195$; $p = .0038$), Mosby Assess Test scores ($N = 226$; $r = .24$; $p = .0003$), the nursing GPA ($N = 217$; $r = .186$; $p = .0059$), and NCLEX-RN success. The NLN Comprehensive Test scores: Adult Health, Maternal Newborn, and Pediatric Nursing were significantly correlated with NCLEX-RN success. When all of the variables were entered into the logistic regression equation, the NLN Adult Health Comprehensive Test was the only variable that was significant.

No significant correlations were found between the independent and dependent variables and NCLEX-RN success in the student group who completed the program in a longer period of time. All decelerated students were able to complete the program within two to three additional semesters and achieved an NCLEX-RN success rate of 90.91%. A statistically significant correlation was identified between pathophysiology grades and program withdrawal; the higher the pathophysiology grade, the higher the probability of program completion and lower the probability of program withdrawal. According to Uyehara et al. (2007), "For each 1-point increase in the letter grade of the pathophysiology course, the

odds of withdrawal are expected to drop as much as 79.4% or as little as 44.8%” (p. 35). No significant correlations were found between the ethnic categories and withdrawal. The most common reason cited for withdrawal was academic failure, followed by health problems, moving, and career change. The researchers concluded that the results of this study validated the prior changes made in the curriculum and increased efforts to retain at-risk students.

Ukpabi (2008) initiated a study to determine the variables that would be the most predictive of the NCLEX-RN success in a nursing graduate population from a North Carolina Central University. Eighteen predictor variables, represented by ATI and NLN assessment scores, were used to determine the significance in predicting NCLEX-RN success. Using discriminant analysis, Ukpabi determined 11 of the 18 variables were statistically significant in predicting NCLEX-RN success ($p \leq .003$ to $p \leq .05$). The statistically significant variables included the ATI Critical Thinking score, ATI reading and math test percentile scores, and a variety of NLN subject area tests. The model was determined to be good and efficient (eigenvalue of 36.78) and the variables were significant (Wilks' Lambda of .026, $p < .006$).

ADN students

Since the late 1990s, there has been an increase in research using associate degree student populations. Briscoe and Anema (1999) initiated a study using the six most commonly used academic and nonacademic variables in studies of baccalaureate nursing student success, with the purpose of determining if the findings would be similar using an associate degree nursing population. Thirty-eight ADN graduates (M age = 35 years) from a public university in 1997 comprised the convenience sample. Using Pearson's product-moment correlation coefficients, the relationship between student gender, race, age, marital

status, pre-admission GPA, clinical course grades, two NLN exams and NCLEX-RN success was determined. Statistically significant relationships existed between four independent variables and NCLEX-RN success. NLN exams I and II were found to be positively correlated with NCLEX-RN success ($r = .476$ and $r = .371$, respectively, $p < .01$). A moderate correlation was found between a student's age and the NCLEX-RN exam, with older students more likely to pass ($r = .373$; $p < .05$). Students of African descent had a moderate probability of failing the NCLEX-RN exam ($r = .471$; $p < .05$), which evidences the need for further assessment of intercultural students.

Recognizing the academic and nonacademic challenges of nontraditional community college nursing students, Jeffreys (1998) examined the relationship between a nontraditional students' self-efficacy, academic and environmental variables, and academic nursing program performance. An urban commuter public university in the northeastern United States that offered an associate degree nursing program was the site of this research. Nontraditional students were students who met one of the following criteria: 25 years of age or older, male, English as a second language, ethnic or racial minority, had dependent children, or held a general equivalency diploma. The academic variables in the study were: study skills, number of study hours, academic advising, absenteeism, course availability and major job certainty. Environmental variables included: family responsibilities, finances, number of work hours, outside support, and transfer opportunities.

A student perception appraisal survey was administered to 151 nontraditional nursing students on the third day of class. Ninety-seven students (64%) returned the survey. The results identified academic variables had a strong positive correlation with academic success ($r = .34$; $p < .001$). Personal study habits and faculty advising were identified as most likely

to enhance academic performance and retention. Family responsibilities and family crises were ranked as significant barriers to academic success. Jeffreys (1998) concluded that a student's perception of environmental variables is a stronger predictor of academic achievement and retention than academic variables, and enrichment programs facilitate student retention and academic achievement. The effectiveness of the enrichment program was ranked second to faculty advisement.

Gallagher, Bomba, and Crane (2001) explored the predictive validity of standardized entrance tests, such as the Nurse Entrance Test (NET), as compared to the Registered Nurse Entrance Examination (RNEE). The community college nursing program under study used the RNEE as a tool to rank program applicants. However, faculty were interested in changing to the NET exam as it included nonacademic factors, such as stress-level profile and test-taking skills, that the RNEE did not include.

A pilot test was conducted with 121 students admitted in the fall of 1995 to the nursing program. The RNEE and NET exams were administered prior to the start of nursing coursework. Students who were identified as deficient in any non-academic areas were referred to counseling. Students successfully completing the first nursing course (NUR 101), as evident by a C or above grade, exhibited a higher score in mathematics on the NET exam and overall higher RNEE admission scores. A logistic regression analysis, utilizing the RNEE test scores as independent variables and NUR 101 as the outcome variable, determined the reading comprehension test was statistically significant ($R = .23; p < .05$). Results determined students had a 50% probability of passing NUR 101 with a RNEE reading sub score of 32, and a 50% probability of obtaining a B or higher in the class, with a score of 59. Admission subscores were not reliable indicators of success in the final nursing

course. The faculty continued to use the RNEE test upon program admission but identified interventions for students who scored below 32 on the reading subscale.

The doctoral dissertation by Collins (2002) focused on the predictive reliability of pre-program science grades, pre-program GPAs, grades in select nursing courses and NCLEX-RN success. Collins' research sample was comprised of 159 associate degree students admitted to a rural Michigan community college from 1992 through May 2001. Pre-program science course grades (Anatomy and Physiology I and II, Chemistry, and Microbiology), cumulative pre-program GPA, and grades from the initial three nursing courses were the independent variables in this study, whereas NCLEX-RN success was the dependent variable. The Pearson product-moment correlation determined the independent variables were significantly correlated to NCLEX-RN success ($p < .05$). Weak correlations existed between the pre-program science courses and NCLEX-RN success. Three out of four nursing theory course GPAs were strongly correlated with the dependent variable with the GPA in the Drug Therapy the strongest correlation ($p < .000$). The logistic regression determined the all independent variables were a good fit ($p < .05$). The four nursing courses accounted for 24.5% of the variance in NCLEX-RN results, followed by cumulative program GPA (11.9%) and pre-program science GPAs (9.7%). The model was able to accurately predict 89.94% of student NCLEX-RN success.

Sayles (2003) conducted a study to determine the relationship between the Nursing Entrance Tests (NET) and Pre-RN Examinations, published by Educational Resources Incorporated (ERI), and the ADN program and NCLEX-RN first-attempt success. Sixty-eight students who passed the NCLEX-RN on the first-attempt, from the 2001 graduating class ($N = 83$), comprised the sample population. A variety of demographic characteristics and

academic data were evaluated using admission and graduate records, self-reported program assessments, and ERI system results. The majority of the successful graduates were female (82.4%) and Caucasian (85.3%). One third of the graduates (33.2%) reported previous employment in a health care field, with 69.6% of the graduates LPNs. Pearson's product-moment correlation revealed six variables were significantly correlated ($p \leq .05$) with NCLEX-RN success, NET family and social stress scores, NET visual learner score, ACT reading score, and grades from two nursing courses. Higher Pre-RN test scores positively correlated with NCLEX-RN success. The likelihood of passing the NCLEX-RN increased with a higher NET composite, math and reading comprehension scores, and GPAs. Minority students were less likely to pass the NCLEX-RN ($r = .263, p = .03$).

Used to compare the successful and unsuccessful NCLEX-RN testers, the independent means *t*-test of significance revealed significant differences on all ten variables analyzed. The NET and Pre-RN exam composite scores were found to be of greatest significance between the two groups ($t = -3.594, p = 0.05$; and $t = -3.371, p = 0.05$, respectively). The study supported past conclusions related to the reliability of standardized tests to predict nursing program success (Alexander & Brophy, 1997; Barkley et al., 1998; Briscoe & Anema, 1999).

The relationship of admission variables and NCLEX-RN success was the focus of a retrospective study conducted by Yin and Burger (2003). Demographic and academic variables were the independent variables, whereas first-attempt NCLEX-RN success was the dependent variable. Demographic variables in the study included: age at admission, gender, race (six categorical groups identified), student type, previous degrees, transfer status, and LPN status. Academic variables included: high school GPA and rank, ACT composite score,

number of college credits prior to nursing program entry, college GPA, and grade in support courses (English, psychology and natural sciences). The sample population was comprised of 325 ADN graduates from a Midwestern state university between 1997 and 2001; 285 who passed the NCLEX-RN on the first attempt and 40 who failed. The majority of the graduates were female (95%) and Caucasian (94%). The students were between 18 and 55 years of age at admission, with a mean average of 26.7 years.

T-tests and Chi-square tests identified three differences between the testers who passed and those who failed the NCLEX-RN on the first attempt; successful testers had higher mean college GPAs prior to admission (3.20 versus 2.99), earned higher grades in introductory psychology (3.11 versus 2.69), and higher grades in natural science courses (3.11 versus 2.85). Bivariate correlations determined college GPA was significantly correlated to NCLEX-RN success ($r = .15; p < .01$). Significant correlations were found between the natural science grade point average and grades in introductory psychology, but these results were not reported. Multivariate analysis identified college GPA prior to admission and high school rank as significant predictors of NCLEX-RN success. These findings support the use of academic ranking variables for nursing program entry.

Muecke (2008) completed a dissertation on the pre- and post-admission variables predictive of academic success in a small, private Midwest nursing program. In an effort to increase the nursing research related to the academic success of associate degree nursing students, Muecke reviewed 404 ADN records of students who were admitted over a five-year period to the program (1998 to 2005). Pre- and post-admission data were the independent variables in the study, whereas NCLEX-RN first-time success and cumulative program GPA were the dependent variables. Pre-admission variables included: ACT reading score, ACT

composite score, high school GPA, high school rank, the number of credits transferred into the program and the GPA of the transferred credits. Post-admission variables included: GPA of three required sciences courses, GPA of the first-term nursing theory courses, and GPA of second-term theory courses.

A regression equation was run to estimate the missing ACT scores that were not retrievable. Pearson's product-moment correlations were used to determine the degree of relationship among the predictor and dependent variables. There was a moderate positive correlation between the final program GPA and NCLEX-RN success ($r = .372$; $p \leq .01$), with ten of 11 predictor variables significantly related to final program GPA.

Two stepwise backward elimination multiple regression models were run: the first using the six preadmission variables, and the second with the five progression variables. In the final equation, eight independent variables explained the program GPA; three of which were pre-admission variables. Two multiple logistic regression models were estimated to determine the predictive relationship between the preadmission variables, the progression variables, and NCLEX-RN success. The 11 original variables, plus first semester age and final GPA were used in the equation. The results indicated the pre-admission variables, previous college GPA along with previous college credits, and post-admission variables: grades in Anatomy, Physiology, Microbiology, and Nursing I and II theory courses were predictive of 92% of the variance in final program GPA.

A one-way ANOVA was run to determine if significant differences existed between the three groups of students: program completers and NCLEX-RN successful, program completers and NCLEX-RN unsuccessful, program non-completers ineligible to sit for the NCLEX-RN. Mean grades (Nursing I, Nursing II, Anatomy, and Physiology) differed

significantly between these three groups. ACT composite scores, ACT reading scores, and Microbiology grades significantly higher in the program completers and NCLEX-RN successful group as compared to the program completers and NCLEX-RN unsuccessful group.

Critical thinking was used as the dependent variable in a study by Shirrell (2008) as the measurement of NCLEX-RN success. A five-year (2001 to 2006) sample comprised of 173 ADN graduate records from a private Midwestern associate degree nursing program was used for this study. The purpose of Shirrell's study was to analyze the relationship between student test scores on the Collegiate Assessment of Academic Proficiency (CAAP) critical thinking test and successful nursing program outcomes (GPA in nursing courses, GPA in science courses, and NCLEX-RN success). Multiple regression analyses indicated the model with the independent variables; critical thinking, nursing GPA, and science GPA, was predictive of NCLEX-RN success ($F = 7.987; p < .0001$), and accounted for 12% of the variance ($R = .352; R^2 = .124$). The nursing GPA was the only significant contributor to the model ($t = 3.939; p > .0001$). A forward logistic regression stepwise regression indicated the model was statistically reliable. The model correctly classified 98% of the students who passed the NCLEX-RN, but only 12% of the students who failed. The science GPA and CAAP critical thinking test results did not contribute to the significance of the model.

Gilmore (2008) initiated a retrospective study to determine the academic factors predictive of NCLEX-RN success. Using a convenience sample of 218 students who graduated from one of two community college nursing programs located in Southeastern United States, Gilmore reviewed student records to identify ACT total and subscores along with the grades from the Anatomy and Physiology I and II classes. Descriptive statistics were

tabulated for all variables. The students were then divided into two groups: those who passed the NCLEX-RN and those who had failed. Students who were successful on the first attempt on the NCLEX-RN had a higher mean ACT, and a nursing GPA that was higher by a mean average of 0.3. A logistic regression analysis determined that the independent variables together were statistically significant as predictors of nursing GPA, with the ACT English subscore predicting approximately 20% of the variance in nursing program GPA. The overall model fit of all the individual variables was statistically significant $F(8,216) = 6.59; p < .001; R^2 = .196$. Gilmore's findings were consistent with past findings (Barkley et al., 2001; Beeman & Waterhouse, 2001; Beeson & Kissling, 2001), and supported the correlation with reading comprehension and NCLEX-RN success.

BSN and ADN students

The effect of lag time, retake attempts and NCLEX success was the focus of the research study undertaken by Woo, Wendt, and Liu (2009). Data were comprised of records of NCLEX-PN and NCLEX-RN testers from July 1, 2006 to June 30, 2008. There were 67,849 PN exams and 176,539 RN exams administered during this time frame. The average age of PN candidates was 31.5 years ($SD = 9.1$ years), and RN candidates, 30.7 years ($SD = 8.5$ years). The majority of the candidates were female (PN = 86.4%; RN = 84.6%), with White reported as the predominant ethnic group (PN = 54.2%; RN = 57.7%). African American was the second largest reported ethnic group among PN candidates (12.2%), and Asian among RN candidates (17.2%).

The independent variables in the study were lag time, or the number of days between the eligibility testing date and actual NCLEX test date, and the number of NCLEX attempts.

