NON-SCIENCE CO/PREREQUISITE COURSE GRADES AS PREDICTORS OF ASSOCIATE DEGREE NURSING PROGRAM COMPLETION AND FIRST-ATTEMPT NCLEX-RN PERFORMANCE

by

Joey Trader

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A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

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APPROVED BY:

Lynne Sanders, Ed. D., MSN, RN, Committee Chair

Kimberly Little, Ph.D., MSN, RN, Committee Member

Shelia Kyle, Ed.D., MSN, RN, Committee Member

Scott Watson, Ph.D., Associate Dean, Advanced Programs

ABSTRACT

This study examined the potential relationship between non-science co/prerequisite courses (English Composition I, English Composition II, General Psychology, Child Psychology, and Nutrition and Diet Therapy) upon successful program completion and first-attempt NCLEX-RN results while controlling for age and gender in a traditional associate degree nursing program in the South Atlantic region of the United States. The rationale for the study was described with General Systems Theory while Schema Theory was tested and framed the study. The researcher employed binary logistic regression. There were 216 cases in the program completion dataset while there were 177 in the NCLEX-RN result data set. The analysis revealed no significant predictors of NCLEX-RN results while the Nutrition and Diet Therapy course represented the only statistically significant predictor of program completion.

Keywords: associate degree nursing program, attrition, non-science courses, General Systems Theory, Schema Theory, and logistic regression

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List of Abbreviations

Accreditation Commission for Education in Nursing (ACEN)

American College Test (ACT)

American Nurses Association (ANA)

Assessment Technologies Institute (ATI)

Test of Essential Academic Skills (ATI TEAS)

Bachelor of Science in Nursing (BSN)

Computerized Adaptive Testing (CAT)

Commission on Collegiate Nursing Education (CCNE)

General Equivalency Degree (GED)

Grade Point Average (GPA)

National Council Licensure Exam for Registered Nurses (NCLEX-RN)

National Council of State Boards of Nursing (NCSBN)

National League for Nursing (NLN)

National League for Nursing Accrediting Commission (NLNAC)

CHAPTER ONE: INTRODUCTION

Background

The impending crisis of an increasing nursing shortage poses a threat to the nation's health care system. The United States' population is aging and now requires greater levels of health care (Davidson, 2013). In addition, the Affordable Care Act will add millions of patients to those who will have health care coverage and will seek health care (United States Department of Health and Human Services [USDHHS] Families website, 2013). Between the years 2010 and 2020, 712,000 additional nursing jobs will be created and there will be an estimated 495,000 nurse retirements requiring replacement (Schaeffer, 2013). These factors result in the present nursing shortage (Schaeffer, 2013). The population of nurses is aging as well. The average age of the registered nurse in the United States is 46 years (American Association of Colleges of Nursing-Nursing Shortage website, 2014). This aging population of nurses may further perpetuate the nursing shortage in the years to come at a time when society's demand for nurses is increasing (Collins-McNeil, Sharpe, & Benbow, 2012).

Schools of nursing serve as the gatekeeper of the nursing practice and hold the solution to the shortage (Hassmiller, 2010). In 2012, 79,659 qualified nursing student applicants were denied admission into baccalaureate and graduate nursing programs with two-thirds of these being directly attributed to a nursing faculty shortage (AACN-Nursing Shortage website, April 2014). Greater availability of nursing faculty would allow greater numbers of admission into nursing programs. Attrition of nursing students also presents "grave obstacles" toward alleviating the nursing shortage (Jeffreys, 2007b). Identification of who is likely to succeed while considering admission of students is a problem

experienced by those determining admission criteria thereby illuminating the need to identify student risk factors to address the nursing shortage (Harris, Rosenberg, & O'Rourke, 2014). Responsive nursing education programs, along with other policy and private-sector efforts may result in a better response to the country's health care needs (Auerbach, Staiger, Muench, & Buerhaus, 2013).

Schools of nursing can admit greater numbers of students in attempts to increase numbers of nursing graduates. However, they must not function as diploma mills providing a poor education for graduates (McEwen, White, Pullis, & Krawtz, 2012; Philipsen, 2010). Doing so provides a disservice to the student and the communities served by these graduates. Therefore, the challenge of producing greater numbers of nurses must be met while complying with state boards of nursing and accrediting body oversight and regulations (Trofino, 2013). Providing the workforce with a finished product proves to be the difficult part of the process. Simply admitting more students and hoping to generate greater numbers of students may not be the solution and may add to the nursing shortage if nursing programs are sanctioned by accrediting bodies (McGahee, Grambling, & Reid, 2010). Increasing admissions must be done while maintaining low attrition rates and high first-attempt NCLEX-RN pass rates (Reinhardt, Keller, Summers & Schultz, 2012).

Between April 2012 and March 2013, 1006 of 1140 (88.2%) associate degree nursing programs exhibited first-attempt NCLEX-RN pass rates of 80% or better (National Council of State Boards of Nursing [NCSBN], 2013a). Between April 2013 and September 2013, however, only 671 of 1099 (61.1%) associate degree programs exhibited first-attempt NCLEX-RN pass rates of 80% or better (NCSBN, NCLEX Examinations website, 2013). While 88.2% of schools exhibiting pass rates of 80% or better may seem high and

unproblematic, the actual number of nursing graduates who failed the NCLEX-RN on the first attempt provides a different perspective. The number of associate degree nursing graduates taking the NCLEX-RN from April 2012 – September 2013 was 142,245 (NCSBN Table of Pass Rates 2012 website, 2013; NCSBN Table of Pass Rates 2013 website, 2013). Of this number, 20,392 (14.34%) students failed on the first attempt of the NCLEX-RN (NCSBN Table of Pass Rates 2012 website, 2013; NCSBN Table of Pass Rates 2013 website, 2013). For the same time period, the institution being studied had 121 of 136 (90.0%) students pass the NCLEX-RN on the first attempt (NCSBN, 2013a; NCSBN, 2013b). However, between April 2013 and September 2013, the institution being studied demonstrated a decline in first attempt NCLEX-RN pass rates with 33 of 44 (75.0%) students passing on the first attempt indicating a sizable decrease in this assessment and thereby justifying investigation into potential causes.

Retention rates in post-secondary programs have been noted to be as low as 50%, and nursing programs have similar percentages (McLaughlin, 2008). It is possible that associate degree programs may exhibit even lower rates of retention due to the significant number of non-traditional students in those programs (Porter, 2008). This demonstrates importance in the study of nursing student retention in that associate degree nursing graduates represent the greatest number of those taking the NCLEX-RN. In 2012, there were 84,517 associate degree nursing graduates taking the NCLEX-RN compared to 65,749 nursing graduates from diploma, baccalaureate, and invalid or special program types (NCSBN Table of Pass Rates 2012 website, 2013). This remained consistent for 2013 wherein 86,722 associate degree nursing graduates attempted the NCLEX-RN compared to

68, 326 nursing graduates from the other program types (NCSBN Table of Pass Rates 2013 website, 2013).

As previously noted, nursing schools receive accreditation and approval with program attrition rates and NCLEX-RN passage rates serving as major factors in the determination of approval (Billings & Halstead, 2012; Giddens, 2009; Hadenfeldt, 2012; Homard, 2013; Reinhardt et al., 2012; Rogers, 2009; Simon, McGinniss, & Krauss, 2013). Some predictors have been suggested such as race and gender (Landry, Davis, Alameida, Prive & Renwanz-Boyle, 2010), nursing course GPA (Alameida et al., 2011), and pre-nursing GPA (De Lima, London, & Manieri, 2011) among others. These are non-generalizable to all programs (Harding, 2010; Simon et al., 2013) for reasons of regional demographics, specific program requirements, and program types to name a few. Since students must graduate from a state board approved nursing program to take the NCLEX-RN (NCSBN Approval vs. Accreditation website, 2013), prospective applicants consider program NCLEX-RN first attempt pass rates and program completion rates when choosing nursing programs to which they will apply (McDowell, 2008). Therefore, it proves most difficult for nursing programs to find the appropriate formula that meets the demands for healthcare by alleviating the nursing shortage, admitting students who are most likely to complete the program, and identifying students at risk for failing the NCLEX-RN on the first attempt.

This chapter provides a synopsis of the overarching problem that is the nursing shortage in this time of increasing healthcare needs. As well, it will discuss the problems that may exacerbate or attenuate this problem. The problem of the nursing shortage is framed within Bertalanffy's General Systems Theory (1950, 1968) which is also briefly

described within this section. The aspects of student attrition and first-attempt NCLEX-RN failure represent problems that ultimately impact the nursing shortage. Additionally, the problem of maintaining approval and accreditation and how this affects students' selections of nursing programs is discussed. Moreover, how all of these factors are affected by intersystem and intrasystem effects is demonstrated in order to describe the rationale of this study. However, Schema Theory, which will be discussed later, will be tested in this study. The research questions, hypotheses, variables, general definitions, summary of the research plan, and the assumptions of the study will be presented.

Schools of nursing seek accreditation from regulating bodies such as the Commission on Collegiate Nursing Education (CCNE) or the Accreditation Commission for Education in Nursing (ACEN) (ACEN website, 2013). They must also maintain approval from their individual state boards of nursing. These regulating bodies evaluate program attrition rates and first-attempt NCLEX-RN pass rates among other criteria and standards to determine if the schools of nursing are within compliance thereby indicating program quality (Billings & Halstead, 2012). When a program is deemed compliant and granted accreditation and approval, it may identify itself as being accredited (ACEN website, 2013). Accreditation of a program is required for students to be eligible for financial aid (Federal Student Aid website, n.d.). Additionally, students who graduate from unaccredited programs may be denied admission to accredited graduate schools (Davila, 2013). Given these possibilities, lack of accreditation may limit the number of quality applicants that enter into a particular program (McDowell, 2008).