NCLEX-RN success was the dependent variable in the study. According to Woo et al. (2009), “A moderated logistic regression was used to ascertain the effects of the number of retake attempts and delay or lag time on pass rate” (p. 23). “To investigate the moderator effect of number of attempts on delay pass rate, an interaction term formed by the 2 main effect variables was also entered into the regression model” (p. 23). Separate regression models were run for PN and RN data, with lag time and number of attempts (main effect variables) and the interaction term entered at the same time. Prior to forming the interaction term, the raw scores of the main effect variables were centered, or “transformed into deviation scores where variable means are set to zero. This technique helps minimize potential multicollinearity among regression variables due to scaling” (p. 24).

A descriptive analysis of the data indicated that PN candidates ($M = 45$ days; $SD = 45.84$ days) wait longer than RN candidates ($M = 34.79$ days; $SD = 28.30$) to take the NCLEX exam. The average number of exam attempts for PN candidates is 1.22 ($SD = 0.67$), and RN candidates, 1.14 ($SD = 0.49$). The results of the PN and RN moderated logistic regression models identified a significant inverse relationship between lag time and NCLEX success (PN: $b = .019$, $p < .0001$; RN: $b = .013$, $p < .0001$). The number of attempts was also inversely related to NCLEX success in both equations. The researchers concluded that eligible candidates should not delay in taking the NCLEX exam.

Health Education System, Inc. (HESI) programs

Recognizing the need for a computerized achievement test that is highly predictive of NCLEX-RN success, Lauchner, Newman, and Britt (1999) initiated a study to validate the reliability of the HESI Exit Exam (E²). The E² exam was selected for analysis as the test

items are analysis and application questions, and measure critical thinking in more than 50 subject categories, rationales are available to students for missed items, student responses are compared to those of all previous candidates, and the test can be used for program outcome evaluation.

A list of all schools administering the E² exam between 1996 and 1997 was obtained from HESI. Nursing groups who took the E² exam within four months of graduation were selected for the sample group. A total of 2,809 students were in the sample group, with the majority being RN students. The 2,613 RN students included: 1,991 associate degree students (ADN), 563 baccalaureate students (BSN), and 59 diploma students. Practical nurses (196) were also included in the sample. A questionnaire was sent to the schools to identify the number of students the E² exam had predicted to pass the NCLEX exam, but had actually failed.

An overall response rate of 94.44% was achieved (51 of 54 RN schools responded). The RN respondents represented 23 states across the United States and 97.78% (2,555) of all the RN students who took the E² within the timeframe. The RN respondents were comprised of 1,976 (77.34%) ADN, 520 (20.35%) BSN, and 59 (2.31%) diploma seeking students. Seven of the eight practical nursing schools responded to the questionnaire (87.50%), representing 86.73% (170) of the 196 practical nursing students who took the E² within the time frame. The majority of schools in the PN sample represented the southwest, with one school located in the northwest and one located in the north central part of the United States.

The E² exam predicted 1,313 students (48.18%) of the total 2,725 respondents to pass the NCLEX exam without additional preparation. Approximately half (48.84%) of the RN

students were predicted to pass the NCLEX-RN, and 38.24% of the PN respondents were predicted to pass the NCLEX-PN without further preparation.

Thirty-four (0.01 %) RN students predicted to pass the NCLEX-RN exam actually failed the exam; 27 ADN, and 7 BSN students. Twenty-four of these students took the E² exam in an unmonitored setting. Nine students, who took the exam in an unmonitored setting and failed, were from the same school. Only ten (0.51%) students testing in monitored environments that were predicted to pass the NCLEX exam, actually failed. These results highlight the importance of monitoring the E² exam. None of the PN respondents predicted to pass the NCLEX-PN exam failed.

A Chi-square test of significance was used to establish the predictive accuracy of the E² exam in monitored environments was significantly greater ($\chi^2 = 4.98$; $p = .05$). No significant difference was found in the accuracy of the E² exam in different types of nursing programs. Lauchner et al. (1999) concluded the E² exam was highly predictive of NCLEX success, but recommended further analysis with practical nursing students who were minimally represented in this study. Further study conducted by Hanks and Lauchner (1999) and Newman, Britt, and Lauchner (2000) also supported these results.

Morrison, Free, and Newman (2002) conducted a study to determine the effect of program progression and remediation policies and NCLEX-RN pass rates. Interviews were conducted with the administrators of five nursing programs that had implemented progression or remediation policies based up the HESI E² exit exam scores. “A progression policy was defined as a school policy that withheld graduation or permission to take the licensure exam until the student had obtained a designated score on the E²” (p. 95). Any type of additional preparation required prior to retaking the E² exam was considered remediation.

Two schools interviewed had two types of nursing programs. Therefore, data were reported on seven programs: three ADN, two BSN, 1 BSN generic, and 1 BSN 2nd degree program. A review of program NCLEX-RN pass rates pre and post policy implementation indicated the pass rates in all programs improved by 9 to 41%, and decreased within 88 to 97%. The results of a Chi-square test of significance analyzing pre and post policy pass rates, determined pass rates increased significantly in six of the seven programs (5 at $p = .001$; 1 at $p = .05$). Results of a t -test of significance using related samples determined the pass rates were significantly higher after policy implementation ($p = .002$).

Little similarity was found between remediation employed by the programs. Remediation activities were comprised of faculty reviewing or re-teaching missed content, students completing assignments related to missed content, self-study, and administrators offering support and encouragement. All programs reported students frequently failed to use the resources provided. The researchers concluded that the implementation of a progression policy was the likely impetus for the increase in NCLEX-RN success, as there was no consistency in remediation activities. The researcher cautioned that such a policy should be implemented with due diligence and legal council should be obtained by the program.

As the E² exit exam increased in popularity, some nursing programs established minimal E² exam benchmark scores that students were required to meet in order to graduate. As prior research had not validated the predictive accuracy of the E² exam and NCLEX failure prior to program graduation, Nibert, Young, and Adamson (2003) initiated a fourth study to further explore the use E² exam as a guide for remediation and benchmark for program progression. Prior research had identified a decrease in NCLEX failure rates when the E² exam results were used as a guideline for remediation (Hanks & Lauchner, 1999;

Newman, Britt, & Lauchner, 2000). No significant difference was identified between the low scoring E² group who remediated prior to the NCLEX exam, and the group who did not remediate (Nibert & Young, 2001).

A descriptive, comparative analysis was conducted using 1999 and 2000 E² exam data provided by HESI. Questionnaires were given to obtain NCLEX outcomes from program administrators who used the E² exam during this time frame. The researchers noted a total of 11,988 students took the E² exam during this time period. However, the data from 7,335 files were able to be exported into the researchers' files. The retrievable data represented 59.74% of the RN students, and 71.78% of the PN students in the sample population. The survey response rate for RN programs was 95.18% (158 of 166 programs), and 86.11% (31 of 36 programs) for PN programs. Similar to the response rates in previous validity studies (Lauchner et al., 1999; Hanks & Lauchner, 1999; Newman et al., 2000), the researchers determined the response rate was representative of the population. There were 5,903 RN respondents, comprised of 3,459 (58.60%) representing 92 ADN programs, 2,346 (39.74%) representing 63 BSN programs, and 98 (1.66%) representing 3 diploma programs. Thirty-one practical nursing programs were represented by 897 respondents.

The questionnaire sent to the nursing programs included a summary report of aggregate data from each school along with student scoring intervals. The scoring intervals were revised to include greater discrimination in the middle and lower scoring E² groups. Administrators were asked to identify student success on the NCLEX exam along with program remediation and progression policies. The final study sample was comprised of 6,800 nursing students; 5,903 were RNs and 897 PNs. A total of 2,400 students were predicted to pass the NCLEX exam without remediation, as indicated by appearance within

the 90.00 to 99.99 percentile on the E² exam. Of the 2,059 RN students who fell into the AB category, 1,303 were ADN students and 726 BSN students. Thirty-five RN students who were predicted to pass the NCLEX-RN had failed the exam; 21 ADN students (1.61%), and 14 BSN students (1.93%). Two (0.59%) of the 342 PN students who scored in the AB category failed the NCLEX-PN exam. The results of a Chi-square analysis determined the predictive accuracy of the AB interval was similar to the validity studies conducted over the past three years (Hanks & Lauchner, 1999; Lauchner et al., 1999; Newman et al., 2000). No significant differences existed in the predictive accuracy related to the type of nursing program.

Unlike prior studies that examined the predictive accuracy of the highest and lowest scoring intervals, the researchers analyzed all five scoring intervals. A Chi-square analysis revealed significant differences between scoring intervals for the RN and PN students. As the scoring intervals decreased, the NCLEX failures increased. A comparison was then done of all scoring intervals and the percentage of students from each type of program. No significance difference was found between the type of program and students scoring at each interval level. A comparison of the RN and PN aggregate data of all five scoring levels determined there was a significant difference among the success of these two groups in the two lowest scoring levels. A greater percentage of RN students scoring in one of the two lowest levels passed the NCLEX exam compared to the percentage of PN students whose scored placed them in one of these levels.

An analysis of the number of programs using a benchmark E² score determined 45 of the 149 RN programs responding (30.20%) used an E² score to determine eligibility for graduation or the NCLEX licensure exam. Five (16.13%) out of 31 PN programs responding indicated they used E² scores this way. The majority of schools using and E² score for

progression established an 850 minimal benchmark. Nibert, Young, and Adamson (2003) concluded the E² exam was 98.46% predictive of NCLEX success, and that inferences can be made with students scoring in the lower levels. Further analysis of the correlation of specific intervention types and NCLEX success was recommended.

In an attempt to expand the original findings of a previous study (Nibert et al., 2002), Nibert, Young, and Britt (2003) distributed a questionnaire to identify the types of progression policies, the E² scores used for benchmarks, and remediation strategies used by RN programs. The survey response rate was 95.18%. The 5,903 students in the population included 3,459 ADN students (58.60%) enrolled in one of the 92 programs represented, 2,346 BNS students (39.74%) enrolled in one of the 63 programs represented, and 98 diploma students (1.66%) enrolled in one of three programs responding.

The adoption or continued enforcement of progression policies during the 1999-2000 school year was reported by 45 of the 149 programs (30.20%) responding to the questionnaire. The three most common consequences identified by program administrators were: denial of graduation eligibility, incomplete or failing capstone course grade, and withholding NCLEX approval. More programs were also requiring mandatory retesting using a different version of the E² exam, with the majority of schools permitting two retests. The majority of programs did not mandate remediation following the E² exam (71.81%). Remediation courses, computer-assisted instructions, review guides and tutoring were strategies identified by the programs requiring remediation. Nibert, Young, and Britt (2003) concluded that benchmarking for graduation and NCLEX candidacy is an emerging trend in nursing which is consistent with Morrison et al. (2002), who identified progression policies

as a prime motivator for NCLEX achievement. Future research regarding E² benchmarks, class size and NCLEX outcomes was suggested.

Spurlock and Hanks (2004) conducted a review of programs utilizing E² exam scores as a primary or one of the primary determinants of program completion or NCLEX readiness. The results of prior HESI validity studies (Hanks & Lauchner, 1999; Lauchner et al., 1999; Newman et al., 2000; Nibert et al., 2003), along with program progression and remediation policies, led them to caution programs to not use an E² as the sole predictor for program progression. Spurlock and Hanks emphasized the E² exam is not predictive of NCLEX failures and encouraged nursing programs to determine additional predictors of program success.

A longitudinal study conducted by Yoho, Young, Adamson, and Britt (2007) was undertaken to determine the predictive accuracy of four standardized tests created by Health Education Systems (HESI), Inc. and associate degree nursing NCLEX-RN success. The E² test had been established as 94.83% accurate in predicting NCLEX-RN success (Hanks & Lauchner, 1999; Lauchner et al., 1999; Newman et al., 2000; Nibert et al., 2003), but the predictive ability of other HESI tests had not been established. Programs utilizing the HESI package administer an Admissions Assessment (A²) math and reading comprehension exams, a Mid-Curricular (MC) exam, and the E² exam to students as they progress through the program. Establishing the predictive ability of the A² exams and the MC exam, and the MC exam and the E² exam, was the purpose of this research. "Predictive accuracy was defined as achieving the faculty-designated scores on the subsequently administered HESI examination or success on the NCLEX-RN when the faculty-designated scores were achieved on the previously administered HESI examination" (Yoho et al., 2007, p. 81).

The convenience sample for the study was comprised of 139 associate degree students who took the A², the MC, and the E², and sat for the NCLEX-RN between August 2002 and October, 2004. Data from the students who did not complete the program in the sample group were collected throughout the time they were in the program. The faculty-designated A² math and reading test scores were 70%; the faculty-designated MC and the E² scores were 850.

The A² results indicated 128 of the 139 students (92.09%) met the math percentile, 121 students (87.05%) met the reading comprehension percentile, and 97.12% of the students ($n = 135$) achieved a 70% or greater A² composite score. At the end of the first program year, 101 students (72.66%) remained in the cohort group, with 22 (21.78%) of those students meeting the 850 MC benchmark. Twenty of the 128 students who met the A² math benchmark and 12 of the 135 students who met the A² reading comprehension benchmark also met the MC benchmark.

Seventy-seven students in the original cohort group completed the program (55.40%) and took the E² exam, 58 (75.32%) of which met the E² benchmark. The 22 students who met the MC benchmark also met the E² benchmark. The majority (94.93%) of the 58 students who met the E² benchmark passed the NCLEX-RN on the first attempt.

Pearson's product-moment correlations, run between A² math, A² reading comprehension, MC and E² tests, determined A² reading comprehension and MC scores were positively correlated ($r = .412$; $p = .01$). The A² math and MC scores were not correlated. A positive correlation was found between the MC scores and E² exam ($r = .617$; $p = .01$). The first version E² exam scores were 94.83% predictive of NCLEX-RN success. The MC exam was also considered highly predictive of program and NCLEX-RN success. As a result of the

high attrition in the cohort group, the faculty of the program under study, is considering raising the A² admission exam benchmarks.

Murray, Merriman, and Adamson (2008) further investigated the predictive relationship of Admission Assessment (A²) and student success in associate degree and baccalaureate populations. The sample group consisting of 286 students (217 ADN and 69 BSN), all took the A² after admission into their program (in these programs the A² was used for placement testing only). Referrals were made to address academic deficiencies noted in the A² exam. Course grade records were also maintained for all students in the cohort group.

A bivariate regression analysis was run to determine the predictive validity of A² composite scores and individual course grades. A significantly positive correlation was found between the A² composite score and eight of nine courses within the associate degree program and 10 of 20 courses within the baccalaureate program. The HESI A² exam was significantly and positively correlated with 100% of all first level courses, 88.89% of all nursing course grades in the ADN program, 50% with all first level courses, and 80.00% with all nursing course grades in the BSN program. The mean A² composite scores were significantly higher ($p < .001$) for the ADN students who completed the program versus the ADN non-completers.

A sixth study was conducted by Adamson and Britt (2009) to determine the predictive accuracy of parallel versions of the E² exam, taken when a student is allowed more than one opportunity to reach the E² benchmark. Employing a descriptive, retrospective, comparative design, 10,147 student records were reviewed. No significance difference was found in the predictive accuracy of the first (96.44%) and second (92.94%) E² tests, and NCLEX-RN success, but the third E² test was significantly less predictive (82.50%). These

findings led Adamson and Britt to conclude the risk of NCLEX-RN failures was greater for the students who needed to take a third E² test to reach the established benchmark.

Traditional and Nontraditional Students

Although age was used as a common variable in many studies, recent research has suggested that students of today are quite different than their predecessors. In addition, “traditional” students are markedly different from “nontraditional” students. Traditional students are fascinated by new technologies, racially and ethnically diverse, and they work to excel and exhibit learning preferences that include teamwork, technology, experiential learning, and structure (Raines, 2002). Typically, these students live on or near campus, attend college full-time, and earn a degree from the institution in which they first enroll.

Nontraditional students are identified by the NCES as having one or more of the following characteristics: delayed enrollment; attend part-time; work fulltime; are financially independent; have dependents; are single parents; or lack a high school diploma. In addition, most non-traditional students have multiple roles: 54% work full-time; 34% have dependents; 16% are single parents; and 40% spend 11 to 30+ hours per week caring for dependents (U.S. Department of Education, NCES, 2006a).

Past research conducted by Staton-Cross (1988) revealed that learning styles and attitudes of adult students differ from those of younger students. Utilizing a sample group of adult nursing students in the community college setting, Staton-Cross investigated the learning styles, learning performance, and learning autonomy of adult students in an Associate Degree Nursing Program. Adult students who were employed had more autonomy than the unemployed adult students. In addition, the majority of these students were found to

be concrete learners with divergent learning styles, some preferring demonstration whereas the majority preferring traditional lecture with the use of visual aids, and discussions over self-paced and self-study modes of learning. Research findings support the need to offer a variety of instructional techniques to adult nursing students.

An ethnomological study conducted by Kamwengo (1993) revealed that older nursing students tend to underestimate their performance because of psychological and social factors. In addition, older students who are motivated have a positive self-esteem and tend to participate in self-evaluation activities. Older students also tend to report manifestations of anxiety based upon the level they are in the program.

Although these studies are not recent, they do raise the question of possible differences among traditional and nontraditional associate degree nursing students that may influence program and NLCEX-RN first-attempt success.

Campus Environment

A research study conducted by Haas et al. (2004) was the only study that included campus location as an independent variable for review. Although there has been limited research conducted on the influence of a campus environment and nursing student success, there are many theoretical models that support the relationship between educational environment, student retention, and completion. Several of these models have been built upon the initial work of Tinto (1975).

The Integration Model developed by Tinto (1975) proposed that students need to form a “match” between their level of commitment and the environment in order to become socially and academically integrated. Students who do not develop a “match” between the

institutional environment and their commitment will likely drop out or transfer from the institution. Higher integration leads to persistence in education, and is cited as a predictor of student retention (Tinto, 1975; 1993).

Bean (1980) supported Tinto's underlying philosophy of student integration, but perceived that retention rates are influenced by a student's interaction and the characteristics of the college. Bean theorized student beliefs shape attitudes, which are predictors of persistence. According to Bean, a student's beliefs are affected by the interaction between the students and the different components of the institution.

The time and energy spent in purposeful activities in college is the most effective predictor of student learning and personal development (Astin, 1993; Pascarella & Terenzini, 1991). The model of student retention proposed by Pascarella and Terenzini (1991) is based on the key elements of interaction and involvement. "A large part of the impact of college is determined by the extent and content of one's interactions with major agents of socialization on campus, namely, faculty members and student peers" (p. 620). Whereas earlier research conducted by Tinto (1975, 1993) focused on the number of student-faculty interactions, Pascarella and Terenzini (1991) looked at the type of interactions.

Pascarella and Terenzini (1979a) determined that a student's informal contact with other students and faculty promoted social and academic integration. Differences were found however, between the type of interaction and gender. Both male and female students were positively influenced by interactions related to intellectual and class content. However, persistence in females was more positively correlated to informal socialization interactions and discussions of related to campus issues. Persistence in males was more positively correlated with interactions related to career and academic planning.

Further results by Pascarella and Terenzini (1983) supported Tinto's (1975) finding that there is a compensatory association between academic and social integration; high levels of academic integration (as evidenced by high faculty contact), compensated for lower levels of social integration. Academic and social integration, often referred to as academic or social self-concept, has been cited as a factor that impacts student engagement (Pascarella & Terenzini, 1983).

Pascarella and Terenzini (1983) determined that Tinto's model was not generalizable to a commuter environment. Citing Chickering's (1974) observations regarding a decline in the interactions of commuter students with faculty and students, and decrease in involvement in cultural and intellectual activities on campus, Pascarella and Terenzini (1983) determined that Tinto's model needed to be revised. Although they found a positive interaction between academic integration and persistence, there was a negative effect between social integration and persistence in the commuter environment. Their findings did support that intention had the strongest positive correlation to persistence in the incoming freshman. The nature of the student interactions between faculty and peers was identified as an important component in the student's educational experience (Pascarella, 1991).

Braxton, Hirschy, and McClendon (2004) developed a model that focused on student motivation, and the influence of the external environment and support systems to explain student retention in commuter institutions. After determining that Tinto's previous work was not applicable to commuter institutions, Braxton identified 16 categorical elements based upon empirical evidence, student characteristics, and commuter environment. The categories of these elements are economic, organizational, psychological, and sociological.

Rendón (2007) posited that students who are likely to be more engaged in college include those who: are females, attend fulltime, live on campus, are affiliated with a learning community, started and graduated from the same school, are international students, and have diversity experience. Students who are more likely to be disengaged and leave college include those who: are part-time, first-generation, low-income, and poorly prepared; have been invalidated in the past; and experience culture shock or have difficulty in becoming involved or transitioning to the college setting.

The preceding theorists identified the critical role an educational/campus environment plays in the engagement, persistence, and ultimate success of a student.

Summary

The majority of nursing research has focused on the academic variables predictive of NCLEX-RN success in the baccalaureate population. These studies have used a variety of independent variables, that are often nonequivalent measures, and have yielded inconsistent conclusions. The findings from one study were often not supported by another study; therefore, generalization would be difficult, if not impossible. Studies conducted prior to 1988 were often able to correctly predict up to 86% of the students who would pass the exam (Jenks, Selekman, Bross, & Paquet, 1989; Krupa, Quick, & Whitley, 1988). With the 1988 change in NCLEX test plan and reporting on a pass/fail, there has been limited success in the ability to identify factors predictive of first-attempt NCLEX success in an efficient manner.

During the past three decades, there has been an increased focus among nursing researchers on strengthening the predictive ability of various nursing models. Munday and Hoyt (1975) raised concern that nursing studies utilizing course grades as independent

variables to predict success may have skewed results, as these variables are often part of the criterion variable measured. Researchers have also worked to identify a practical and efficient way to predict nursing student success as multivariate analysis is time consuming and requires expertise. Barkley et al. (1998) experimented with a modified RAI assessment tool designed to identify at-risk students, and suggested the number of C+ or higher grades provides evidence of NCLEX-RN success. Beeman and Waterhouse (2001) revealed a correlation between C+ or higher grades and NCLEX-RN success, and suggested programs use this method as a rough estimate for student success.

Several pre-admission variables have been found to be predictive of NCLEX-RN success: Pre-nursing GPAs (Jenks et al., 1989; McClelland, McKinney, Small, O'Dell, & Coonrod, 1988; Payne & Duffey, 1986; Quick et al. 1988; Yang et al., 1987; Young & Glick, 1992); pre-requisite science course grades (Jenks et al., 1989; Whitley & Chadwick, 1986; Yang et al., 1987); and individual humanity and social science course grades (Yang et al., 1987).

Researchers have also demonstrated the predictive relationship between nursing program performance variables and NCLEX-RN success. Nursing program and individual course grade point averages have often been cited as common predictors of NCLEX-RN success (Beeson & Kissling, 2001; Glick, McClelland, & Yang, 1986; Haas et al., 2003; Jenks et al., 1989; Krupa et al., 1988; McKinney et al., 1988; Payne & Duffey, 1986; Whitley & Chadwick, 1986; Yang et al., 1987; Yin & Burger, 2003, along with senior year nursing Younger & Grap, 1992).

The effectiveness of standardized testing has been reported for many years. ACT and SAT tests have been reliable indicators of student ability upon entrance to the program

(Alexander & Brophy, 1997; Carpenter & Bailey, 1999; Foti & DeYoung, 1991; Haas et al., 2003; Lengacher & Keller, 1990; Mills et al., 1992; Payne & Duffey, 1986; Yang et al., 1987; Younger & Grap, 1992). The Mosby Assess Test has been shown to have moderate to strong predictive reliability in a variety of studies (Beeson & Kissling, 2001; Foti & DeYoung, 1991; Fowles, 1992; Jenks et al., 1989; McKinney et al., 1988; Uyehara, Magnussen, Itano & Zhang, 2007). The predictive reliability of the NLN Preadmission Test and the NLN Comprehensive Examination and NCLEX-RN has also been demonstrated (Alexander & Brophy, 1997; Briscoe & Anema, 1999; Horns et al., 1991; Wall et al., 1993; Younger & Grap, 1992). The increased use of the HESI E² Exit exam has led to a series of validity studies utilizing a combined associate and baccalaureate sample group (Daley et al., 2003; Newman et al., 2000).

Non-cognitive factors have been identified as contributing to program and NCLEX-RN success. Dell and Valine (1990) studied the influence of self-esteem and NCLEX-RN performance, and revealed student age and self-esteem contributed to the variance in NCLEX-RN scores. Poorman and Martin (1991) identified a student's self-perceived grades and self-predicted NCLEX-RN scores were the best predictors of NCLEX-RN success. Test anxiety was shown to be negatively correlated to NCLEX-RN success. Jeffreys (1998) determined personal study habits and faculty advising were most likely to enhance academic performance and retention, whereas family responsibilities and family crisis were significant barriers. Arathuzik and Aber (1998) found increased confidence, and lack of family and work responsibilities contributed to student success.

Significant positive correlations between student age and NCLEX results have been identified (Briscoe & Anema; 1999; Haas et al., 2003; Wong & Wong, 1999), and several

researchers have emphasized the importance of understanding the diverse nature and needs of nursing students in order to effectively provide remediation and support (Arathuzik & Aber, 1998; Haas et al., 2003; Lengacher & Keller, 1990; Oliver, 1985; Uyehara et al., 2007). The characteristics related to student age groups (U.S. DOE, NCES, 2006a), and Statin-Cross (1988) and Kamewengo (1993) highlight the need to further explore academic and nonacademic needs of the diverse students enrolled in our programs.

The predictive relationship between campus environment and NCLEX-RN success was supported by Haas et al. (2004) who were able to identify 71% of successful first-time testers and 61.2% of those who failed when campus location was included in a logistic regression equation. Campus environment was not used as a variable in the other studies cited in the literature review.

The nature of the relationship between a student and his or her educational environment is critical to student engagement and persistence. Whether students form a match between level of commitment and institution (Tinto, 1975), their beliefs and attitudes affect persistence (Bean, 1980), and informal contact with other students and faculty promote social and academic integration (Pascarella & Terenzini, 1979a). Research by Braxton, Hirschy, and McClendon's (2004) uncovered the unique needs of commuter students. Findings by Rendón (2007) indicated that all community college students are at-risk for disengagement. Therefore, it is critical for faculty and students to develop an awareness of students' needs within the educational environment, and provide solutions to enhance engagement and learning that lead to attrition and graduation, more specifically, first attempt NCLEX-RN success.

CHAPTER 3. METHODOLOGY

The purpose of this study was to analyze the predictive relationship between demographic and academic variables and first attempt NCLEX-RN success. A second purpose of this study was to determine if there are significant differences between urban and rural nursing students that could account for the increased percentage of rural NCLEX-RN failures. This chapter is organized as follows: (1) Research Design; (2) Study Population; (3) Procedures; (4) Ethical Considerations; and (5) Data Analysis.

Research Design

This exploratory study was conducted utilizing a quantitative non-experimental design. A variety of demographic and academic variables were explored to identify which variables should be included in a discriminant analysis of NCLEX-RN success. The independent variables included: age group, gender, financial status, dependents, type of nursing program enrolled in, program option enrolled in, program admission reading scores (ACT, Accuplacer, Asset, or Compass), Anatomy and Physiology GPA, the number of terms a student attempted to complete practical and associate degree nursing coursework, associate degree nursing course grades, core practical theory GPA, core associate degree theory GPA, PN program outcome, ADN program outcome, and program level completion rates. The dependent variable in the study was NCLEX-RN first-attempt success.

Gender, financial status, dependents, type of nursing program enrolled in, program option enrolled in, and program admission reading scores (ACT, Accuplacer, Asset, or Compass) were excluded for analysis beyond research question 1. The reason for the exclusion of these variables is presented in Chapter 4.

The results of the initial research questions led to the inclusion of six independent variables and one dependent variable in the Demographic and Academic Variables and NCLEX-RN Success Model (p. 10). The independent variables were comprised of two demographic and four academic variables. The demographic variables were: student age group, and the campus the student was enrolled in the nursing program; urban versus rural. The academic variables were separated into two program levels: academic environment 1, and academic environment 2. Academic environment 1 represented the first year of the Associate Degree Nursing Program. This level, also known as the practical nursing level in the program, included the academic variables: Anatomy and Physiology GPA; the number of terms the student attempted to complete practical nursing coursework; and the cumulative GPA of the core practical Nursing courses. Academic environment 2 represented the second year, or the registered nursing level in the program. The number of terms the student attempted to complete registered nursing coursework was the academic variable in academic environment 2. The sample was divided into those attending the urban campus and those attending the rural campus to identify differences between the two groups.