Two of the most prominent concerns of accrediting bodies are attrition and NCLEX-RN first attempt passage rates (ACEN website, 2013). Schools of nursing must

demonstrate low attrition rates while exhibiting high first attempt NCLEX-RN passage rates to attain and retain accreditation (Reinhardt et al., 2012). An increase in attrition may result in higher first-attempt NCLEX-RN passage rates while greater retention may decrease first-attempt NCLEX-RN pass rates. (Rogers, 2009).

Given the importance of maintaining accreditation and approval, the implementation and maintenance of sound admitting criteria becomes vitally important to schools of nursing. In the past, researchers have investigated numerous predictors for the desired outcomes (Reinhardt et al., 2012). Preadmission tests have provided some evidence of early and overall program success and NCLEX-RN passage (Knauss & Wilson, 2013; Lancia, Petrucci, Giorgi, Dante, & Cifone, 2013; Wolkowitz & Kelley, 2010). Some of these include the Test of Essential Academic Skills (TEAS) from Assessment Technologies Institute (ATI) (Newton, Smith, Moore, & Magnan, 2007; Wolkowitz & Kelley, 2010) and the ACT examination (Gilmore, 2008). Additionally, pre-nursing grade point average (GPA) has been examined as a possible predictor of the attrition and first-attempt NCLEX-RN passage (Kowitawakul, Brenkus, & Dugan, 2013; Uyehara, Magnussen, Itano, & Zhang, 2007). Science courses build foundations for nursing knowledge and have therefore been determined to have a predictive relationship with nursing student success (Campbell & Dickson, 1996; Simon et al., 2013). English and reading performance on standardized testing have previously been shown to be predictive of nursing student success (Wolkowitz & Kelley, 2010). There is no research that specifically looks at non-science co/prerequisite courses as predictors of program completion and first-attempt passage of the NCLEX-RN. This demonstrates the gap in the research.

Theoretical Framework

General Systems Theory

General Systems Theory by Bertalanffy (1950, 1968) explains the purpose of this study. Bertalanffy (1950) indicated that systems do not generally exist in isolation in that a change in one system will likely have an effect on an adjacent system. A change to one aspect of the system affects change upon other aspects of the system thereby altering the entire system. Laszlo and Krippner (1998) described this theory as an attempt to focus on systems as a whole and to consider the system itself as a conglomeration of parts rather than trying to further reduce it into integrals. While this study investigated one portion of the system (program completion within six semesters), how one portion of the system can affect the systems of nursing programs and health care will be explained utilizing Bertalanffy's process of General Systems Theory.

The health care system may be affected by the system of nursing programs while the opposite may also be true. Each of these systems may be considered an open system since each may be permeated by input of the other system. Bertalanffy (1968) defined an open system as a "system in exchange of matter with its environment, presenting import and export" (p. 141). Changing nothing in the school of nursing system will likely have an effect upon the health care system. Lack of student application, lack of student enrollment, increased attrition, and decreased NCLEX-RN first attempt passage rates will weaken the integrity of the health care system by perpetuating an existing problem of the nursing shortage. Program completion, and greater NCLEX-RN pass rates will positively affect the health care system by alleviating the nursing shortage. On the other hand, a failed imposition of increased enrollment may continue the decline of nurses in the health care

system to effectively manage the health care needs of society. These examples can be identified as intersystem effects.

Intrasystem effects may be realized within the nursing program system itself. Bertalanffy's (1950) discussion of open systems may be applied to these intrasystem effects as well. An attempt to increase the nursing workforce by increasing nursing graduate output will be affected by throughput. The output may then affect the input. The throughput in the nursing program can be conceptualized by student attrition and NCLEX-RN results. If attrition increases and NCLEX-RN first attempt passage increases, or if attrition decreases and NCLEX- RN first attempt passage decreases accreditation may be negatively affected (Rogers, 2009). Questionable accreditation may decrease input, student admissions, by making the program less desirable to students as they are guided to ask questions regarding accreditation when seeking admission to schools of nursing (Colorado Center for Nursing Excellence website, 2010). Again, these intrasystem effects may lead to the aforementioned intersystem effects by failing to decrease the nursing shortage.

Schema Theory

While General Systems Theory provides the justification for this study, this study tested Schema Theory. The concept of schemata, the singular of schema, was first described by Kant in 1781 by discussing how previous experiences and prior knowledge are utilized in the understanding of more novel knowledge and concepts (Kant, 1781/n.d.). Schema Theory was operationalized by Bartlett (1932/1995) in his attempt to describe memory. Kant sought the actuality of knowledge and concepts by valuing not only the knowledge itself, but also the experience that goes along with that knowledge in order to truly understand concepts. Kant

(1781/n.d.) further asserted that "schema relates to the reproductive imagination, which calls up the objects of experience, without which they have no meaning" (p. 50).

Schema provide a foothold, welding point, or scaffolding for new knowledge to take root (Anderson et al., 1976). Mental structures rising from general knowledge define schema thereby summarizing commonalities between concepts or situations (Anderson, Spiro, & Anderson, 1977). Given this definition, schema must be relatively more abstract than the concepts being built upon them (Anderson et al., 1977).

Non-science courses required for completion of an associate degree nursing program represent relatively abstract concepts in relation to the concepts of nursing. For instance, the two English courses should assure and possibly enhance students' oral and written communication skills that are compulsory in both the education of and the practice of nursing. Additionally, the introductory and developmental psychology courses provide a basis for students' understanding of the human mind, growth, and development so that they may be able to implement care and communicate in an age-appropriate or developmentally appropriate manner. Therefore, testing this theory by assessing relationships between performance in these courses and program completion and first-attempt NCLEX-RN success is justified.

Performance in certain courses has been investigated historically as to their ability to predict nursing school completion and NCLEX-RN passage. Gilmore (2008) found that ACT composite subscores along with anatomy and physiology and pre-nursing GPA predicted overall nursing GPA and NCLEX-RN success. Select preadmission science course performance has been shown to predict first-attempt NCLEX-RN success and NCLEX-RN readiness Exam scores (McGahee et al., 2010; Simon et al., 2013). In another study, a non-science prerequisite psychology course along with the number of course failures was statistically significant in

predicting nursing program completion (Abele, Penprase, & Ternes, 2013). However, in this study the psychology course was developed in conjunction with the nursing department and was presented in a similar manner as are the nursing courses (Abele et al., 2013). This study involved students on academic probation and it was not indicated if nursing or psychology faculty taught the course (Abele et al., 2013). Given these previous studies and the procedures for devising the psychology course, an empirical gap exists in the literature regarding non-science course co/prerequisite courses and their relationships with nursing school completion and first-attempt NCLEX-RN success.

Problem Statement

To avert the worsening nursing shortage, it now becomes incumbent upon schools of nursing to prepare nurses to care for the aging population (Newton et al., 2007). It is not enough simply to admit minimally qualified students and hope for successful completion of the program and thus, successful first time passage of the National Council Licensure Exam-Registered Nurses (NCLEX-RN). Applicants will likely seek programs that are accredited by ACEN or CCNE. Therefore, it remains in the interest of schools of nursing to seek and maintain full accreditation and approval. Hence, the identification of predictors of nursing program completion and first-attempt NCLEX-RN passage becomes paramount for the viability of individual nursing programs.

Two of the criteria examined by ACEN are attrition rates and first-attempt NCLEX-RN passage rates (ACEN website, 2013). High attrition rates may result from the admission of minimally qualified students who lack academic acumen to perform well in nursing courses (Newton & Moore, 2009). It becomes a balancing act to maintain high

NCLEX-RN passage rates while maintaining low attrition rates (Reinhardt et al., 2012). This study attempted to identify predictors of these two measures.

Although schools of nursing have increased enrollment to meet the challenge of the nursing shortage, this will not conquer the problem if programs do not admit students who can complete the programs and succeed on the first attempt of the NCLEX-RN (Rogers, 2009). Predictors of program completion may provide schools of nursing with more solid admission criteria in order to admit those with the greatest likelihood of successfully completing a nursing program and passing the NCLEX-RN on the first attempt (Gilmore, 2008; Kowitawakul et al., 2013; Trofino, 2013). While many predictors have been investigated, they still remain uncertain and ungeneralizable (Simon et al., 2013). Academic and non-academic predictors need to be determined. This study aims to analyze one subset of academic variables: grades in non-science co/prerequisite courses. Identification of predictors, while difficult to generalize due to geographical or institutional factors (Fowler & Norrie, 2009), may increase admittance of students with the greatest chances of success thereby providing the greatest opportunity to allay the present nursing shortage.

From a systems standpoint, identification of predictors of program completion and first-attempt NCLEX-RN success affects all areas of the system of healthcare. Nursing programs must maintain state board approval in order for their graduates to seek licensure via the NCLEX-RN (NCSBN Approval vs. Accreditation website, 2013). They must also maintain appropriate graduation rates for state board approval and accreditation (ACEN, 2013). Since schools of nursing have been identified as an integral part of the nursing shortage solution (Evans, 2013), it seems logical to increase nurse graduates by increasing

admissions. If this is done without sound admissions criteria, first-attempt NCLEX-RN pass rates may decline and/or nursing program attrition may increase leading to possible loss of approval and accreditation. Therefore, identification of variables that predict success becomes an important task for nursing programs (Alameida et al., 2011).