Study Population

The convenience sample in this study was comprised of students who entered or exited the Practical Nursing or Associate Degree Nursing Program at a community college located in the Midwest from January, 2005 through December, 2007. Participants were selected from the initial and terminal nursing class rosters within this time frame. This timeframe was selected as there were no significant curriculum changes in the program which ensured the majority of students starting the program in January, 2005 would have

adequate time to complete it. There were 398 student cases in the study, with adequate representation between the urban and rural campus: 197 students (49.5%) and 201 students (50.5%), respectively. Consistent with gender patterns in nursing, there were 363 females and 35 males in the sample population. There was equal representation of gender on each campus: 178 females (90.4%) and 19 males (9.6%) on the urban campus, and 185 females (92%) and 16 males (8%) on the rural campus.

Procedures

Secondary data, consisting of a student's MWCC college application for admission, pre-admission testing results, financial aid applications, student's MWCCNP transcripts, MWCCNP course rosters, nursing course grade reports, and NCSBN NCLEX-RN score reports were utilized. Student age was determined by subtracting the birth date of the student listed on the admission application from the first date a student was enrolled in foundation nursing theory/clinical course. Student gender and campus in which he or she was enrolled was obtained from the college application form. Student transcripts were used to identify the program in which the student was enrolled: Practical Nursing, Associate Degree Nursing, or Advanced Associate Degree Completion.

Pre-admission reading scores were retrieved from an internal query to identify the students who met the reading benchmark, those who tested below the reading benchmark, and those who were given a reading entrance waiver prior to program admission. The exam and test score that met the reading benchmark was used for students who submitted more than one exam and test score. Students who did not meet the benchmark were granted a waiver upon successful completion of identified coursework. An assumption was made that

the students who did not meet the benchmark eventually received a waiver to enter into the program for cases where no additional scores were submitted by the applicant. Waivers had time limit. The established reading benchmarks for the MWCCNP are provided in Table 2.

Course grades, and the number of terms attempted to complete the practical and associate degree nursing program were obtained from review of a student's transcripts. Course grades were converted into percentile grades utilizing the 4.0 grading scale of MWCC (see Appendix C, Data Key). The core nursing GPA was a measurement of the mean grade point score based on a student's grades in nursing theory courses. The core nursing grade point average was calculated by the number of credit hours multiplied by the grade points for the grade received, divided by the total number of credit hours attempted. In cases where a course was attempted more than once, all grades and course credits were included in the formula. The Anatomy and Physiology GPA was calculated in the same manner.

An internal query identified the students who received financial aid for the semesters which they were completing core nursing coursework. Students were classified as "financially dependent" if they used financial aid for 50% to 75% of the terms enrolled in core nursing coursework. The students who received financial aid less than 50% of the semesters they were enrolled in core nursing coursework, were classified as "financially independent". Students who received financial aid were required to answer a question on the financial aid application regarding responsibility for dependents; i.e. children, aged parents etc. This data was not available for students who did not complete a financial aid application form. Financial status and dependents were used as proxy variables for potential barriers to success in the program.

The NCSBN NCLEX-PN and NCLEX-RN reports, released to the college from the testing agencies, were used to identify licensure success. Data were entered into an Excel spreadsheet and coded according to a data key established by the researcher. Data were then reviewed and cleaned. Categorical information was recoded using a dichotomous scale of 0 and 1. Cases with missing variables were deleted from the sample.

Ethical Consideration

Prior to the initiation of this study, the researcher obtained approval from the Iowa State Institutional Review Board and Midwest Community College. The study (09-448), was declared exempt from the requirements of the Human Subject Protections Regulations by both institutions as there was no risk for the students within the sample group. Student files were retrieved by program personnel, and information that could link a student to the data was removed prior to utilization by the researcher. The researcher then assigned a subject identifier to each file. The subject identifier was then used to retrieve and collate the requested data provided by the institution. The data was maintained in a secure location throughout the course of this study, and shredded upon the completion of the research. Those involved with this research maintained confidentiality at all times.

Data Analysis

The Statistical Product and Service Solutions (SPSS) (version 16.0) program was applied for data analysis. Descriptive statistical analyses: frequency counts, percentages, and cross tabulation were used to answer the first two research questions in this study. Means and standard deviations were used to answer the second and fourth research questions. The population was recoded into urban and rural, and practical and associate degree nursing

categories for campus and program level comparisons. The independent means *t*-test of significance was used to determine if there were significant differences between the nursing students on the urban and rural campuses related to the variables in the third and fourth research questions.

The Pearson product- moment correlation was used to determine the degree of relationship between the academic variables in the fifth research question, and to validate the variables used in the multivariate analysis to answer the sixth research question. A logistic regression model was selected in order to combine categorical and continuous predictor variables in a model to predict the dichotomous outcome of NCLEX-RN first-attempt success (Tabachnick & Fidell, 2007). Logistic regression produces an estimate of the probability of first-attempt success on the NCLEX-RN exam based on the predictor variables. Logistic regression makes no assumption about the distribution of the independent variables. Therefore, the variables do not need to be normally distributed, linearly related or of equal variance (Urduan, 2005). Logistic regression was applied to answer Research Question 6: Is there a statistically significant relationship between associate degree nursing course grades, and cumulative core PN and core ADN GPAs on the urban and the rural campus?

CHAPTER 4. RESULTS

The purpose of this study was to analyze the predictive relationship between demographic and academic variables and first attempt NCLEX-RN success. A second purpose of this study was to determine if there are significant differences between urban and rural nursing students that could account for the increased percentage of rural NCLEX-RN failures. The chapter is organized according to demographic results (research questions 1 and 2), and inferential statistics (research questions 3 – 6).

Descriptive Analysis

Research Question 1: What are the student demographics and program reading admission scores for the MWCC nursing students on the urban and rural campus?

Descriptive statistics for the six demographic characteristics of the population are shown in Table 1. The majority of students in the aggregate population, 60.6%, were older than 24 years of age at the start of nursing coursework. Thirty-nine percent of the students were between the ages of 18 and 24 years at the start of core nursing coursework. A greater percentage of traditional students were reported on the urban campus (21%) versus the rural campus (18.3%).

A majority of students, 83.7%, were utilizing financial aid to attend the program. As an aggregate: 47.2% of the students reported dependents, 41% no dependents, and it was unknown if 11.8% of the students were responsible for dependents. A greater percentage of rural students used financial aid (50.8%).

There were closely approximated distributions of students enrolled in the practical, associate degree and advanced transfer associate degree programs on the urban and rural

Table 1. Demographic characteristics of urban and rural nursing students

Variable	Campus				Total
	Urban	Percent (%)	Rural	Percent (%)	
<i>Gender</i>					
Female	178	90.4	185	92.0	363
Male	19	9.6	16	8.2	35
Total	197	100.0	201	100.0	398
<i>Age Group</i>					
Traditional	84	42.6	73	36.3	157
Non-traditional	113	57.4	128	63.7	241
Total	197	100.0	201	100.0	398
<i>Financial Status</i>					
Has Aid	164	49.2	169	50.8	333
No Aid	33	50.8	32	49.2	65
Total	197	100.0	201	100.0	398
<i>Dependents</i>					
Yes	83	42.1	105	52.2	188
No	92	46.7	71	35.3	163
Unknown	22	11.2	25	12.5	47
Total	197	100.0	201	100.0	398
<i>Programs Enrolled in</i>					
Practical	64	32.5	57	28.3	121
Associate Degree	126	64.0	137	68.2	263
Advanced ADN	7	3.5	7	3.5	14
Total	197	100.0	201	100.0	398
<i>Nursing Program Options</i>					
Day	171	86.8	179	89.1	350
Evening/Weekend	26	13.2	22	10.9	48
Total	197	100.0	201	100.0	398

campuses. As shown in Table 1, there were seven more practical nursing graduates on the urban campus. A Chi-square test of significance determined the groups were homogenous in nature with the exception of the number of dependents ($x^2 = .022$; $p < .05$).

Consistent with seat availability in the program, the number of advanced transfer associate degree students, and the number of students enrolled in the day practical nursing program versus the evening/weekend program was similar between campuses. As a result of statewide budgetary reductions, the evening/weekend program was suspended during the time this research was being conducted.

Reading program entrance scores

Among the 398 students in the sample population, 255 students submitted reading entrance scores prior to program admission, and 143 students received a waiver for this requirement. Seventy-four of the 255 students who submitted reading entrance scores did not meet the established reading benchmark. An assumption was made that these students eventually received a waiver to enter the program as no further testing results were submitted. This would result in 217 applicants out of the total population (54.5%), received a reading entrance waiver prior to admission to the nursing program. Waivers for this requirement are granted based upon receiving a C- or above in one of the following courses; General Psychology, Introduction to Psychology, or Introduction to Sociology, and have no expiration time. Further exploration determined many waivers were granted based upon coursework that was transferred into MWCC. The reading entrance scores of the students enrolled in the MWCCNP are summarized in Table 2.

Among the 255 students who submitted reading scores, Asset exam scores were most commonly submitted (45%) followed by ACT scores (28.2%). All of the students who submitted Compass scores met the benchmark, followed by 93.5% of the students meeting the Accuplacer benchmark. When analyzing entrance reading scores the researched noted a number of students who submitted an unsatisfactory ACT or Asset score would retest with the Accuplacer exam and obtain a higher reading standard on the MWCC Admission Exam Concordance Table. The Asset test is no longer offered at MWCC. Therefore, this score was not considered for inclusion in further analyses.

Table 2. Reading entrance scores of urban and rural nursing students

Assessment Test	Campus				Total
	Urban	Percent (%)	Rural	Percent (%)	
<i>ACT Reading</i>					
Below minimum (1-18)	11	30.6	13	36.0	24
Acceptable (19-36)	25	69.4	23	63.9	48
Number of Testers	36	100.0	36	100.0	72
<i>Accuplacer Reading</i>					
Below minimum (0-69)	4	12.5	2	6.5	6
Acceptable (70-120)	28	87.5	29	93.5	57
Number of Testers	32	100.0	31	100.0	63
<i>Asset Reading</i>					
Below minimum (23-42)	17	30.9	27	45.0	44
Acceptable (43-53)	38	69.1	33	55.0	71
Number of Testers	55	100.0	60	100.0	115
<i>Compass Reading</i>					
Below minimum (0-82)	0	0.0	0	0.0	0
Acceptable (83-99)	2	100.0	3	100.0	5
Number of Testers	2	100.0	3	100.0	5

Research Question 2: What are the anatomy and physiology grade point averages, the number of terms attempted for PN and ADN program completion, program outcomes and completion rates, and cumulative and core program level grade point averages for the MWCC PN and ADN graduates, on the urban and rural campus?

The mean anatomy and physiology grade point averages, shown in Table 3, indicate the Anatomy and Physiology grade averages were slightly higher with a larger standard deviation between the scores for rural nursing students (Table 3). This may be a result of differences in science course content, rigor, or the grading scale between campuses: a C- is 70% on the rural campus and 78% on the urban campus.

Table 4 and 5 illustrate the number of terms attempted for practical and associate degree nursing students. A minimum of two terms is required to complete the PN program. Three terms are required to complete the ADN program level. Students may attempt core nursing courses multiple times, as evident by a higher incidence of number of program terms attempted. Two hundred and seventy-nine students (72.7%) attempted the minimum of two

Table 3. Anatomy and physiology GPAs of urban and rural nursing students

Sample Group	<i>N</i>	Mean	Standard Deviation
Urban	197	3.0283	.7087
Rural	201	3.0506	.7862
Total	398	3.0396	.7480

terms in the practical nursing program. Thirty-four students (8.9%) attended the program for one term, and 71 students (18.5%) attempted more than two terms in the program. Further analysis of program completion results determined 324 students completed the practical nursing program; 61 students graduated and left MWCC, and 263 students went on to the associate degree level (Table 5). Sixty students did not complete the practical nursing program; 21 students left the program in good academic standing (1 died), and the remaining 39 students were unsuccessful in meeting program requirements (Table 5).

Table 4. Number of terms attempted by urban and rural Practical Nursing students

Terms	Urban	Percent (%)	Rural	Percent (%)	Total Percent (%)
One	18	9.0	17	8.7	8.9
Two*	133	70.4	146	74.9	72.7
Three	26	13.7	22	11.3	12.5
Four	9	4.8	7	3.6	4.2
Five	4	2.1	3	1.5	1.9
Total**	189	100.0	195	100.0	100.0

*Required for program completion.

***N*=384; Advanced transfer RN students not included in totals.

Table 5. Outcomes of PN program for urban and rural nursing students

Program Outcome	Urban	Completer (%)	Rural	Completer (%)	Total
Completed, graduated and left MWCC	36	19.0	25	12.9	61
Completed, progressed to ADN	126	66.3	137	70.6	263
Did not complete, left MWCC after course failure	13	6.8	23	11.9	36
Did not complete, left MWCC with satisfactory grades	7	3.7	3	1.5	10
Changed programs and graduated from MWCC	4	2.1	6	3.1	10
Died during program	1	0.5	0	0.0	1
Unable to complete program due to grades or background check	3	1.6	0	0.0	3
Total Program Completers*	190	100.0	194	100.0	384

*N=384; Advanced transfer RN students not included in totals.

The number of terms attempted by the 277 students who entered into the second year of the program is shown in Table 6. Eighty-one percent of the PN completers progressed into the ADN level. Fourteen students (5%) entered MWCC as advanced transfer ADN students.

As shown in Table 6, 187 students (67.5%) attempted the minimal of three terms in the associate degree nursing program. Forty-one students attended the program less than the

Table 6. Number of terms attempted by urban and rural Associate Degree nursing students

Terms	Urban	Percent (%)	Rural	Percent (%)	Total Percent (%)
One	14	10.5	12	8.3	9.4
Two	8	6.0	7	4.9	5.4
Three*	82	61.7	105	72.9	67.5
Four	23	17.3	18	12.5	14.8
Five	6	4.5	2	1.4	2.9
Total**	133	100.0	144	100.0	100.0

*Required for program completion.

required number of terms, and 49 students (17.7%) attempted more than three terms at this level. There was a 14.8% attrition rate within the first associate degree term compared to 8.9% in the first practical nursing term.

Further analysis of associate degree program outcomes summarized in Table 7 determined 215 students (77.6%), completed the associate degree nursing program, and 8 students (2.9%) are working to complete the program. Fifty four students (19.5%) left the program; 26 students left the program after receiving a failing grade in a core nursing course, and the 24 students who left the program did not receive a failing grade in the most current core nursing course attempted. As students are allowed to withdraw from a course when failing theory in the MWCCNP, these students may or may not have been failing the course prior to leaving. Four students were unable to progress in the program after failing their background checks or a nursing course twice.

The percentage of students that completed the practical and associate degree programs on both campuses is summarized in Table 8. The students who switched majors and graduated from MWCC in another major were separated to identify the actual number of

Table 7. Outcomes of ADN program for urban and rural nursing students

Program Outcome	Urban	Percent (%)	Rural	Percent (%)	Total
Completed, graduated and left MWCC	100	75.2	115	79.9	215
Still progressing in program	4	3.0	4	2.8	8
Did not complete, left MWCC after course failure	15	11.3	11	7.6	26
Did not complete, left MWCC with satisfactory grades	13	9.8	11	7.6	24
Failed out of program due to grades or background check	1	0.7	3	2.1	4
Total	133	100.0	144	100.0	277

*N=384; Advanced transfer RN students not included in totals.

Table 8. Program completion rates for urban and rural nursing students

Program Outcome	Urban	Percent (%)	Rural	Percent (%)
PN Completers	162	85.3	162	83.5
Other Program Completers	4	2.1	6	3.1
Non-completers	24	12.6	26	13.4
Total	190	100.0	194	100.0
ADN Completers	100	75.2	115	79.8
Progressing	4	3.0	4	2.8
ADN Non-completers	29	21.8	25	17.4
Total	133	100.0	144	100.0

students who did not graduate from MWCC. The practical nursing completion rate was higher on the urban campus (85.3% versus 83.5%), but the associate degree completion rate was higher on the rural campus (79.8 versus 75.2%).

The core program level GPA is defined as the grade point average of core nursing coursework, or nursing courses that consist of theory, lab and clinical activities. Urban, rural, and mean GPAs of practical and associate degree core nursing coursework are listed in Table 9. The practical nursing core GPA is higher than the associate degree GPA district-wide. The associate degree core GPAs are at least 0.95 points lower than the practical nursing GPAs, with a greater variance in standard deviations. There is a greater difference in the practical and associate degree core GPAs on the rural campus. A review of the cumulative GPAs (Table 10), in the urban and rural groups, indicates higher practical cumulative GPAs versus cumulative associate degree GPAs. However, there is a greater difference between the cumulative practical and associate degree GPAs in the urban population.

Table 9. PN and ADN core GPAs for urban and rural campuses

Campus	Core GPA	
	Practical Nursing	Associate Degree
Urban (N=197)		
Mean	2.1930	1.2422
Std Dev	1.0192	1.2683
Rural (N=201)		
Mean	2.2718	1.4412
Std Dev	1.1133	1.2972
Total (N=398)		
Mean	2.2328	1.3427
Std Dev	1.0671	1.2842

Table 10. PN and ADN cumulative GPAs for urban and rural campuses

Campus	Cumulative GPA	
	Practical Nursing	Associate Degree
Urban (N=197)		
Mean	2.4681	1.4445
Std Dev	1.1145	1.4593
Rural (N=201)		
Mean	2.5186	1.6917
Std Dev	1.2050	1.5009
Total (N=398)		
Mean	2.4937	1.5693
Std Dev	1.1600	1.4838

Inferential Statistics

Research Question 3: Is there a statistically significant difference in: (a) the anatomy and physiology grade point averages; (b) the number of terms attempted for PN and ADN program completion; and (c) program completion rates, and core program grade point averages for the first year (practical level) and second year (associate degree) nursing students attending the urban versus the rural campus?

Table 11 presents the results of the independent significance means *t*-test evaluating differences between urban and rural student on academic variables. Equal variances were not assumed in PN completion rates, ADN completion rates, and the number of terms attempted in the ADN program level. No statistically significant difference was found between urban and rural students on A & P GPA, or the number of terms attempted, program completion rates or core GPA for either PN or ADN programs.

Table 11. Independent significance means *t*-test for academic variables

Variable Error	<i>t</i> (urban/rural)	<i>df</i>	Sig (2-tailed)	Difference	
				Mean	Standard
A & P GPA	-.298	396	.766	-.0224	.0742
Terms attempted					
First level (PN)	.806	396	.421	.063	.078
Second level (ADN)	-.643	391.347	.521	-.099	.155*
PN Completion Rate	-1.564	315.849	.119	-.068	.043*
ADN Completion Rate	-1.121	331.686	.263	-.059	.052*
Core PN GPA	-.736	396	.462	-.0788	.1071
Core ADN GPA	-1.547	396	.123	-.1990	.1286

*Equal variances not assumed; $p < .05$.

Research Question 4: Is there a statistically significant difference in the second level nursing course grades on the urban and rural campus?

The urban campus associate degree nursing course grades were lower for all courses (Table 12). A statistically significant difference was found between the urban and rural group with respect to Comprehensive Pediatrics course grades, and Mental Health course (Table 13).

Table 12. Associate degree course grades for urban and rural campuses

Course	Urban		Rural		Program	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Trans	1.7017	1.3123	1.8612	1.2847	1.7822	1.2992
Comp Peds	1.4671	1.3199	1.7362	1.3810	1.6030	1.3561
Comp OB	1.5666	1.3529	1.6431	1.2915	1.6052	1.3211
MH	1.2882	1.2340	1.6314	1.3021	1.4615	1.2788
Comp Adult	1.1912	1.2017	1.3627	1.2239	1.2778	1.2144

Key: Trans=Transitions to Associate Degree Nursing; Comp Peds=Comprehensive Pediatrics; Comp OB=Comprehensive Obstetrics; MH=Mental Health; Comp Adult=Comprehensive Nursing Care of Adults
Urban, $N = 197$; Rural, $N = 201$; Program, $N = 398$

Table 13. Independent significance means t -test for Associate Degree course grades

Course	t (urban/rural)	df	Sig (2-tailed)	Difference	
				Mean	Standard
Transitions to associate degree nursing	-1.225	396	.221	-.1595	.1302
Comprehensive pediatrics	-1.987	396	.048	-.2691	.1355
Comprehensive obstetrics	-0.577	396	.564	-.0765	.1326
Mental health	-2.699	396	.007	-.3432	.1272
Comprehensive nursing care of adults	-1.411	396	.159	-.1716	.1216

Equal variances assumed in all courses; $p < .05$.

Research Question 5: Is there a statistically significant relationship between associate degree nursing course grades, and core PN and ADN GPAs on the urban and the rural campus?

Table 14 illustrates the relationships between the associate degree nursing course grades and core practical and associate degree GPAs. Strong, positive correlations ranging from $r = .791$ (Comprehensive Nursing Care of Adults with Transitions to Associate Degree Nursing), to $r = .922$ (Comprehensive Obstetrics with Comprehensive Pediatrics) were found. The core PN GPA was moderately correlated with all courses ($r = .613$ to $r = .686$), and the core ADN GPA was strongly correlated with all courses ($r = .792$ to $r = .916$). The core PN GPA was moderately correlated with the core ADN GPA ($r = .603$).

Table 14. Correlations between ADN course grades and program level core GPAs

Course	Trans	Comp Peds	Comp OB	MH	Comp Adult	PN GPA	ADN GPA
Trans	1.00						
Comp Peds	.856*	1.00					
Comp OB	.867*	.922*	1.00				
MH	.831*	.901*	.916*	1.00			
Comp Adult	.791*	.876*	.891*	.916*	1.00		
PN GPA	.686*	.625*	.640*	.613*	.614*	1.00	
ADN GPA	.792*	.881*	.898*	.916*	.978*	.603*	1.00

*Significant at 0.01 level (2-tailed).

Key: Trans=Transitions to Associate Degree Nursing; Comp Peds=Comprehensive Pediatrics; Comp OB=Comprehensive Obstetrics; MH=Mental Health; Comp Adult=Comprehensive Nursing Care of Adults.

Research Question 6: To what extent do student demographics and academic performance data of PN and ADN levels predict the first time passing of the NCLEX-RN among the MWCC nursing students?

Although there were 398 students in the original sample, only 263 students (66.1%) progressed into the associate degree level of the program, and 206 (78.3% of the 263; 51.8% of 398) students graduated and attempted the NCLEX-RN exam. A sample size of 206 was

available to the researcher at the initiation of this multivariate analysis. A review of literature determined no specific sample size rules when using logistic regression, but uncovered recommendations from a variety of statisticians (Peng, Lee, & Ingersoll, 2002). Tabachnick and Fidell (2007) recommended a minimal sample size of 50 or 100, with a ratio of 10 cases for each variable, plus a variable number that is a function of the number of predictors. Urdan (2005) proposed a sample size guideline of 30 cases plus 10 cases for each variable. A sample size of 206 meets both of these recommendations.

In order for each predictor variable to explain a unique portion of the variance in the logistic regression, the correlation between predictor variables cannot be too strong (Urdan, 2005). The Pearson product-moment correlation was used to evaluate multicollinearity among the academic predictor variables prior to the initiation of the logistic regression.

As shown in Table 15, correlations ranged from $r = .157$ (# terms PN with # terms ADN), to $r = .603$ (PN theory with ADN theory). Approximately one third of the correlations were greater than .30, and one-third greater than .40. The highest correlation, PN theory with ADN theory ($r = .603$), resulted in the decision to remove ADN core theory GPA from the logistic regression in order to improve the predictive validity of the other variables in explaining the variance in NCLEX-RN first-attempt success. As Tabachnick (2007) stated, “Unless you are doing analysis of structure or are dealing with repeated measures of the same variable (as in various forms of ANOVA including profile analysis), think carefully before including two variables with a bivariate correlation of, say, .70 or more in the same analysis” (pp. 89-90). The ADN core theory GPA was selected over the PN core theory GPA in order to utilize variables that are measurable by the end of the practical nursing level, and could assist in progression policy development.

Table 15. Correlations between academic predictor variables

Predictor variables	PN # Terms	A & P GPA	PN Theory GPA	ADN Theory GPA	ADN # Terms
PN # Terms					
Pearson correlation	1				
Sig. (2-tailed)					
<i>N</i>	356				
A & P GPA					
Pearson correlation	-.357**	1.000			
Sig. (2-tailed)	.000				
<i>N</i>	356	398.00			
PN Theory GPA					
Pearson correlation	-.382	.467**	1.000		
Sig. (2-tailed)	.000	.000	.000		
<i>N</i>	356	398	398		
ADN Theory GPA					
Pearson correlation	-.403**	.347**	.603**	1.000	
Sig. (2-tailed)	.000	.000	.000	.000	
<i>N</i>	356	398	398	.398.00	
ADN # Terms					
Pearson correlation	.157*	-.216**	-.376**	-.444**	1.000
Sig. (2-tailed)	.017	.001	.000	.000	
<i>N</i>	229	236	236	236	236.00

* Significant at 0.05 level (2-tailed)

** Significant at 0.01 level (2-tailed)

A variety of demographic variables were also excluded from this model; student gender and nursing program option were not included due to the low numbers of subjects in these categories. The suspension of the evening/weekend program justified eliminating the program enrolled from the model. Though critical, the admission reading scores were excluded as a result of the low frequency of participants who submitted the same test score. The proxy variables, financial status and dependents, were excluded from the final model as their interpretation is ambiguous.

A Sequential Logistic Regression analysis was used to evaluate the prediction of the independent variables of student age group, campus enrolled, Anatomy and Physiology GPA, the number of terms attempted in the practical nursing, the core PN GPA, and the number of

terms attempted in the associate degree program related to the dichotomous outcome, passed the NCLEX-RN, or failed the NCLEX-RN (0 = failed the NCLEX-RN on the first attempt; 1 = passed the NCLEX-RN on the first attempt).

“Logistic regression identifies the coefficients, standard errors and significance levels of a formula to predict a *logit transformation* of the probability of presence of the characteristic of interest, such as first-attempt NCLEX-RN success” (MedCalc, n.d.). Unlike ordinary regression, logistic regression chooses the parameters that maximize the likelihood of observing the dependent variables (Med Calc, n.d.).

The logistic regression model of demographic and academic variables predictive of first-attempt NCLEX-RN success is expressed by:

$$\text{logit}(p) = b_0 + b_1x_1 \text{ AgeGroup} + b_2x_2 \text{ CampusEnrolled} + b_3x_3 \text{ Anatomy\&PhysiologyGPA} + b_4x_4 \text{ NumberPNtermsattempted} + b_5x_5 \text{ PNcore theoryGPA} + b_6x_6 \text{ NumberADNtermsattempted}$$

where p is the probability of passing the NCLEX-RN on the first attempt. The logit transformation is defined as the logged odds:

$$\text{odds} = \frac{p \text{ (probability of passing the NCLEX-RN on the first attempt)}}{1-p \text{ (probability of not passing the NCLEX-RN on the first attempt)}}$$

and

$$\text{logit}(p) = \ln \left[\frac{p}{1-p} \right]$$

There were three blocks in the sequential logistic regression. Block 1 included the two demographic variables: age group and campus enrolled. These two variables did not contribute significantly to the variance in NCLEX-RN success individually or collectively.

The 0.38 Naglekerke R^2 value (with a maximum possible value of 1.0) indicates that

NCLEX-RN first-attempt success could be minimally predicted by these two variables. This block delineates correct prediction of passing NCLEX on the first-attempt for 86.9% of the students.

The practical nursing level variables; anatomy and physiology GPA, number of PN terms attempted, and core PN theory GPA were the variables added in block 2. Campus ($p < .05$) and the core PN theory GPA were significant in this block ($p < .001$). The block was not significant. The variables in this block were able to explain 21% of the variation in NCLEX-RN first-attempt success (0.216 Naglekerke R^2 value). This block delineates correct prediction of passing NCLEX on the first-attempt for 87.4% of the students.

The last academic variable, the number of ADN terms attempted, was added in block 3. This variable was not significant. The full regression model is depicted in Table 16.

The model summary indicates 22.5% of the variation in NCLEX-RN first-attempt success was able to be explained (0.225 Naglekerke R^2 value; .121 Cox & Snell R Square). A -2 Log likelihood of 133.378 indicates this model does not fit the data. A perfect model has a 0 -2 Log likelihood (George a& Mallery, 2009, p. 329).

Table 16. Logistic regression for predictors of first-time NCLEX-RN success

Step 1(a)	B	S.E.	Wald	df	Sig.	Exp (B)	95.0% C.I. for EXP(B)	
							Lower	Upper
Campus	-1.273	.501	6.455	1	.011	.280	.105	.748
Age group	.272	.482	318	1	.573	1.312	.510	3.374
PN terms	.211	.636	.110	1	.740	1.235	.355	4.294
A & P GPA	-.612	.455	1.814	1	.178	.542	.222	1.321
PN Core GPA	2.740	.791	11.992	1	.001	15.490	3.285	73.047
ADN terms	-.500	.475	1.109	1	.292	.606	.239	1.539
Constant	-1.529	3.091	.245	1	.621	.217		

The model was able to correctly predict 87.4% of the students who would pass the NCLEX-RN on the first attempt. The classification table for the full model (Table 17) indicates the model correctly classified 11.1% of the students who failed the NCLEX-RN on the first attempt, and 98.9% of the students who passed the NCLEX-RN on the first attempt. The overall rate of classification with the full model was 87.4%.