Within the framework of Schema Theory, non-science co/prerequisite course grades serve as prior knowledge and, therefore, footholds for new knowledge to flourish. The new knowledge will be represented by its application as evidenced by successful completion of nursing school and first-attempt NCLEX-RN success. The investigation of the relationship between non-science co/prerequisite courses and successful nursing school completion and first-attempt NCLEX-RN success will attempt to fill the gap in the literature regarding these potential relationships.

Purpose Statement

The purpose of this retrospective, predictive correlation study was to test Schema Theory (1932/1995) by correlating first attempt non-science co/prerequisite grades (English Composition I, English Composition II, General Psychology, Child Development, and Nutrition & Diet Therapy), successful completion of all non-science co/prerequisite courses prior to the first nursing course, and pre-entry GPA to student persistence and NCLEX-RN success in a traditional associate degree program in the South Atlantic region of the United States while controlling for gender and age. Persistence in nursing was defined as completion of the nursing program within six continuous semesters while NCLEX-RN success will be defined by the result of the NCLEX-RN on the first attempt.

The first predictor variable was generally defined as the grade received on the first attempt of each non-science co/prerequisite (A, B, C, D, F, or W) or equivalent course for which credit was granted. The second predictor variable was generally defined as whether or not all of the non-science co/prerequisite courses were successfully completed prior to taking the first nursing course. The pre-entry GPA predictor variable was generally defined as the GPA reported on the final transcript submitted that determined admission into the nursing program. The overall GPA was generally defined as the GPA calculated by the degree-granting institution upon successful completion of the program. The first criterion variable was generally defined as whether or not the student successfully completed the program within six semesters (yes or no). The second criterion variable was generally defined as whether or not the graduate passed the NCLEX-RN on the first attempt.

Significance of the Study

The significance of this study lies in its potential of adding to the empirical knowledge regarding predictors of successful associate degree nursing program completion perhaps resulting in decreased attrition and increased first-attempt NCLEX-RN pass rates. Implementation of any identified predictor may attenuate the present and worsening nursing shortage. While previous studies have suggested predictors of success, the variables have been broad and not generalizable to all program types (Harding, 2012). Science course GPAs have been identified as significant predictors of program completion (Seago, Keane, Chen, Spetz, & Grumbach, 2012). As well, ACT subsection scores (Gilmore, 2008; Wolkowitz & Kelley, 2010) have been identified as predictors of success along with subsections of the ATI TEAS (Wolkowitz & Kelley, 2010). It is important to mention that not every program utilizes ATI TEAS or ACT scores as admission criteria. However, non-

science co/prerequisite courses are a mainstay of associate degree nursing education (Keating, 2011) and warranted investigation into the possibility of them offering a more generalizable predictor of success. This study investigated grades in non-science co/prerequisite courses including two psychology courses, two English courses, and a nutrition course to determine if they could predict associate degree nursing program completion and first-attempt NCLEX-RN success.

Research Questions

The research questions for this study were:

RQ1: Is there a statistically significant relationship between first-attempt non-science co/prerequisite course grades and successful program completion for students in a traditional associate degree nursing program while controlling for the demographic variables of gender and age?

RQ1a: Is there a statistically significant contribution from the demographic variables of gender and age to the model predicting successful program completion for students in a traditional associate degree nursing program?

RQ1b: Is there a statistically significant contribution from pre-entry GPA to the model predicting successful program completion for students in a traditional associate degree nursing program?

RQ1c: Does completion of all non-science co/prerequisite courses prior to taking the first nursing course significantly predict successful program completion for students in a traditional associate degree nursing program?

RQ2: Is there a statistically significant relationship between first-attempt non-science co/prerequisite course grades and first-attempt NCLEX-RN results for students in a

traditional associate degree nursing program while controlling for the demographic variables of gender and age?

RQ2a: Is there a statistically significant contribution from the demographic variables of gender and age to the model predicting first-attempt NCLEX-RN results for students in a traditional associate degree nursing program?

RQ2b: Is there a statistically significant contribution from the final overall GPA as calculated by the degree-granting university to the model predicting first attempt NCLEX-RN results for students in a traditional associate degree nursing program?

Null Hypotheses

The following are the null hypotheses:

H_{01}: There is no statistically significant relationship between first-attempt non-science co/prerequisite course grades and successful program completion for students in a traditional associate degree nursing program while controlling for the demographic variables of gender and age.

H_{01a}: There is no statistically significant contribution from the demographic variables of gender and age to the model predicting successful program completion for students in a traditional associate degree nursing program.

H_{01b}: There is no statistically significant contribution from pre-entry GPA to the model predicting successful program completion for students in a traditional associate degree nursing program.

H_{01c}: Completion of all non-science co/prerequisite courses prior to taking the first nursing course has no significantly predictive relationship to successful program completion for students in a traditional associate degree nursing program.

H_{02}: There is no statistically significant relationship between first-attempt non-science co/prerequisite course grades and first-attempt NCLEX-RN results for students in a traditional associate degree nursing program while controlling for the demographic variables of gender and age.

H_{02a}: There is no statistically significant contribution from the demographic variables of gender and age to the model predicting first-attempt NCLEX-RN results for students in a traditional associate degree nursing program.

H_{02b}: There is no statistically significant contribution from the final overall GPA as calculated by the degree-granting institution to the model predicting first-attempt NCLEX-RN results for students in a traditional associate degree nursing program.

Identification of Variables

The variables controlled for in this study were the demographics of gender and age. Age was defined as the age in years of the admitted student at the time of admission. Gender was defined as male or female.

The first predictor variable was non-science co/prerequisite grades for students in a traditional associate degree nursing program. These courses were English Composition I, English Composition II, General Psychology, Child Development and Nutrition and Diet Therapy. While diet therapy and nutrition are sciences and may be labeled as science or biology at some institutions, they are not at the institution providing data for this research. The researcher investigated these predictor variables that are not identified as biology or chemistry in the course listings. These general education courses should provide foundational concepts to apply to nursing education (Cannon & Boswell, 2012). Identifying predictors in this realm of courses may prove beneficial in choosing students

with the greatest chances for success. Moreover, it may provide opportunities to identify at-risk students so that intervention or remediation may be offered to enhance these students' chances of success (Reinhardt et al., 2012). Course grades were identified A, B, C, D, F, or W with D, F, and W being grouped together since these grades result in the same negative outcome within the program. The A, B, C, D, F grading scale has been widely accepted as appropriate for evaluation in post-secondary education (Rojstaczer & Healy, 2012).

The second predictor variable was the completion of the non-science co/prerequisite courses in relation to the beginning of the first nursing course. Number of credit hours in which students are enrolled has been determined to be predictive of attrition in non-traditional students (Metzner & Bean, 1987). Gregory, Krupp, and Williams (2013) asserted that students in an accelerated RN-to-BSN program had higher graduation rates when they completed all of the prerequisite courses prior to beginning the first nursing course. This factor was investigated within an associate degree nursing program for this study. This portion will be a replication in a different program type.

The pre-entry GPA predictor variable was the GPA utilized in consideration of the admission. This variable was only considered in the investigation of the successful program completion variable. Pre-entry GPA has been similarly investigated previously in studies of persistence in nursing programs (Kowitawakul et al., 2013). This variable is justified for use in this study.

The final overall GPA was the GPA as calculated by the degree-granting institution upon successful completion of the program. In previous studies, the final overall GPA has been utilized so as to determine its correlation or its ability to predict performance on the

first-attempt of the NCLEX-RN. This variable is justified for use in this study (Alameida et al., 2011; De Lima et al., 2011).

The first criterion variable was program completion within six semesters which is the guideline set forth by the Accreditation Commission for Education in Nursing (ACEN) (ACEN website, 2013). This variable weighs heavily due to its importance in program approval by state boards of nursing (National Council of State Boards of Nursing Preferred Future for Prelicensure Program Approval website, 2012) and accreditation (ACEN website, 2013). Given that graduation from a nursing program is required for a student to take the NCLEX-RN, it remains important to investigate since it is the first step in alleviating the aforementioned nursing shortage.

The second criterion variable will be performance on the NCLEX-RN. Similarly to program completion rates, institutional first-attempt NCLEX-RN pass rates are crucial in the awarding of approval and accreditation (Giddens, 2009; Hadenfeldt, 2012; Simon et al., 2013). Additionally, it is important for the viability of each individual nursing program as students evaluate programs based upon this variable.

Definitions

1. *Accreditation Commission for Education in Nursing (ACEN):* In supporting nursing education, practice, and the public, this agency grants accreditation to nursing education programs (ACEN Mission website, 2013).
2. *Attrition:* "Refers to students 'dropping out' of the nursing program" (Jeffreys, 2012, p. 10). Jeffreys further discussed voluntary or non-academic program attrition versus involuntary or academic program attrition.