Table 17. Logistic regression classification table

	Observed		Predicted Nclexfinal		Percent correct (%)
			Failed	Passed	
Step 1	Nclexfinal	Failed	3	24	11.1
		Passed	2	177	98.9
		Overall Percent			87.4

Cut value=.500.

Twenty-six cases were not correctly predicted; 24 students who were expected to fail, passed the exam, and two students who were expected to pass the exam, failed. Table 18 illustrates the inter-correlations of the predictor variables used in the final logistic regression.

Table 18. Final logistic regression for correlations between predictor variables

	Constant	Campus	Age group	# PN terms	A & P GPA	PN core CPA	# RN terms
Constant	1.000						
Campus	-.071	1.000					
Age group	.214	-.205	1.000				
# PN terms	-.541	-.017	-.023	1.000			
A & P GPA	-.203	.024	-.056	.184	1.000		
PN core GPA	-.541	-.176	-.182	.065	-.501	1.000	
# RN terms	-.654	.180	-.221	-.031	-.028	.271	1.000

N=206

Correlations ranged from $r = -.028$ (# RN terms with A & P GPA), to $r = -.654$ (# RN terms with the constant). The cross-tabulation of the independent variables and NCLEX-RN success is depicted in Table 19.

Campus and the practical nursing core GPAs were found to be significant predictors of NCLEX-RN success. The odds ratio of .28 shows that an outcome of 1 is 0.28 times as likely (or 72% less likely: $1 - 0.28 = 0.72$) with a one unit increase in the predictor: the odds are decreased by 72%. Student age group, number of PN terms, A & P GPA, and number of RN terms were not found to be statistically significant individual predictors of NCLEX-RN success.

Table 19. Classification summary of independent variables and NCLEX-RN success

Predictor variables	Significance Sample ($n=206$) Intercept	Odds Ratio
Campus	.011	.280
Age group	.573	1.312
# PN terms	.740	1.235
A & P GPA	.178	.542
PN core GPA	.001	15.490
# RN terms	.292	.217

Summary

Descriptive analyses were used to describe demographic and academic characteristics of 398 students who entered the practical or associate degree nursing program at MWCC between 2005 and 2007. Female, non-traditional nursing students who relied on financial aid to attend college, and declared dependents, comprised the majority of the population.

The majority of students obtained waivers for program reading entrance scores. As a result, these scores were not included in the multivariate analysis. Independent significance means *t*-tests determined there was no significant difference in Anatomy and Physiology GPA's, the number of terms attempted for PN and ADN program completion, program completion rates, and core program level GPA's between the urban and rural campus. The independent significance means *t*-test of the associate degree nursing course grades determined the Comprehensive Pediatrics and Mental Health grades were statistically different between the urban and rural campuses.

Prior to conducting the logistic regression, the Pearson product-moment correlation was used to determine the correlations among potential academic predictor variables. Correlations greater than .70 weaken the analysis as they inflate the size of error terms. Statistical problems occur with correlations greater than .90 (Tabachnick & Fidell, 2007, pp. 90-91). Significantly high correlations between associate degree nursing course grades, and PN and ADN core GPAs (Table 14) resulted in the decision to include only the PN core GPA in the logistic regression.

The campus and the PN core GPA were found to be significant predictors of NCLEX-RN success, with the PN core GPA the strongest predictor. Student age group, number of PN terms attempted, A & P GPA and number of RN terms attempted were not found to be significant predictors in the logistic regression. The highest correlation, Anatomy and Physiology GPA with the PN Core GPA ($r = -.541$), along with a -2 Log likelihood of 133.378 indicates the need to expand this model exploring additional variables in the future with a larger sample.

CHAPTER 5. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to determine the predictive relationship between demographic and academic variables and NCLEX-RN first-attempt success, and explore the demographic and academic differences between urban and rural nursing students. This chapter summarizes the study and highlights the conclusions regarding the findings detailed in Chapter 4. A brief discussion follows each conclusion. The delimitations and limitations of the study are then presented. The changes made in the nursing policies and procedures at MWCC are then discussed, along with the recommendations for practice, policy, and research.

Summary

In this retrospective study, 398 records of students who were admitted to the MWCC practical or associate degree nursing program between 2005 and 2008 were reviewed. Data were collected on demographic and academic variables. The demographic variables included: student age, gender, campus enrolled, utilization of financial aid, dependents, program option enrolled in, and program entrance reading scores. Academic variables included: A & P GPA, number of PN terms attempted, PN core GPA, PN program outcomes; number of ADN terms attempted, ADN core GPA, ADN program outcomes, PN and ADN program completion rates, and ADN course grades. All were used as independent variables in the analysis. NCLEX-RN first-attempt success was the dependent variable in the study.

The population was recoded into urban and rural, and practical and associate degree nursing categories for campus and program level comparisons. Frequency counts, percentages and cross tabulation, were used to determine the demographics of the groups.

Means, standard deviations and the independent means *t*-test of significance were used to determine if there were significant differences between urban and rural nursing students. The Pearson product-moment correlation determined the degree of relationship between the academic variables prior to the initiation of the discriminant analysis. Six variables were selected for inclusion. Age, campus enrolled, A & P GPA, number of PN terms attempted, PN core GPA, and the number of ADN terms attempted were used as independent variables in a logistic regression analysis, with the dichotomous outcome of NCLEX-RN first-attempt success as the dependent variable.

Delimitations

The following delimitations were imposed to increase the rigor and validity of the study:

1. The time frame selected for this study was the period in which there were limited curricular and program policy changes.
2. A peer reviewer was used for analysis of the data. This practice enhanced the objectivity of the researcher, who is the administrator over the program under study.
3. PN and ADN core theory grade point averages were used rather than individual nursing course grades to minimize the wide variation in mean course averages between the urban and rural campus.
4. In cases where data were missing, the subject was not included in the analysis.

Limitations

The limitations of this study included:

1. Limited admission data was available to determine the relationship between ACT, ASSET, Accuplacer and Compass entrance tests scores and NCLEX-RN success.
2. The size of the sample population that graduated and attempted the NCLEX-RN exam was not large enough to provide reliable results on the logistic regression.
3. Data were extracted from 2005 to 2008 for one associate degree program; therefore, the findings of this study may not be representative of the nursing students presently enrolled in the MWCC nursing program, or generalizable to other nursing programs.

Conclusions

The following conclusions were made based on the results and findings of the study:

1. The MWCC nursing students in the sample group were homogenous in nature with regards to gender, age, and the use of financial aid to attend college. The rural nursing students had a greater percentage of declared dependents.

The percentage of non-traditional (60.6%) and male (8.7%) students in the sample group is reflective of the changing demographics in education (U.S. DOE, NCES, 2002). A majority of students (83.7%) use financial aid to attend the nursing program. This finding is consistent with the American Association of State Colleges and Universities (AASCU) policy brief, "Top 10 State Policy Issues for Higher Education in 2009". A greater percentage of rural students used financial aid (50.8%), which may be related to a greater frequency of dependents in this subgroup. In addition, there were seven more practical nursing graduates on the urban campus, which may be reflective of greater employment opportunities in the

urban area during this time frame, or student mobility. Enrollment numbers in the nursing program options was consistent with program limits.

2. The majority of students in the study received reading entrance score waivers. The equivalency of a waiver to a standardized entrance score is undetermined. Therefore, it is questionable if students who have received reading waivers are prepared to enter the nursing program.

An analysis of program reading admission scores identified 54.5% of the students received waivers on meeting standardized reading benchmark scores. Waivers were granted based on successful completion of identified coursework with a C- or higher grade. Waivers did not have an expiration time. The equivalency of a waiver to a standardized entrance score is undetermined. There was no literary evidence to support course substitution as equivalent to standardized test scores (ACT, ASSETT, COMPASS, Accuplacer). Therefore, it is questionable if students who have received reading waivers are prepared to enter the nursing program.

The predictive ability of standardized entrance scores, such as ACT scores, and NCLEX-RN success is supported in the literature (Campbell & Dickson, 1994; Carpenter & Bailey, 1999; Fowles, 1992; & Lengacher & Keller, 1990). Pre-admission criteria (Jenks et al., 1989; McClelland et al., 1992, McKinney et al., 1988; Payne & Duffey, 1986; & Yang et al., 1987) and pre-nursing GPAs (Jenks et al., 1989; Yang et al., 1987) have all been correlated to NCLEX-RN success. There is a need to establish reliable admission criteria for the MWCC nursing program.

3. Rural students had a slightly higher Anatomy and Physiology GPA than urban students. This difference was not statistically significant, and the Anatomy and Physiology grade point average is not predictive of NCLEX-RN first-attempt success.

The science grading scale differs between the urban and rural campus: A C- is 70% on the rural campus, whereas it is 78% on the urban campus. This may account for rural students having a higher mean average, or may be related to differences in student ability across the district. The predictive relationship between Anatomy and Physiology grades and NCLEX-RN success that has been identified in the literature (Campbell & Dickson, 1994; Fowles, 1992; Glick et al., 1986; Huepel, 1994; Wong & Wong, 1998) was not supported in this study. The Anatomy and Physiology I course, the only science pre-requisite to the MWCC nursing program, is considered a “gate keeper” in the program. There is no evidence to suggest the lower grading scale on the rural campus resulted in a greater number of NCLEX-RN failures.

4. There is a need to assess the reasons for student attrition and implement strategies to improve nursing program attrition rates.

Sixty (15.6%) of the 384 students did not complete the Practical Nursing program, with 34 of the 384 students (8.9%) exiting the program after the first term. With minimal program entrance criteria in place, it is likely some students are not prepared for the demands of the program. A higher percentage of practical nursing students changed majors and graduated from MWCC on the rural campus. This may be related to the short wait list on the rural campus which results in limited exposure to foundation coursework prior to determining nursing is their career of choice. Rural students who change majors and graduate from MWCC remain engaged with the institution. There was a greater attrition rate in the

first semester of the associate degree level of the nursing program; 14.8% as compared to 8.9% in the practical nursing level. A student, who left the program “in good academic standing” may have withdrawn from coursework when failing.

5. Practical nursing core GPA was found to be a significant predictor of NCLEX-RN success.

The predictive relationship between program and course GPAs and NCLEX-RN success have been well documented (Beeson & Kissling, 2001; Glick et al., 1986; Haas et al., 2003; Horns et al., 1991; Jenks et al., 1989; Krupa et al., 1988; McKinney et al., 1988; Payne & Duffey, 1986; Quick et al. 1988; Waterhouse et al., 1993; Whitley & Chadwick, 1986; Yang et al., 1987; Yin & Burger, 2003; Younger & Grap, 1992).

6. The number of terms attempted in the nursing program is not significant related to NCLEX-RN success. However, the percentage of students attempting more than the standard number of terms is higher than anticipated.

Seventy-one (18.5%) practical nursing students and 49 (17.7%) associate degree nursing students attempted more than the required number of terms to complete the program. Although the number of terms was not related to NLCEX-RN success, this percentage is high. A review of factors associated with students repeating nursing coursework, and the fact that the nursing courses with high attrition have re-entry wait lists, led the program to change fall 2010 program guidelines. Students are allowed 200% of the time required for program completion, and are able to re-enter the program twice with the approval of the Dean of Nursing.

7. The campus in which the student is enrolled was found to be a significant predictor of NCLEX-RN success. Therefore, there is a need to explore the student and program variables that may influence student success and initiate appropriate interventions.

The rural students in the sample population were 72% less likely of passing the NCLEX-RN on the first attempt than urban students. Students were 15 times as likely to pass the NCLEX-RN, for an increase of 1.0 on their core practical nursing GPA.

The MWCC nursing program is a district-wide program offered on two campuses; one urban, the other rural. Students are required to commute to school as no housing is offered on either campus. Nursing students are generally on campus two days a week, and attend clinical off-campus two days per week. On the urban campus, the majority of clinical sites are within a twenty-mile radius of the college. Students on the rural campus are required to attend clinical in sites that are 20 to 220 miles from the college. Regardless of where a student lives, travel will be greater for a student who is enrolled at the rural campus. At MWCC, students attending the rural campus experience more class cancellations as a result of hazardous weather, drive longer distances to clinical sites, and have different experiences in the clinical arena. The relationship between these factors and NCLEX-RN success may be the topic of future research.

There are many potential explanations for the campus as being significant to NCLEX-RN success. Within the time frame of this study, there was a higher nursing faculty turnover on the rural campus, resulting in the hiring of faculty who were new to nursing education. Since 2008, the nursing curriculum has been aligned district-wide, shared test banks created, and cross-training has been conducted with seasoned instructors. Faculty assignments have been recently modified to capitalize on individual strengths.

Recommendations

The following recommendations for practice, policy, and future research are made based on the findings and conclusions of the study:

Practice

Many decisions were made by the MWCC nursing faculty and administrator as a result of this study. The following changes have been implemented for the Fall 2010 term.

1. The admission reading score requirement was discontinued;
2. A standardized nursing entrance test, the HESI A² pre-admission reading test, is currently being reviewed with plans to implement an A² pilot study with the Spring 2011 practical nursing class;
3. Three nursing foundation courses: Nutrition, Anatomy and Physiology II, and Dosage Calculations, have been added to Anatomy and Physiology I as pre-requisite courses;
4. The program re-entry policy was revised. Students are now allowed to re-enter the program (based upon space availability) a maximum of two times. Students have 200% of the time to complete each level of the program (2 years to complete the 1 year core PN nursing level; 2 years to complete the core ADN nursing level).
5. Students requesting to re-enter the program are evaluated by the Program Chair and are required to remediate in identified areas or fulfill criteria outlined on an individualized student success plan;

The findings of this study were shared with the coordinators of the health programs the researcher supervises. As a result, the programs of Dental Assisting, Respiratory Therapy,

and Radiologic Technology, along with the Nursing Program have adopted the following practices:

6. Questionnaires are handed out the first week for the incoming students to broaden the instructor's understanding of student demographics, barriers, concerns etc.;
7. All programs are in the process of evaluating program admission criteria;
8. Data bases, utilizing the data categories in Appendix C and adding categories related to high school health consortium students, have been established for the programs to assist with program evaluation;
9. A fall meeting date is scheduled inviting student support services (Advising, Learning Center, TRIO, Admissions, and the Disability Coordinators) to a meeting to create a list of standardized interventions and resources available for student success;

Policy

The following recommendations for policy are recommended for local, state, and national levels:

Local

The 2006, Carl D. Perkins Career and Technical Education Improvement Act, known as Perkins IV, mandated an increase in the accountability of educational institutions related to the identification, measurement and reporting of student outcomes (U.S. Department of Education, Carl Perkins Career & Technical Education Act, 2006). In order for secondary and postsecondary educational institutions to receive funding, student outcomes must be scientifically based, measurable, and documented throughout a students' educational pathway from high school through graduation from a community college career or technical

program. Nursing, a career and technical program in the community college setting, is directly affected by the Perkins IV legislation. The increased standards of Perkins IV will strengthen the relationship between the administration and faculty in the high schools and community colleges as they work together to identify factors that related to a high school student's success as he/she enters into a community college nursing program. The following recommendations apply to all career and technical programs.

1. Identify the academic pathways between high school coursework and career and technical community college programs;
2. Increase the participation of program faculty and administrators on high school Advisory committees to establish outcomes that align with career and technical program admission requirements;
3. Evaluate the effectiveness of high school courses taught for concurrent enrollment, and the retention of these students within the community college setting; and
4. Explore advanced placement for students in the high school nursing consortium who are ready to enter into the nursing program upon high school graduation.

State

As a severe nursing shortage approaches, recent reductions in state and federal funding have heightened the need for all health care programs to not only be fiscally accountable, but creative in the use of resources and program planning. In the community college, the viability of career and technical programs are dependent upon the ability of the college to recruit, retain, and graduate students who are able to meet program and career entrance requirements. Increasing the knowledge regarding factors that are associated with

nursing program and licensure success provides a foundation for faculty and administrators as they modify program curriculum. This knowledge also assists faculty and administrators as they work to establish program admission, progression, withdrawal and completion policies consistent with an environment that supports student success. The following recommendations are made:

1. Increase funding for community colleges to enhance Institutional Research and Student Support Services.
2. Establish a statewide database utilizing consistent measures to increase the efficiency and quality of research of career and technical programs.
3. Strengthen the lines of communication between statewide educational entities; Department of Education, Health Occupations groups, community college administrators and faculty, accrediting institutions (State Board of Nursing) to identify consistent evidenced-based outcomes and strengthen assessment and evaluation strategies.

National

1. Increase federal funding for all institutions of higher education to enhance student assessment, evaluation and support services; and
2. Initiate legislative action to mandate institutions of higher education must make public information regarding career and technical program comparisons, costs, accrediting agencies, licensure scores etc.

Additional national recommendations to address the nursing shortage include:

3. Implement changes in Medicare policies in rural areas to enable rural hospitals to become more competitive in health care salaries;
4. Providing incentives for nurses to return to school to obtain advanced degrees;
5. Initiate loan forgiveness programs for full and part-time health care workers employed in economically disadvantaged areas;

Future research

The multivariate analyses used in the majority of research studies in the literature review, require relatively large number of subjects, entry of data into a database, computerized analysis, understanding of the statistical approaches, and are time consuming and not practical for educators. Many of the past studies have been retrospective in nature, with the researcher utilizing the data available to identify the combination of variables that account for the greatest variance in program outcomes. A proactive approach, requiring a specified comprehensive and testable theoretical framework versus a data mining approach is recommended.

1. Petition the National Council of State Boards of Nursing to release raw scores to nursing program to enhance statistical analysis of unsuccessful testers;
2. Collaborate research activities among comparable associate degree programs to increase consistency in design and methodology, and improve applicability of the findings;
3. Use more refined sampling methods;
4. Conduct research to identify reliable measures of professional nursing competencies (critical thinking, problem solving);

5. Initiate research to explore qualitative variables to identify at-risk students while in the program; and
6. Increase opportunities for novice nursing administrators to collaborate with more expert administrators to prevent the loss of knowledge when program leadership changes.

Nursing programs are challenged to produce a steady supply of nurses whose preparation and capabilities reflect an ever changing health care workforce that requires practitioners to be innovative, evidence critical thinking and a high level of technical skill. Nursing leaders and faculty must strive to make sound educational decisions, and continue to maintain high standards within a cultural framework that is demanding easier student access, flexibility, and less time commitment on the part of the student. There is an ethical obligation on the part of nursing administrators to ensure admission criteria and academic standards are reasonable and fair. In addition, admission criteria must be evidenced based, and an effective indicator for program success.

As Katherine Boswell stated:

In light of these challenges, community colleges' traditional reliance upon anecdote rather than data-supported evidence to report on performance may no longer be good enough. College leaders must begin to ask hard questions of themselves and their institutions: Do we regularly collect, analyze, and report on student learning and persistence? Does our college break down student performance and persistence data by age, socioeconomic status, race and ethnicity, and other variables to identify groups of students who may be falling behind? Has our college tried to identify and adopt successful practices identified by the League's Learning College Project, or other policy and practice initiatives that focus on student achievement? (Boswell & Wilson, 2004, p. 51)

APPENDIX A. THEORETICAL APPLICATION AND STATISTICAL ANALYSIS OF INDEPENDENT VARIABLES

Research Question	Variables	Astin's IEO Framework	Quantitative Analysis
1. What are the student demographics and program reading admission scores for the MWCC nursing students on the urban and rural campus?	Campus Enrolled Age Group Gender Financial Status Dependents Program Enrolled in PN Program Option ACT Reading Score Accuplacer Reading Score Asset Reading Score Compass Reading Score	Environment Input Input Input Input Environment Environment Input Input Input Input	Frequency Counts, Percentages, Cross Tabulation, Means and Standard Deviations
2. What are the anatomy and physiology grade point averages, the number of terms attempted for PN and ADN program completion, program outcomes and cumulative and core program grade point averages for the MWCC PN and ADN graduates on the urban and rural campus?	Anatomy and Physiology GPA Number of PN Terms Attempted PN Program Outcome Number of ADN Terms Attempted ADN Program Outcome PN Completion Rate ADN Completion Rate PN Core Nursing GPA ADN Core Nursing GPA PN Cumulative GPA ADN Cumulative GPA	Environment Environment Output Environment Output Output Output Environment Environment Output Output	Frequency Counts, Percentages, Cross Tabulation, Means and Standard Deviations
3. Is there a statistically significant difference in: a. the anatomy and physiology grade point averages, b. the number of terms attempted for PN and ADN program completion, completion rates, and core program grade point averages for the first year (practical level) and second year (associate degree) nursing students attending the urban versus the rural campus?	Campus Enrolled Anatomy and Physiology GPA Number of PN Terms Attempted Number of ADN Terms Attempted ADN level PN level PN Completion Rate ADN Completion Rate PN Core Nursing GPA ADN Core Nursing GPA	Environment Environment Environment Environment Output Output Output Output	Independent Means t-test of Significance
4. Is there a statistically significant difference in the second level nursing course grades on the urban and the rural campus?	Campus Enrolled Transitions to ADN Comprehensive Pediatrics Comprehensive Obstetrics Mental Health Comprehensive Nursing Care of Adults	Environment Environment Environment Environment Environment Environment	Means, Standard Deviations, Independent Means t-test of Significance
5. Is there a statistically significant relationship between associate degree nursing course grades, and core PN and ADN GPAs on the urban and rural campus?	Campus Enrolled Transitions to ADN Comprehensive Pediatrics Comprehensive Obstetrics Mental Health Comprehensive Nursing Care of Adults Core PN GPA Core ADN GPA	Environment Environment Environment Environment Environment Environment Output Output	Pearsons Product Moment Correlation, Independent Means t-test of Significance
6. To what extent do student demographics and academic performance data of PN and ADN levels predict the first time passing of the NCLEX-RN among the MWCC nursing students?	Campus Enrolled Age Group Number of PN Terms Attempted Anatomy and Physiology GPA PN Core Nursing GPA Number of ADN Terms Attempted NCLEX-RN First-Attempt Success	Environment Input Environment 1 Environment 1 Environment 1 Environment 2 Output	Pearsons Product Moment Correlation, Logistic Regression

APPENDIX B. SUMMARY OF PREDICTORS OF NCLEX-RN SUCCESS

Researcher(s) & date	Sample size & population	Statistically significant correlations & predictors of NCLEX-RN success
Glick, McClelland & Yang; 1986	51;BSN records, large Midwestern University	Pathology class contributed 10% of the variance in nursing GPA in a stepwise multiple regression ($F = 8.27$; $R^2 = 0.41$, $P < 0.001$), p. 102.
Payne & Duffey; 1986	283 BSN records, Chapel Hill School of Nursing, NC	Correlation of 4 nursing GPAs and NCLEX scores ($r = .575$ to $r = .694$, $p < .05$). Nursing GPAs were strong predictors of NCLEX-RN scores ($R^2 = .432$, $p < .0001$), and entrance GPA fairly good predictor ($R^2 = .219$, $p < .0001$) of NCLEX-RN scores (p. 330).
Whitley & Chadwick; 1986	1982 and 1983 BSN records; Northwest nursing program	Science and prerequisite entry GPA ($p \leq 0.05$) were the best predictors of NCLEX-RN success (p. 98).
Yang, Glick & McClelland; 1987	210 BSN records (1983 - 1985), large Midwestern University	ACT social science sub score was the highest predictor of NCLEX-RN achievement ($r = .48$), p. 304.
Krupa, Quick, & Whitley; 1988	138 transfer BSN records	Discriminate analysis determined all nursing course theory grades and cumulative program GPA are predictive of NCLEX-RN performance (Wilks' Lambda = 0.824, $\chi^2 = 67.64$, $P < .0001$). An introductory sophomore nursing course was the best predictor (structure coefficient = .7600), p. 296.
McKinney, Small, O'Dell & Coonrod; 1988	136 BSN records (1983 – 1985), liberal arts college in eastern U. S.	Significant correlation between pre-entrance test scores, cumulative college GPA, Mosby Assess Test scores, and the number of nursing courses repeated and NCLEX-RN ($p < 0.001$), p. 58.
Feldt & Donahue; 1989	189 BSN records; small, private college in the Midwest	ACT composite scores, high school percentile rank, nursing GPA, and first semester chemistry grades were the best combination of predictors for NCLEX-RN passage (p. 419).
Jenks, Seleman, Bross, & Paquet; 1989	407 BSN eastern university program	Strong correlations with junior and senior year nursing theory course grades and Mosby Assess Test scores and NCLEX performance ($p < .0001$), p. 116.
Dell & Valine, 1990	78 senior nursing student volunteers	College GPA accounted for 58% of the variance of NCLEX-RN scores $R = .76$, $F(1, 48) 66.44$, $p < .001$), p. 161.
Lengacher & Keller; 1990	146 ADN records, public community college	Best predictors of NCLEX-RN performance were cumulative program GPA ($R = .71$); ACT composite scores ($R = .75$; and Medical/Surgical course grade ($R = .77$) and Maternal/Child course grade ($R = .79$), p. 168.
Foti & DeYoung; 1991	298 BSN records (1985 – 1988), state program in the Northeast	Mosby Assess Test, SAT verbal score, cumulative GPA were the best predictors of NCLEX performance ($R^2 = 0.49$, $P = 0.001$), p. 103.
Horns, O'Sullivan & Goodman; 1991	394 BSN graduate records from a southern university	67% of the variance in NCLEX-RN scores accounted for by the admission GPA (p. 11).
Poorman & Martin; 1991	102 second-semester senior nursing students, 25 years or younger enrolled in 1 of 2 BSN programs in Western PA	Self-predicted nursing course grades were positively correlated with NCLEX success; test anxiety was negatively correlated with NCLEX success (p. 28).
Fowles; 1992	Mixed NCLEX-RN data set (1985-1989)	Correlations with NCLEX-RN scores: Mosby Assess Test scores ($r = 0.9035$); ACT social science scores ($r = 0.5547$); ACT composite scores ($r = 0.5259$), A & P II grades ($r = 0.3043$); first program level GPA ($r = 0.7388$). Multivariate analysis revealed first quarter program GPA, Assess Test percentile, A & P II grade and ACT social science or total score were the best predictors of program success (adjusted $r^2 = .74507$), pp. 55-56.
Younger & Grap; 1992	388 upper-division BSN	Four nursing course grades (Pediatrics, Health Needs of

	records (1984 - 1987)	Women, Medical-Surgical I and II) combined relationship to NCLEX ($R = .74$), and explained 55% of the variance in NCLEX-RN scores. SAT verbal ($R = .48$), and quantitative scores ($R = .46$), and NLN composite scores ($R = .58$). NLN raised the explained variance to 62%, (pp. 24-25).
Wall, Miller & Widerquist; 1993	92 BSN graduates (1988 – 1991) small, Midwest liberal arts college	High school rank, sophomore GPA, and science GPA were significant predictors of NCLEX-RN success (p. 641).
Waterhouse, Carroll & Beeman; 1993	313 BSN graduates (1988 – 1990) from the University of Delaware	The first senior level course grades and graduation GPA two best predictors of NCLEX-RN success (p. 280).
Campbell & Dickson; 1996	1981-1990; review of 47 studies	Parental age, financial status & educational level, pre-nursing, science, nursing theory course grades & cumulative program GPAs, GPAs in nursing theory & nursing clinical courses & a chemistry course; standardized admission tests; (ACT most often predictive); NLN pre-nursing exam (100% predictive) in one study that used it.
Alexander & Brophy; 1997	ADN & BSN graduate data (1988-1994)	Statistically different SAT test scores [$t(105) = 3.33, P = 0.0001$] and .NLN Comprehensive Achievement Test scores between the group who failed NCLEX and the group that passed the NCLEX [$t(128) = 8.08, P < 0.0001$]. The mean program GPA was 3.33 in the group that passed the NCLEX-RN, versus a mean GPA of 2.70 in the group that failed the NCLEX-RN (p. 444).
Arathuzik & Aber; 1998	79 senior nursing students enrolled in an urban, public institution	Point Biserial Correlation Coefficients – NCLEX-RN Results and Sense of competency in taking tests that require critical evaluation and thinking (.245, and family demands (-.293) were significant (p. 123).
Briscoe & Anema; 1998	38 ADN records from a public university (1997)	Significant correlation between NLN exams I and II and passing the NCLEX-RN ($r = 0.476$ and $r = 0.371$ respectively; $p = 0.01$); Older students more likely to pass the NCLEX-RN ($r = 0.373, p = 0.05$) p. 82
Lauchner, Newman & Britt; 1998	2,809 mixed group (ADN, BSN and diploma)	E ² Exit Exam Scores were found to be 99.49% predictive of NCLEX success in monitored settings, and 96.82% predictive in unmonitored settings ($P < .001$). No significant difference was found in the predictive accuracy among ADN, BSN, diploma and PN programs ($X^2/3 = 2.49; P = .01$) p. 7S.
Wong & Wong; 1998	258 graduates from a generic nursing program in Canada	Basic sciences (Physiology, Anatomy, Microbiology, and Chemistry) and GPA of year 3 and 4 contributed significantly to program success ($p < 0.001$). Cumulative program GPA and age ($p = 0.0001$) significant predictors of NCLEX-RN success (p. 350).
Carpenter & Bailey; 1999	1976-1999; review of literature	High school ranking, GPA, ACT scores, SAT scores and nursing program GPAs were found to be significant predictors of NCLEX-RN success in a variety of studies.
Beeman & Waterhouse; 2001	289 BSN records from the University of Delaware	Number of C+ or lower grades were negatively correlated with NCLEX-RN success ($r = -.394, P < .0001$), p. 162.
Beeson & Kissling; 2001	505 BSN records (1993 – 1998)	Logistic regression indicated the number of C's, D's, or F's in nursing courses ($p < .0038$) through junior year, the Mosby Assess Test scores ($p = .0002$) of the first semester of senior year, and age group (traditional/nontraditional) best combination of variables for predicting NCLEX-RN success. The odds of failing the NCLEX-RN increased 56% for each additional C, D, or F grade in nursing courses. Each 10 point increase on the Mosby Assess test decreased the odds of failing