3. *General Systems Theory:* Entities do not generally exist in isolation in deference to other systems (Bertalanffy, 1950, 1968). Bertalanffy asserted that systems have inputs, outputs, and throughputs that permeate one another to bring about change based upon the interactions. Utilization of this framework attempts to look at systems as integrated wholes rather than integral parts (Laszlo & Krippner, 1998).
4. *Non-science Co/prerequisite Course Grades:* The Accreditation Commission for Education in Nursing and each state nursing board requires other science and general or non-science co/prerequisites as part of the nursing curriculum (Keating, 2011). Operationally, the criterion variables will be defined as A, B, C, D, F, or W. The grades of D, F, and W will be grouped together as one level of the predictor variable as they all result in the same outcome. The A-F grade scale is widely used and accepted in post-secondary education (Rojstaczer & Healy, 2012). In this study, these courses will be represented by English Composition I, English Composition II, General Psychology, Child Development, and Nutrition & Diet Therapy, or any equivalent course for which credit was granted.
5. *Program Approval:* "Official recognition of nursing education programs that meet standards established by the board of nursing" (Spector & Woods, 2013, p. 47). Spector and Woods (2013) further asserted that students must have graduated from a board-approved nursing program to sit for the NCLEX-RN.
6. *Program Completion:* Successful completion of the coursework within the specified amount of time. For associate degree accreditation from ACEN this is within 150% of the full-time load (ACEN website, 2013). For purposes of this study, this will be within six consecutive semesters.

7. *Schema Theory:* The concept that previous experience and knowledge provide critical welding points for the acquisition of new knowledge (Anderson et al., 1976; Anderson et al., 1977; Bartlett, 1932/1995; Kant, 1781/n.d.).

Research Summary

The ability of non-science co/prerequisites to predict program completion and first-attempt NCLEX-RN results for traditional associate degree nursing students was investigated. Permission to collect data was obtained from the institution providing archival data for the study. Approval from the Institutional Review Board (IRB) at Liberty University was then obtained. After obtaining this IRB approval, IRB approval from the institution providing the archival data was obtained. A retrospective predictive correlational design was employed since the researcher examined relationships between predictor and criterion variables (Warner, 2013). Institutional archival data was provided to the researcher. The initially provided data contained student names. However, the names were removed by the researcher and coded with sequential numbers to conduct logistic regression in the Statistical Package for the Social Sciences (SPSS) Version 22. Convenience sampling was utilized since the data were readily available and appropriate for retrospective studies (Gall, Gall, & Borg, 2007). The sample consisted of nursing students in a traditional associate degree program located in the South Atlantic region of the United States who entered the program between August 2008 and January 2010, providing 227 participants. Utilization of this timeframe dismissed the possibility of any student included in the study of having been eligible to take any version of the NCLEX-RN test plan other than the 2010 version. This number exceeds the Warner's (2013) recommendations suggesting a minimum sample size of $104 + k$ where k is the number of predictor variables with an effect

size of .5 and statistical power of .80. This sample size also exceeded the assertion of Tabachnick and Fidell (2013) indicating that an appropriate number of cases with the aforementioned effect size and power for testing multiple correlations is *50 + 8m* where *m is the number of independent variables* or *104 + m* where *m* is the number of predictors when testing individual correlations.

Logistic regression was implemented in order to evaluate the relationship between the nominal and ordinal predictor variables and the dichotomous criterion variables (Tabachnick & Fidell, 2013; Warner, 2013). The researcher conducted two regressions: one for each criterion variable (successful program completion and NCLEX-RN performance). Additionally, the effect size was reported as the odds ratios since the Cox and Snell R^2 and the Nagelkerke R^2 is not an accurate measure of effect size in logistic analysis. (Warner, 2013). The methodology will be discussed in further detail in Chapter 3.

Assumptions

First and foremost, anonymity was maintained as no personal information was nor will be published (Gall et al., 2007). Second, students at the institution sign consent for research to be conducted utilizing demographic and academic variables upon their admission to the program. The aforementioned anonymity is assured and emphasized in this consent. Additionally, the school of nursing was not nor will be identified. This study was a predictive correlation that employed logistic regression analysis to test the relationship between the dichotomous and ordinal predictor variables and dichotomous criterion variables (Tabachnick & Fidell, 2013; Warner, 2013). It was also assumed that all students who complete the nursing program intended to take the NCLEX-RN. Finally, it

was assumed that the archival data was accurate as it was utilized in the decisions to admit students and/or to permit progression within the program.

CHAPTER TWO: REVIEW OF THE LITERATURE

Introduction

Literature demonstrates the investigation of variables that predict both nursing school completion and first-attempt NCLEX-RN success (Alameida et al., 2011; Cuellar & Zaionst, 2013; Emory, 2013). While these studies investigated various program types such as traditional and non-traditional BSN programs as well as associate degree programs, this study investigated a traditional associate degree nursing program in the South Atlantic region of the United States. Studies have focused upon academic and non-academic variables (De Lima et al., 2011; Homard, 2013; Newton & Moore, 2009) as well as pre-admission variables (De Lima et al., 2011; Gilmore, 2008; Simon et al., 2013), within program variables (Abele et al., 2013; Alameida et al., 2011; Hadenfeldt, 2012; Pryjmachuk, Easton, & Littlewood, 2009; Tipton et al., 2008) and exit examinations (Alameida et al., 2011; Harding, 2010; Spurlock & Hunt, 2008). This literature review examines each of these aspects from various program types to compile information that guides this study. Additionally, this literature review provides insight on the causes and implications of the nursing shortage as well as discussions about and implications of nursing school attrition, NCLEX-RN pass rates, and their affects upon approval and accreditation.

Bertalanffy's General Systems Theory (1950) provided the rationale for this study while Schema Theory will be tested. Each topic was discussed in relation to its contribution and effect upon a general system. Also, various aspects of the literature review relate to the presence of previous knowledge and experiences and how they may affect attrition and NCLEX-RN success. I utilized multiple databases to identify pertinent literature to develop this review. Google Scholar® served as a general search engine to identify articles that may have been available in

the Liberty University online journal library. The online journal library at Liberty University then served as the primary starting point for the searches. The specific search engines utilized through Liberty University were Academic Search Complete®, CINAHL Plus with Full Text®, Education Research Complete®, ProQuest Dissertations and Theses®, ProQuest Nursing and Allied Health Source®, and Science Direct College Edition. Keywords utilized in the various databases included, but were not limited to *NCLEX-RN, attrition, predictor, associate degree nursing, accreditation, Schema Theory, and General Systems Theory*.

Theoretical Framework

General Systems Theory

Bertalanffy's General Systems Theory (1950) is compared to a science or discipline of wholeness (Friedman & Allen, 2011). Bertalanffy discussed the beginnings of General Systems Theory in 1937 during a symposium in Chicago, Illinois (International Society for the Systems Sciences website, 1999). In describing General Systems Theory, Bertalanffy (1950) attempted to align various disciplines together to eliminate or reduce redundancies in the sciences of discovery such as biology and physics. He asserted that scientists' goals formerly were to identify individual phenomena within their own discipline and describe them as an entity in isolation (Bertalanffy, 1950/1968). Yet, General Systems Theory supports the concept that very few if any entities exist in isolation and in refractoriness to other forces. Bertalanffy asserted that the goal of biological sciences was to discover properties of organization applicable to natural entities at all different levels of existence in order to analyze them (Friedman & Allen, 2011; Laszlo & Krippner, 1998). Bertalanffy (1968) emphasized the need for an all-encompassing structure of science based upon models that are common or applicable to all

fields. Essentially, this embraces the notion that "the whole is greater than the sum of its parts" (Bertalanffy, 1968, p. 18).

Systems, being affected by internal and external forces, provide feedback so that the system can adapt to meet the needs of the environment (Bertalanffy, 1950/1968). They are driven by input, throughput, and output which serve as feedback (Bertalanffy 1950/1968; Friedman & Allen, 2011). Systems may be theoretical as they are composed of suppositions and propositions or they may be empirical thereby being visible, describable, and analyzable (Bertalanffy, 1968). They exist in a dynamic environment generating outputs through effects and interactions from the environment (Friedman & Allen, 2011; Laszlo & Krippner, 1998). However, for a system to maintain its overall integrity, it must be able to withstand initial insult or challenges and adapt based upon the output and eventual reinsertion of input (Bertalanffy, 1950).

General Systems Theory provides rationale for this study given that health care is affected by many factors within it and that which surround it. The increased need for healthcare by the populace affects the healthcare system (Davidson, 2013; McHugh, 2010; Reinhard & Hassmiller, 2012), the actual and potentially worsening healthcare shortage related to an insufficient number of nurses (Juraschek, Zhang, Ranganathan, & Lin, 2012), and the strategies employed to address this nursing shortage (Kaji, Koenig, & Lewis, 2007; Kuehn, 2007). While each of these facets affects the overall healthcare environment, the output provided by each of them individually exerts a force or a new input upon the other thereby exemplifying the wholeness of a system described by Bertalanffy (1950/1968).

Schema Theory

Schema Theory asserts that "knowledge is stored in the layers of organized frames in brains" (Ying & Yu, 2013, p. 681). Schema Theory is "based upon the belief that knowledge is organized into complex representations called schemata … that control the retrieval of stored information, the encoding of new information, and the storage of information in memory" (Hampton, 1994, p. 15). Schema Theory has been investigated within many disciplines and concepts. This portion of the review of the literature concerning Schema Theory will discuss it and some of the concepts and disciplines that have applied this theory in research.

Although Kant (1781/n.d.) initiated discussion of schema, Bartlett retains credit with the origin of Schema Theory. Schema Theory was operationalized by Bartlett in trying to describe memory (Bartlett, 1932/1995). Possibly the most enlightening experiment directed subjects to read Native American ghost stories and to then retell the tales. Given different backgrounds and experiences, the stories were told differently with incongruent details by the participants.

Bartlett (1932/1995) proposed that memory involves reconstruction. To describe Schema Theory as it is understood today, schemata (the plural of schema) are packets of knowledge that serve as scaffolding for acquiring new knowledge. The stronger the scaffolding, the better the acquisition of new knowledge. Hence, Schema Theory asserts that new knowledge is affixed to previous knowledge thereby emphasizing the understanding of certain concepts in order to learn new ones.

Reproductive imagination calls up previous experiences Kant (1781/n.d.). Neither the reproductive imagination nor the prior experiences possesses value if they are not utilized in conjunction with one another. In other words, the prior experiences must be relevant and strong enough to bear the burden of the new knowledge acquisition. This premise helps to frame this

current study in that student performance in non-science co/prerequisite courses are being analyzed to assess for relationships with new knowledge acquisition to be successful in a nursing program and on the NCLEX-RN. Regarding cognition, Schema Theory asserts that mental depictions are devised through repetitive exposure to concepts, ideas, or notions (Greenwood, 2000). Previously learned ideas or concepts interrelate and are chunked together in a hierarchical fashion to be accessed later when learning new knowledge according to Schema Theory (Greenwood, 2000). Previously attained basic or general knowledge may be accessed to understand new and more complex knowledge. For purposes of this study, the notion is that general knowledge of the non-science co/prerequisite courses are being assessed as to their ability to serve as welding points for new more complex knowledge to be affixed.

Schema Theory has also framed studies regarding retrieval of previous information. This retrieval of information may be laborious and unsuccessful in the absence of background knowledge or schema (Konopka & Benjamin, 2009). Konopka and Benjamin (2009) asserted, therefore, that "background knowledge may play a particularly salient role under suboptimal retrieval conditions" (p. 43). Nursing school often provides opportunities for students to experience many stressful situations and difficult concepts and phenomena of healthcare such as death and dying for the first time (Stephens, 2013). These situations contribute to the suboptimal attempt of the NCLEX-RN and may comprise a suboptimal retrieval condition for students further framing this study.

Richter, Zwaan, and Hoever (2009) indicated that referent objects consisting of pictures of objects shown to facilitate recall of associated pseudowords did so more effectively than did new stimuli that were more representative the object's schema. It indicated that scaffolding facilitated better recall of an object than did presentation of a new stimulus in the absence of

scaffolding (Richter et al., 2009). Given this, knowledge attained from the scaffolding of non-science co/prerequisite courses may be beneficial in the learning of new nursing knowledge. This concept of beneficial scaffolding may also be important to consider in this study when completion or non-completion of all of the non-science co/prerequisite prior to the first nursing course is investigated as to its potential relationship to nursing school success.

Within nursing, schemata are considered an integral part of communication regarding patient care (Matney, Maddox, & Staggers, 2014). When caring for patients, communication between nurses at shift change is comprised of schemata representing a patient and his or her condition. The patient situation, condition, and previous care provide a foundation of knowledge or schemata about a particular patient. Nurses utilize the provided schemata in order to care for this patient and to identify changes in status (Matney et al., 2014). While most schemata in this situation are retrospective in nature, it has been suggested that communication or schemata construction be prospective and discuss what the patient will require (Dowding, 2001). In either case, schemata are developed in order to act in future patient experiences. In essence, nurses learn and interpret the new knowledge of patient presentation and data based upon the previously reported condition or schema as discussed by Konopka and Benjamin (2009).

Nursing Shortage

The average age of the registered nurse in the United States today is 46 years and nearly half of them are nearing retirement (American Nurses Association Nursing Shortage website, 2013). Additionally, the increasing medical needs of the aging population will likely further stress the health care system (Davidson, 2013). As a result, health care facilities may be unable to provide quality care as a result of the nationwide nursing shortage (McHugh, 2010). The

multitude of factors leading to the nursing shortage results in lower quality healthcare for those receiving it (Littlejohn, Campbell, Collins-McNeil, & Khayile, 2012).

The aging population ushers in an inevitable increased demand for increased healthcare services (Davidson, 2013; Reinhard & Hassmiller, 2012). Approximately 75 million Baby Boomers, those born between 1946 and 1964, comprise this aging population bringing to fruition the anxiously-awaited impact upon the healthcare system (Hussain, Rivers, Glover, & Fottler, 2012). This shortage coupled with the explosion of the Baby Boomer's healthcare consumerism brings into question the ability of the current nursing workforce to provide quality care (Hussain et al., 2012).

To address the nursing shortage, researchers have attempted to identify the root of its causes. In the 1990s, managed care led many healthcare institutions to contain costs by eliminating nursing positions and/or replacing these positions with unlicensed assistive personnel (Hussain et al., 2012; Huston, 2014). Additionally, recruitment and retention efforts for nursing were lacking at this time further exacerbating the shortage (Huston, 2014). Furthermore, the rigors of the profession such as stress and understaffing are noted as part of the reason for the nursing shortage (Hussain et al., 2012).

Some argue that the nursing shortage does not exist or does not stress the healthcare system as stated (Hussain et al., 2012). This assertion is often countered with the argument that many of the apparent shortages have been reduced by retirement-eligible nurses delaying retirement or part-time nurses taking full-time positions in an effort to battle the economic downturn (Brewer, 2010). Moving to the present, models predict that a national shortage of registered nurses will reach 300,000 to 1,000,000 nurses by 2020 (Juraschek et al., 2012). Moreover, nursing programs must increase production of graduates by 30% annually over the

next ten years to meet healthcare's demand for nurses (Evans, 2013). Therefore, it becomes incumbent upon those responsible for the nation's healthcare system to understand the origin of the shortage and to develop strategies to remedy it.

While the aging population's demand for increased care in a shrinking nursing supply mode may be a worsening evolutionary problem, acute issues may also arise in response to the nursing shortage (McHugh, 2010). It is believed that sound public health relies on a robust nursing workforce (Kersey, 2012; McHugh, 2010). A regional or institutional nursing shortage may arise from the overall nursing shortage. For instance, a terrorist attack or infection control disaster may become increasingly worse as a function of this shortage. To frame this within the framework of General Systems Theory (Bertalanffy, 1950), the input of fewer numbers of nurses will affect or decrease the throughput, which is the implementation of high quality care for the patients in the system. Thus, the output or overall health of society or a pocket of society may become adversely affected or become a casualty of poor input.

As previously noted, many causes can be attributed to the nursing shortage. However, the aging population and its increased healthcare needs may be the primary force exposing the nursing shortage (Kuehn, 2007). Yet, the most glaring underlying cause of the nursing shortage is a chokepoint in the admission process due to aging faculty who are retiring or who are near retiring (Kaji et al., 2007).

Strategies to Address the Nursing Shortage

Bottlenecks comprised of qualified nursing school applicants often result from a general lack of nursing school faculty (Kaji et al., 2007; Kuehn, 2007). The nursing faculty shortage imposes further detriment to the overall nursing shortage by causing denial of nursing program admission to qualified applicants (Wyte-Lake, Tran, Bowman, Needleman, & Dobalian, 2013).

There were 1,181 full-time nursing faculty vacancies or 1.8 vacancies per nursing school in the United States during the 2012-2013 academic school year (Fang & Li, 2012). Nursing programs denied admission to over 75,000 qualified applicants as a result of insufficient numbers of faculty members in 2011-2012.

These two contributors to the nursing shortage perpetuate one another within the framework of General Systems (Bertalanffy, 1950). While nursing faculty may be considered as input into the system to provide an output of graduate nurses, the lack of faculty may decrease the output of graduates thereby decreasing future input of newer faculty further perpetuating a shortage in the future. Efforts to remedy the nursing shortage have been directed at these two factors.

The faculty shortage limits nursing program capacity thereby attenuating efforts to alleviate the overall nursing shortage. The average age of nursing faculty is 55.2 years (Evans, 2013) and they are nearing retirement. When numbers of nursing faculty are improved, nursing's ability to meet healthcare needs will be enhanced (Nardi & Gyurko, 2013). Still, many causes of the nursing faculty shortage exist including average nurse faculty age and retirement, salary disparity between academia and clinical or private-sector settings, and a lack of masters and doctorate prepared nurses to fill the positions. While healthcare organizations have been compelled to increase compensation for nurses working solely at the bedside, faculty salaries have not maintained such increases (Kuehn, 2007). This last factor is driven by accreditation and approval requirements for schools of nursing which will be discussed in a later section. .

To teach associate degree nursing students, ACEN requires faculty to have a minimum of a graduate degree in nursing (ACEN, 2013). To teach baccalaureate and graduate nursing students as a full-time faculty member, accrediting bodies require an earned doctorate or

enrollment in a doctorate program for at least 25% of the faculty within a program (ACEN Standards and Criteria Baccalaureate website, 2013). While baccalaureate programs may be accredited by either ACEN or the Commission on Collegiate Nursing Education, this researcher will reference ACEN given that it is the accrediting body for associate degree nursing programs. These faculty requirements affect input into the system further perpetuating the faculty shortage and, therefore, the overall nursing shortage. Given the cost and time investments required to obtain these degrees, nurses may not be motivated to pursue these degrees for the salary provided to nursing faculty. However, attempts have been made to address and alleviate the nursing faculty shortage. Reliable measures of assessing any recommended modality to increase numbers of nursing faculty are unavailable due to few quality experimental and quasi-experimental studies in this area (Wyte-Lake et al., 2013).