		150%. Nontraditional students had 30% the odds of failing that traditional students had. The model correctly classified 85.8% of those that passed, and 66.7% of those who failed the NCLEX-RN (pp. 132-124).
Collins; 2001	159 ADN records (1992-2001) from a rural Michigan Community College	The GPA in three selected nursing theory courses strongly correlated with NCLEX-RN success ($p < .000$), p. 123.
Morrison, Free & Newman; 2002	7 nursing programs (3 ADN & 4 BSN)	NCLEX pass rates improved in the 7 programs by 9-41% and ranged from 88-97% within 2 years after implementation of a progression and remediation policies. Pass rates increased significantly in 6 out of 7 programs after implementation of a progression policy, 5 at the $P = .001$ level, and 1 at the $P = .05$ level. All 7 program pass rates were significantly higher on the t-test ($P = .002$) after implementation of a progression policy (p. 95).
Daley, Kirkpatrick, Frazier, Chung & Moser (2003)	244 BSN records (1999 or 2000) from a generic program	Students successful on the NCLEX-RN earned significantly higher raw Mosby Assess Test scores (93.8 ± 10.7 versus 77.5 ± 11.6 , $p < .001$), had a higher percentage of items corrected (62.5 ± 7.1 versus 51.5 ± 7.7 ; $p < .001$), and a higher percentile rank (55.2 ± 28.2 versus 19.7 ± 19.3 , $p < .001$). Students successful on the NCLEX-RN scored significantly higher on the HESI Exit Exam ($67.6 \pm .2$ versus $48.0 \pm .9$, $p = .002$), had a higher percentage of items corrected (62.5 ± 7.1 versus 51.5 ± 7.7 ; $p < .001$), and a higher percentile rank (55.2 ± 28.2 versus 19.7 ± 19.3 , $p < .001$), p. 394.
Haas, Nugent & Rule; 2003	351 records (1991-2000) nursing school in southeastern U.S.	SAT verbal score, SAT quantitative scores, nursing GPAs, and age were common predictors of NCLEX-RN success (p. 44).
Nibert, Young & Adamson; 2003	6,8000 data files mixed group (ADN, BSN, diploma& PN)	The predictive accuracy of the E ² Exit Exam in year 4 98.30% for RN students, 99.41% for PN students, and 98.46% for all students. X ² goodness of fit determined no significant difference in predictive accuracy in the 3 previous years of study, or in the types of nursing program (p. 31S).
Sayles; 2003	68 ADN students who passed the NCLEX-RN in 2001	T-test analysis of students who passed and those who failed the NCLEX-RN; NET academic and money/time stress levels, passive social interaction profile and visual learning style ($p \leq .002$); ACT verbal score, program GPA and NET scores - family stress level, math, oral dependent learning style, test taking and writing dependent learning style ($p \leq .03$), pp. 118-119.
Yin & Burger; 2003	325 ADN graduates (1997-2000) from a Midwestern state university	College GPA prior to nursing program admission between students who passed and those who failed NCLEX-RN ($t = -2.30$, $p < 0.024$); Bivariate correlations of GPA and NCLEX success ($r = 0.15$, $p < 0.01$). The overall likelihood ratio statistic for college GPA prior to admission and high school rank was significant. For each 0.1 increase of GPA, the odds of passing NCLEX increased 3x (p. 233).
Crow, Handley, Morrison & Shelton; 2004	160 generic BSN programs	Correlations with NCLEX pass rates: use of a standardized entrance exam ($\chi^2 [1, n = 12] = 11.11$; $P = .00$); SAT exam scores ($r = -0.4$, $P = .03$, $n = 34$); NLN Mental Health scores ($r = .55$, $P = .02$, $n = 18$); NLN Community Health scores ($r = .76$, $P = .02$, $n = 9$), p. 183.
Seldomridge & DiBartolo; 2004	186 BSN (1998-2002) records from a rural, mid-Atlantic public	NLNCATBS (Comprehensive Achievement Test for Baccalaureate Students) scores ($r = .452$, $P = .000$)

	nursing program	correlation with NCLEX-RN success (p. 363).
Uyehara, Magnussen, Itano & Zhang; 2007	280 BSN students (2000-2005) from the University of Hawaii	Significant correlations between NCLEX-RN success and Mosby Assess Test scores ($N = 216, r = .24, p = .0003$); the Fundamentals Nursing Course grade ($N = 217, r = .195, p = .0038$); and the nursing GPA ($N = 217, r = .186, p = .0059$), p. 34.
Yoho, Young, Adamson & Britt; 2007	139 ADN students	Mid-curricular HESI exam scores was positively correlated with the E ² Exit exam scores ($r = .617; p = .01$), and the first version of the E ² was 94.83% accurate in predicting NCLEX-RN success (p. 83).
Gilmore; 2008	218 ADN graduates of one of two community college nursing program in the Southeastern U.S.	LR model including pre-nursing GPA, ACT composite and subscores, and A & P I and II GPA was statistically significant $F(8, 216) = 6.59, p < .001, R^2 = .196$. ACT English subscore was a statistically significant predictor of program success ($t = 2.307, p = .022$) and accounted for 20% variance (p. 123).
Muecke; 2008	303 ADN records (1998- 2005)	Significant correlations between previous college GPA ($r = .644$); ACT composite scores ($r = .232$); nursing theory I grade ($r = .341$); nursing theory II grade ($r = .327$); Anatomy grade ($r = .258$); Physiology grade ($r = .284$); and Microbiology grade ($r = .236$) all at a $P < .001$ level (p. 74).
Shirrell; 2008	173 ADN records (2001-2006) from a Midwestern program	The multiple regression model containing critical thinking scores on (CAAP), nursing GPA, and science course GPA predicted success on the NCLEX-RN ($F = 7.987, p < .0001$), accounting for 12% of the variance ($R = .352, R^2 = .124$). Nursing GPA was the only significant contributor to the model ($t = 3.939, p > .0001$) p. 134.
Ukpabi; 2008	39 graduates from North Carolina University who took the 2006 version of the NCLEX-RN	Model using ATI scores (Critical Thinking, TEAS Comp, Reading, Math, English, Psych-Mental Health, Pharmacology, and Nursing Fundamentals), and NLN Adult I, II, and Pediatric test scores indicated 96% of the shared variance between students who passed and those who failed the NCLEX-RN was accounted for in the discriminate analysis (Eigenvalue 36.784; Wilks' Lambda 0.26), pp. 37-38.
Adamson & Britt; 2009	10,147 records (ADN, BSN & diploma)	No significant difference in predictive accuracy between the first (96.44%) and the second (92.94%) versions of the E ² Exit Exam, but the third (82.50%) was significantly less accurate in predicting NCLEX-RN success than were the first two E ² versions (p. 395).

APPENDIX C. DATA KEY

Midwest Community College Nursing Data Set (2005-2007)

Column	Variable name/Code	Explanation
1.	id	Arabic number in order of file entry
2.	program	Program enrolled in 1 = Practical Nursing 2 = Associate Degree Nursing 3 = Returned to complete ADN; PN level at MWCC 4 = Transferred in to complete ADN; PN level not at MWCC
3.	campus	Campus enrolled in 0 = Urban 1 = Rural
4.	progopt	Practical Nursing option enrolled in 1 = Day program 2 = Eve/wknd program 3 = Returned to complete RN, PN at MWCC 4 = Returned to complete RN, PN not at MWCC
5.	gender	Gender 0 = Female 1 = Male
6.	age	Age at start of first Practical Nursing theory/ Clinical course (70A16 or PNN:174)
7.	financial	Financial Independence 0 = No financial aid 1 = Has financial aid
8.	Dependents	Has Dependents 0 = No dependents 1 = Has dependents 2 = Unknown
9.	actread	ACT Reading Score
10.	compread	Compass Reading Score
11.	assetread	Assett Reading Score
12.	accread	Accuplacer Reading Score
13.	waiveread	Waiver of Reading Score 0 = Scores submitted 1 = Waiver 2 = Unknown
14.	readmet	0 = Reading score not met 1 = Reading score met 2 = Waiver

15. pnterm Term of first core Practical Nursing Course
 0 = Prior to Spring, 2005
 1 = Spring, 2005
 2 = Fall, 2005
 3 = Spring, 2006
 4 = Fall, 2006
 5 = Spring, 2007
 6 = Fall, 2007
 7 = Spring, 2008
16. nmbrpntms Number of terms to complete core PN theory
17. pnoutcome Outcome PN program
 0 = Completed PN level at another school
 1 = Completed, graduated and left MWCW
 2 = Completed, progressed to ADN level at MWCC
 3 = Did not complete; left MWCC after a course failure
 4 = Did not complete; left MWCC with satisfactory grades
 5 = Changed and graduated from another program at MWCC
 6 = Died while in program
 7 = Unable to complete program due to grades or background check
 8 = Graduated in past PN class from MWCC
18. appga Grade point average of A & P I and II with Lab Courses
19. pncoregpa Grade point average of core PN theory Courses
20. pngpa Grade point average of end of PN program
21. pnclex PN NCLEX Outcome
 0 = Did not pass on first attempt
 1 = Passed on first attempt
 2 = Transfer student, passed PN NCLEX, unknown attempts
 3 = Not eligible to test
 4 = Unknown if tested
22. adnterm Term of first core ADN Course
 0 = prior to Spring, 2006
 1 = Spring, 2006
 2 = Summer, 2006
 3 = Spring, 2007
 4 = Summer, 2007
 5 = Spring, 2008
 6 = Summer, 2008
 7 = Spring, 2009
 8 = Summer, 2009
 9 = Spring, 2010
23. transrn Grade in Transitions to Associate Degree Nursing (ADN:147 or ADN 148)
 A = 4.0 C = 2.0

	A- = 3.67 B+ = 3.33 B = 3.0 B- = 2.67 C+ = 2.33	C- = 1.67 D+ = 1.33 D = 1.0 D - = 0.67 Transfer Credit = 0 OC = Other Curriculum
24.	pediatrics	Grade in Comprehensive Pediatrics (ADN: 444)
	A = 4.0 A- = 3.67 B+ = 3.33 B = 3.0 B- = 2.67 C+ = 2.33	C = 2.0 C- = 1.67 D+ = 1.33 D = 1.0 D - = 0.67 Transfer Credit = 0
25.	obstetrics	Grade in Comprehensive Obstetrics (ADN:434)
	A = 4.0 A- = 3.67 B+ = 3.33 B = 3.0 B- = 2.67 C+ = 2.33	C = 2.0 C- = 1.67 D+ = 1.33 D = 1.0 D - = 0.67 Transfer Credit = 0
26.	mntlhlth	Grade in Mental Health (ADN:475)
	A = 4.0 A- = 3.67 B+ = 3.33 B = 3.0 B- = 2.67 C+ = 2.33	C = 2.0 C- = 1.67 D+ = 1.33 D = 1.0 D - = 0.67 Transfer Credit = 0
27.	compadlt	Grade in Comprehensive Medical-Surgical Nursing (70:019 or ADN:526)
	A = 4.0 C- = 3.67 B+ = 3.33 B = 3.0 D- = 2.67 C+ = 2.33	C = 2.0 C- = 1.67 D+ = 1.33 D = 1.0 D - = 0.67 Transfer Credit = 0 OC = Other Curriculum
28.	nmbrnrterms	Number of terms to complete core Associate Degree theory
29.	adnoutcome	Outcome ADN program
	1 = Completed, graduated and left MWCW 2 = Still enrolled and progressing in the program at MWCC 3 = Did not complete; left MWCC after a course failure 4 = Did not complete; left MWCC with satisfactory grades 5 = Failed out of MWCC program	
30.	adngpa	Grade point average at end of Associate Degree Program

31.	adncoregpa	Grade point average of core ADN theory Courses
32.	rnclex	RN NCLEX Outcome 0 = Did not pass on first attempt 4 = unknown if tested 1 = Passed on first attempt 2 = Eligible, has not tested 3 = Not eligible to test 4 = Unknown if tested
33.	nclex1	Passed NCLEX 0 = Failed first attempt 1 = Passed first attempt
34.	trad	Traditional/Non-traditional 0 = Traditional (18-24 years of age) 1 = Non-traditional (25 and older)
35.	assettpass	Assett Reading Benchmark 0 = Below Benchmark 1 = Met Benchmark 2 = Did not take test
36.	compass	Compass Reading Benchmark 0 = Below Benchmark 1 = Met Benchmark 2 = Did not take test
37.	accpass	Accuplacer Reading Benchmark 0 = Below Benchmark 1 = Met Benchmark 2 = Did not take test
38.	actpass	ACT Reading Benchmark 0 = Below Benchmark 1 = Met Benchmark 2 = Did not take test
39.	programnew	When program was started 0 = PN program started at MWCC 1 = ADN slot-in
40.	NCLEXfinal	NCLEX Final Results 0 = failed 1 = passed
41.	PNcompleters	PN Completion 0 = completers 1 = noncompleters
42.	PNterms	PN Terms 0 = more than 2 terms 1 = 2 terms

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