Recommendations have been made to increase full-time funding for nursing faculty positions (Kuehn, 2007; Nardi & Gyurko, 2013). While this seems to be the most evident remedy for the problem, it may prove to be the least feasible strategy. Additionally, recruitment of nurses into faculty roles should be bundled with targeted reimbursements for the costs of obtaining the requisite education to do so (Nardi & Gyurko, 2013). An example of a program offered to nurses to facilitate the furthering of their education in order to transition into the faculty role is the Jonas Nurse Leaders Scholar Program (Jonas Nurse Leaders Scholars website, 2013) which began in 2008 as an effort to nurture the development of joint appointments between nursing schools and clinical facilities. However, the educational requirements of nursing faculty are driven by program accrediting bodies and state boards of nursing.

Program Accreditation and Approval

Nursing programs are granted accreditation by an accrediting body such as the Accreditation Commission for Education in Nursing (ACEN) (ACEN website, 2013). Nursing programs also must earn and maintain approval from their resident state boards of nursing. Maintaining accreditation and approval provides benefit for both the programs themselves and the students.

Accrediting bodies evaluate nursing programs to ensure that nursing programs are meeting certain criteria such as student completion or attrition rates and first-attempt NCLEX-RN pass rates (Billings & Halstead, 2012). Adherence to and compliance with accrediting body standards permit nursing programs to identify themselves as being accredited (ACEN website, 2013). Receipt of financial aid is often restricted to students who attend accredited programs (Federal Student Aid website, n.d.).

Graduation from unaccredited programs may result in a student's inability to be accepted into an accredited graduate school (Davila, 2013). For a student to be able to sit for the NCLEX-RN, he or she must graduate from a state board approved nursing program (NCSBN Approval vs. Accreditation website, 2013). The NCSBN defines approval as "the official recognition of nursing education programs which meet standards of approval established by boards of nursing" (para. 1). Given these possibilities, lack of accreditation and approval may limit quality applicants' interest of a program (McDowell, 2008).

Accreditation and approval rely heavily upon nursing programs' completion/attrition rates and first-attempt NCLEX-RN pass rates (Reinhardt et al., 2012; Rogers, 2009). In West Virginia, a nursing program may lose approval for "failure to maintain at least 80% passing rate on the licensure examination by first time candidates" (Policies, Standards, and Criteria for the

Evaluation and Accreditation of Colleges, Departments or Schools of Nursing, 2009, p. 5). North Carolina requires that NCLEX-RN pass rates "shall maintain a three year average at or above 95% of the national pass rate for licensure level pass rate on first writing of the licensure examination" (North Carolina Board of Nursing General Provisions website, n.d., p. 37). South Carolina recognizes a deficient NCLEX-RN pass rate as "an annual pass rate of first-time takers of the NCLEX-RN that is more than 5 percent below the annual national pass rate" (South Carolina Legislature Online - Code of Regulations Chapter 91 website, n.d., Section 91-3 K). Accreditation standard 6.4.1 from ACEN regarding licensure exam performance states, "…the program's three-year mean for the licensure exam pass rate will be at or above the national mean for the same three-year period" (ACEN, 2013, p. 6). Furthermore, ACEN (2013) addresses program completion with respect to accreditation by indicating that faculty will determine the expected level of program completion while reflecting student demographics. West Virginia Board of Examiners for Registered Professional Nurses (2008) mandates that nursing programs within their jurisdiction complete ongoing systematic self-evaluation that includes monitoring of graduation rates and attrition (Policies, Standards, and Criteria for the Evaluation and Accreditation of Colleges, Departments or Schools of Nursing, 2009).

Within the framework of General Systems Theory (Bertalanffy, 1950), approval and accreditation represent input into the system at one point. These aspects provide the throughput of students into nursing programs resulting in the output of nursing graduates. However, at another point within the system, the approval and accreditation represent the output that exists as a function of quality graduates who have completed the nursing program and have satisfactory first-attempt NCLEX-RN pass rates. Given the previous discussion of approval and accreditation of nursing programs, the intrasystem and intersystem effects of first-attempt

NCLEX-RN pass rates and program completion upon them become evident. Therefore, student attrition merits further discussion.

Attrition

Participation in post-secondary education may be considered an experiment where one of the possible outcomes is attrition (Manski, 1989). Student persistence has been investigated extensively with many assertions as to why students persist or fall to attrition (Astin, 1984; Bean & Metzner, 1985; Jeffreys, 2007b; Tinto, 1975, 1987; Whitehead, 2012). While college attrition has been compared to failed attempts at starting businesses (Fischer, 1987), attempting to gain a college education has been a worthwhile risk for students. As it pertains to nursing programs, Newton and Moore (2009) asserted that student attrition within nursing programs results primarily from minimally qualified students being admitted who are insufficiently prepared academically. Schools of nursing must address the nursing shortage by the penultimate action of increasing admissions and through the ultimate action, of increasing graduates who will be successful on the first attempt of the NCLEX-RN (Evans, 2013). This must be done carefully as to not increase attrition in the attempt to do so (Schmidt & MacWilliams, 2011).

This fits well into the framework of General Systems Theory (Bertalanffy, 1950). The input or the applicants who are granted admission are affected by predictors of completion. If they are successful, this is perceived as quality output. If they are not successful, this output then negatively disturbs the system by affecting future input of students in that the output is evaluated by future applicants. If the output of low attrition rates, continued approval, and continued accreditation exists, then the output will be seen as positive. This continuance of approval and accreditation serves as input and makes the program more desirable for applicants. Therefore, a change in one aspect of the system renders change to the entire system.

Theories of Attrition

Astin (1984) theorized that student retention is governed by student involvement in the entire process of their college experience. The more a student is involved and the more time he or she invests in academic and social aspects, the more likely he or she is to be successful (Astin, 1984). College educators can contribute to a student's involvement in his or her education by facilitating greater student involvement. This may be achieved by faculty being astutely aware of student involvement and how much time students are dedicating to their education and social experiences and tailoring instruction to enhance this aspect. Additionally, this theory emulates General Systems Theory (Bertalanffy, 1950) in that it involves input, throughput, and output. The input or experiences the student brings to the table exposes the student to college experiences or the throughput. Each experience is deemed to be positive or negative leading the student toward completion of the college goal or attrition respectively (Astin, 1984). Completion or attrition represents the output within General Systems Theory.

Tinto (1975, 1987) paralleled Astin's Theory of Student Involvement in that he asserted student attrition or completion provides a view into the overall health of college life and not just the students who drop out or persist. He further iterated that student integration into college life and student-faculty relationships or interactions provide the focal point of understanding student attrition and completion. Student performance and intellectual development provide a precursor to academic integration that runs parallel with social integration (Tinto, 1975). Finally, both lanes of integration impact goal commitment and institutional commitment which ultimately influence attrition or persistence (Tinto, 1975). Interestingly, goal commitment and institutional commitment initially affect performance and intellectual development (Tinto, 1975). Hence, this model represents a system effect as described by Bertalanffy's General Systems Theory (1950).

A change in one component of the model or system affects other aspects of the system. As well, the output and the input are the same: goal commitment and institutional commitment.

While Tinto (1975, 1987) and Astin (1984) built models of retention based heavily on social aspects such as integration and involvement within the community, Bean and Metzner (1985) did not. The aforementioned models involved more traditional college students whereas Bean and Metzner (1985) focused on the non-traditional student. Since traditional and non-traditional students have varied levels of campus presence and involvement, Metzner and Bean (1987) asserted that the model for non-traditional students would rely on other variables. Their model of attrition or persistence rested on four variable sets which were academic acumen, intent to persist, demographic variables, and environmental factors that were not controllable by the college or its environment such as finances and support systems (Harpe & Kaniuka, 2012). Given the significant number of non-traditional students in nursing programs today (Ooms, Fergy, Marks-Maran, Burke, & Sheehy, 2013), Metzner and Bean's theory may be more applicable for students in this study.

While the previously discussed theories tend to delineate variable types by social and environmental aspects, Jeffreys (2012) described a model of attrition specific to student nurses utilizing all of these aspects. The Nursing Undergraduate Retention and Success (NURS) conceptual model frames the path of retention within the auspices of academic, demographic, integration, and environmental aspects (Jeffreys, 2012). A combination of all these factors along with the student's affective factors such as values, self-efficacy, and motivation drive the student toward attrition or retention (Jeffreys, 2012). Again, these factors of input affect the output of retention or attrition in the likeness of General Systems Theory (Bertalanffy, 1950). However,

the investigation of predictive qualities of co/prerequisite courses for this study is informed by part of the NURS model.

National Council Licensure Examination for Registered Nurses (NCLEX-RN)

The NCLEX-RN serves as the capstone experience for nurse graduates by allowing them to display competence regarding their previous years of nursing education (NCSBN, NCLEX Examinations website, 2013). Within the framework of Schema Theory, this represents schema accretion wherein "new information is encoded in terms of existing schemata" (Hampton, 1994, p. 20). The NCLEX-RN acts as a decision-making tool in the licensure of graduate nurses by assessing their competence and apparent safety and effectiveness as a new nurse (NCSBN, NCLEX Examinations website, 2013). The first-attempt pass rates on the NCLEX-RN of particular nursing programs represent a gold-standard quality indicator for these programs (Giddens, 2009; Hadenfeldt, 2012; Simon et al., 2013). As previously noted, state boards of nursing and accrediting bodies assess programs' first-attempt NCLEX-RN pass rates in rendering decisions regarding accreditation and approval (ACEN, 2013; WVBOE-RN, 2008).

Based upon a detailed test plan of client needs, the NCLEX-RN assesses the candidate's knowledge regarding the four broad categories of safe and effective care environment, health promotion and maintenance, psychosocial integrity, and physiological integrity (NCLEX-RN Examination Test Plan website, 2013). Also, the test plan consists of the following subcategories: management of care, safety and infection control, basic care and comfort, pharmacological and parenteral therapies, reduction of risk potential, and physiological adaptation (NCLEX-RN Examination Test Plan website, 2013). The National Council of State Boards of Nursing reviews the NCLEX-RN test plan every three years to ensure that the exam "measures the essential competencies for safe and effective practice by a newly licensed RN"

(Oermann & Gaberson, 2014, p. 151). The last change in the NCLEX-RN test plan was implemented in April 2013 (NCLEX-RN Examination Test Plan website, 2013).

The NCLEX-RN utilizes computerized adaptive testing (CAT) to assess graduate nurses' abilities to practice safely as a new nurse. The CAT model provides validity and reliability measures of nursing competence. It also reduces the number of easy items that high-performing candidates take while reducing the number of difficult items that poorly-performing candidates take to better estimate a candidate's knowledge and ability to practice safely. In essence, with each answered question, the next question should be at a level of difficulty that has a 50% chance of being answered correctly. Passing is not determined by a specific score but by a probability level determined by logits (Lavin & Rosario-Sim, 2013). When a test item is answered correctly, an increasingly difficult question is asked while an increasingly easier question is asked following an incorrectly answered test item (Lavin & Rosario-Sim, 2013).

Predictors of Nursing School Completion

The reason for identifying predictors of nursing school completion is multifaceted. The nation is facing a health care crisis exacerbated by the nursing shortage (McHugh, 2010). Given this, schools of nursing can address this shortage by admitting greater numbers of students (Newton et al., 2007). However, simply admitting students and producing greater numbers of graduates is not a task to be undertaken in isolation, as increases in admission of students who do not complete the program produce effects upon the program as a system.

Schools of nursing must maintain satisfactory completion rates for multiple reasons that result from systems effects. Nursing students must graduate from a state board approved program in order to sit for the NCLEX-RN (NCSBN Approval vs. Accreditation website, 2013). If previous input of poor completion rates and poor first-attempt NCLEX-RN results in the

output of non-approval or denial of accreditation, then this output serves as input into the system and will result in decreased numbers of graduates thereby perpetuating or exacerbating the nursing shortage. The following will discuss previously studied predictors of nursing program completion.

Non-Academic Predictors of Nursing School Completion

Some observations by nursing faculty indicate there are students who possess adequate academic ability to succeed in a nursing program but still fail to do so (Freitas & Leonard, 2011). Yet, some students who experience great life challenges throughout their nursing program successfully complete a nursing program (Freitas & Leonard, 2011). Non-academic factors play a greater role than academic factors do in success for non-traditional students defined as students who are a product of "trends in minority population growth, globalization, and immigration patterns, as well as a restructured workforce, welfare-to-work initiatives, displaced home-makers, popularity of mid-life career changes, and healthcare career ladder programs" (Jeffreys, 2007a, p. 161).

According to Maslow (1943), physiological and safety needs of humankind must be met before psychosocial issues and self-actualization. Students meeting the admission criteria for nursing programs possess the potential to be successful in the program (Davenport, 2007). It may then be assumed that these students' basic needs are met leaving the psychosocial issues and the self-actualization of being successful in the program to be resolved (Freitas & Leonard, 2011; Williams, 2010). Students identified some of these aspects to be related to anxiety, responsibilities of family, financial concerns, health status and psychological stress (Freitas & Leonard, 2011). Unmet needs related to these psychosocial aspects may affect students' classroom and/or clinical performance (Freitas & Leonard, 2011). Additionally, women often

have greater psychosocial needs than do men (Freitas & Leonard, 2011). This becomes important given the fact that women comprise 91.4% of the nursing workforce (Minority Nurse Nursing Statistics website, 2013). Hence, nursing faculty must work diligently to identify students at risk for having unmet psychosocial needs and direct them to appropriate resources to move toward resolution of the needs (Freitas & Leonard, 2011; Williams, 2010). Psychosocial needs requiring nursing students to cope with stressful situations often arise from many first-time experiences such as death and dying, exposure to diverse lifestyles, and exposure to communicable diseases (Stephens, 2013). Additional stressors for nursing students are the required endurance for long hours of study and fear of not completing the program (Cuellar & Zaionst, 2013). All of these challenges influence students' persistence (Pence, 2011). Therefore, identifying and assisting students who are at risk for and are exhibiting ineffective coping to stressors may better equip those who graduate and eventually practice nursing to better handle stressful situations (Cuellar & Zaionst, 2013). Some resources that may improve students' ability to meet psychosocial needs may include involvement in learning communities, student nurse support groups, and student nurse associations (Freitas & Leonard, 2011; Williams, 2010). Additionally, individuals other than nursing faculty such as advisors, counselors, and mentors can assist students to critically analyze and reflect upon stressors and adversities to identify effective coping mechanisms for them (Stephens, 2013). This diligence on the part of faculty increases student perceived faculty support which has also been indicated as a factor in student program completion (Uyehara et al., 2007).

Student sense of community (SOC) plays a role in students' success in their education (Cuellar & Zaionst, 2013). Students with higher SOC exhibited higher social function possibly resulting in their success (Cuellar & Zaionst, 2013; Morrow & Ackermann, 2012). Moreover,

students identified collaboration with other students in the learning environment as a likely tool for completion of a program (Rogers, 2009).

Students' further identified their sense of well-being as a factor in their success in an associate degree nursing program (Rogers, 2009). Beyond meeting Maslow's (1943) basic physiologic needs of rest and nutrition, nursing students often endured a very stressful education experience in a nursing program while neglecting these basic tenets (Rogers, 2009). Success in the same associate degree nursing program was perceived by the students to be a product of tending to these basic needs as a prerequisite for meeting academic potential and being successful within a nursing program (Rogers, 2009).

In relation to General Systems Theory (Bertalanffy, 1950) the SOC and/or other psychosocial aspects serve as input into the entire educational experience for the students beyond their academic ability. Given the relationship between SOC and success, nurse educators are compelled to identify methods of improving student success beyond their teaching andragogy and methods. The intrasystem effects of student completion or attrition and the intersystem effects of impacting the nursing shortage either positively or negatively influence each other. Therefore, the responsibilities of nursing faculty and all who work with nursing students weigh heavily in addressing the overall problem of the nursing shortage.

Academic Predictors of Nursing School Completion

Academic factors affect the system of student attrition or completion given that nursing programs admit students who meet the minimum academic requirements (Newton & Moore, 2009). While relieving the nursing shortage relies partially upon the increased enrollment in nursing programs (Evans, 2013), these programs must act responsibly through the identification of predictors of student program completion (Alameida et al., 2011). Even though it may not be

possible to isolate factors of student success due to the effect of non-academic variables, it remains important for nurse educators to identify potential academic variables, both preadmission and within program, given that poor academic preparation lends to attrition.

Preadmission. Pre-nursing grade point average (GPA) is a common admission criterion and stable predictor of success in nursing programs and other health professions (Ali & Naylor, 2010; Timer & Clauson, 2011). Even though GPA seems to be an objective measure of students' academic performance, it is not without perceived bias since some institutions implement more stringent grading policies than others leading to a possible disadvantage to students from those schools (Timer & Clauson, 2011).

Studies have examined pre-nursing GPA in relation to the course content such as science, math, or English (Gilmore, 2008). Even though some of these individual GPAs had some correlation with nursing program completion, they have been generally determined to be multifactorial (Seago et al., 2012; Simon et al., 2013). For instance, science GPA has been correlated with program success possibly due to the fact that nursing courses heavily rely upon concepts from those courses (Ali & Naylor, 2010). Lower grades in the biological sciences were correlated with lower rates of program completion in associate degree programs (Gilmore, 2008; Seago et al., 2012). Research has further demonstrated that the grades in anatomy and physiology courses were predictive when combined with other variables such as American College Test (ACT) composite score, ACT subset scores, and cumulative pre-nursing GPA (Gilmore, 2008). Additionally, biology, chemistry, and pre-nursing GPA have appeared to have a predictive relationship with nursing program success (Simon et al., 2013). Given the framework of General Systems Theory (Bertalanffy, 1950), system wide effects are evident in

that the performance in these courses affects completion while completion or attrition in nursing programs affects the overall problem of the nursing shortage.

Pre-admission assessment tests such as the Assessment Technologies Institute Test of Essential Academic Skills (ATI TEAS) have been rigorously studied as potential predictors of nursing program success. The ATI TEAS consists of five scores: composite, reading, mathematics, science, and English and language usage (ATI Product Solutions webpage, 2013). The Kaplan admission exams assess the basic skills of math, reading, science, and writing (Kowitawakul et al., 2013) while the Health Education Services Incorporated Admission Assessment (HESI A^2) evaluates math, English, and science aptitude through seven component exams (Knauss & Wilson, 2013). Additionally, the National League for Nursing Pre-Admission Exam (PAX) assesses verbal, math, and science abilities (National League for Nursing Testing Services webpage, 2013).

In evaluating predictors for nursing school success, researchers have frequently examined students' first semester success (Newton et al., 2007; Wolkowitz & Kelly, 2010). Early success serves as an appropriate criterion variable since non-academic variables are more likely to affect attrition at the end of a nursing program (Wolkowitz & Kelley, 2010). The greatest amount of attrition usually occurs within the first year of nursing school if not in the first semester (Knauss & Wilson, 2013; Peterson, 2009) given that the first semester is usually the most rigorous and challenging for students (McGahee et al., 2010).

Some research has indicated that pre-nursing GPA and anatomy and physiology grades did not significantly correlate with attrition (Jeffreys, 2007b). However, the same research asserted that these variables were significantly correlated with first semester success as measured by the first medical/surgical nursing course. Research has also demonstrated that subscores on

the Kaplan admission exams were correlated with first semester GPA (Kowitawakul et al., 2013) while the ATI TEAS subset scores on math and English did not predict nursing program success (Wolkowitz & Kelley, 2010). However, the HESI A^2 has demonstrated a significant correlation between performance on its four non-science content exams and first semester nursing program success (Knauss & Wilson, 2013).

Within program. Studies of within program indicators of program completion have not provided a definitive set of predictors nor can the findings be generalized across programs (Uyehara et al., 2007). Specific nursing course grades have been shown to predict program completion (Abele et al., 2013; Jeffreys, 2007b). In one study, the researchers previously identified that a correlation existed between a developmental psychology course and program success (Abele et al., 2013). Therefore, the school of nursing faculty collaborated with those developing this psychology course in order to construct it in the same manner as nursing courses to deliver the material in a consistent format. The results indicated that as the psychology course grade increased that the odds of program completion also increased (Abele et al., 2013). However, this is not generalizable across programs and developmental psychology courses due to the intimacy of the two departments' collaboration in course development. Additionally, Jeffreys (2007b) has noted that the grade earned in the initial medical-surgical course was correlated with attrition. In that study, it was determined that students who earned a C+ in this course were considered at-risk thereby providing a benchmark for faculty to identify these at-risk students early in the foundational portion of their education.

Beyond looking at the previous pre-nursing predictors related to admission exams and pre-nursing course grades, assessing students via examination at points within the curriculum may be beneficial in predicting program success and identifying students who are considered to

be at-risk (Harding, Rateau, & Heise, 2011). The MC-HESI™ is a specialized 105-item examination that evaluates student mastery of core content in the first half of the nursing program (Harding et al., 2011). The MC-HESI provided statistically significant results in predicting student program success (Harding et al., 2011) and in the identification of the at-risk students.

Identification of at-risk students remains an important task for nurse educators (Alameida et al., 2011). The earlier in the program students at risk are identified, the earlier that interventions may be implemented to allow more time for intervention to aid in their future success (Lockie, Van Lanen, & McGannon, 2013). In relation to General Systems Theory (Bertalanffy, 1950), nursing faculty can manipulate the throughput of the system (student learning) in order to affect the output of increased program completion rates and greater numbers of graduate nurses into the nursing workforce to attenuate the nursing shortage. Further, the output of completion rates becomes input thereby affecting the output of program approval and accreditation which then serves as a factor in the input students consider when investigating programs to which they will apply.

Predictors of First-Attempt NCLEX-RN Success

The institutional rate of first-attempt passage on the NCLEX-RN is often used as an indicator of program quality (Billings & Halstead, 2012; Homard, 2013). It is a criterion utilized by state boards of nursing for program approval and by accrediting bodies such as the Accreditation Commission for Education in Nursing (ACEN) (Reinhardt et al., 2012; Rogers, 2009). Yet, identifying generalizable predictors of NCLEX-RN success has proven difficult (Fowler & Norrie, 2009). Therefore, the identification of students at risk for failing the NCLEX-RN remains equally difficult.

From a systems standpoint, first-attempt NCLEX-RN passage rates serve as nursing program output which is then utilized as input for the approval, accreditation, and student interest. A high NCLEX-RN passage rate provides multiple benefits for an institution (McDowell, 2008). Students consider NCLEX-RN first attempt pass rates when applying to nursing programs (McDowell, 2008). Faculty recruitment, institutional support, and community support are affected by the first-attempt pass rates (McDowell, 2008). Perhaps, the greatest benefit of having high first-attempt NCLEX-RN pass rates is that it is the genesis of addressing the nursing shortage.

Within Program

Just as some nursing courses may be correlated with and/or predict student program completion, research has shown that they may as well be able to predict first-attempt NCLEX-RN success. Again, early success in the program may be related to completion since it is rare for students to complete the first semester and not complete the program (McGahee et al., 2010). In reference to systems, early success represent throughput leading to the output of completion. If completion is not achieved, even attempting the NCLEX-RN is not possible since graduation from an approved nursing program is the foremost prerequisite for taking the exam (Alameida et al., 2011).

Higher overall nursing GPAs have been shown to be associated with first-attempt NCLEX-RN success (McGahee et al., 2010; Tipton et al., 2008). While the overall differences in the cumulative GPAs of those who passed and of those who failed on the first attempt were subtle, they were statistically significant. Tipton et al. (2008) noted that the cumulative GPAs between those who passed and those who failed differed by only 2.75 on a 100 point scale. Yet, that difference equated to being six times lower when speaking in terms of standard error of the

means. They further asserted that these minor empirical differences provide nursing faculty with a tool to identify students who are at risk for failing the NCLEX-RN on the first attempt.

The usage of Content Mastery® examinations from ATI have been shown to predict NCLEX-RN outcomes (Emory, 2013). These examinations, part of ATI's Comprehensive Assessment and Review Program, assess students' mastery of concepts that are based upon the NCLEX-RN test plan (ATI Comprehensive Assessment and Review Program website, 2013). They cover the areas of adult medical surgical, fundamentals, pharmacology, focused adult medical surgical, maternal-newborn, pediatrics, mental health, community health, nutrition, and leadership and management. Performance on the ATI pharmacology examination has been shown to be a significant predictor of first-attempt NCLEX-RN success (Emory, 2013; Ukpabi, 2008). Emory (2013) determined that the ATI pharmacology examination "predicted NCLEX-RN outcomes of pass or fail accurately 73.7% of the time" (p. 68). However, McCarthy, Harris, and Tracz (2014) indicated that prediction of NCLEX-RN success in baccalaureate graduates was supported by the medical surgical and mental health content mastery exams from ATI.

Exit Examinations

In an attempt to improve NCLEX-RN first attempt pass rates, many schools of nursing have implemented progression policies based upon NCLEX-RN predictor examination benchmarking (Alameida et al., 2011; Harding, 2010; Homard, 2013; Spurlock & Hunt, 2008). Generally, when there are greater consequences for not meeting benchmarks on these exit exams, students generally perform better on them (Homard, 2013). Given that students increase their chances of failing when there is increased lag time between graduation and taking the NCLEX-RN (Woo, Wendt, & Liu, 2009), failure of the final nursing course seems to be a better consequence for students not meeting the determined benchmarks (Homard, 2013). Simply

requiring students to take the exit examinations until the benchmark is met may actually cause detriment to first-attempt NCLEX-RN pass rates (Spector & Alexander, 2006). Additionally, requiring certain benchmarks on exit examinations may result in lawsuits against schools of nursing for "breach of contract, lack of due process, and educational malpractice" (Santo, Frander, & Hawkins, 2013).

Some examples of exit examinations are the ATI Comprehensive Predictor ® and the Health Education Systems, Incorporated (HESI) Exit Examination (Alameida et al., 2011; Harding, 2010). In studies with over 17,000 students over four years, the HESI Exit Examination was 96.4% - 98.3% accurate in predicting NCLEX-RN success for students who scored the highest (Harding, 2010). Harding (2010) further indicated that this exam is only accurate in prediction of passing and not failure. However, the data remains inconclusive as to whether or not progression policies based upon these examinations actually improve NCLEX-RN first-attempt pass rates (Harding 2010). The ATI Comprehensive Predictor ®, even though the predictive probability may vary by program type, still significantly predicted first-attempt NCLEX-RN passage (Alameida et al., 2011). When students do not perform well on exit examinations, remediation or specific fully-funded support courses should be part of the plan to improve their chances of passing the NCLEX-RN on the first attempt (Homard, 2013).

Literature Summary

The literature clearly demonstrates a nursing shortage at a time when the demand for care is increasing (Collins-McNeil et al., 2012; Davidson, 2013; Reinhard & Hassmiller, 2012). The aging population coupled with the aging nursing workforce and limited numbers of nursing faculty may exacerbate this shortage (Kaji et al., 2007; Wyte-Lake et al., 2013). However, schools of nursing possess the potential solution to alleviate this

shortage by admitting more students and producing greater numbers of nursing graduates (Hassmiller, 2010). While attempting to admit and graduate more students, nursing programs must wisely consider other factors. When considering increased admissions, nursing programs must identify predictors of program completion and first-attempt NCLEX-RN pass rates to maintain program accreditation and state board approval (Harding et al., 2011). Accrediting bodies and state boards of nursing heavily weigh these criteria when rendering decisions regarding accreditation and approval. Loss of accreditation and/or approval may cause detriment to a program in the form of loss of public and financial support, student interest, and ability to produce students eligible to take the NCLEX-RN (McDowell, 2008).

Studies have investigated predictors of nursing program completion and first-attempt NCLEX-RN success. Some research indicated that demographic variables such as gender and race were correlated with both program completion and first-attempt NCLEX-RN success (Alameida et al., 2011; Homard, 2013; Kowitawakul et al., 2013; Landry et al., 2010). Other research has suggested that non-academic variables such as the meeting of psychosocial needs and students' sense of community were correlated with the criterion variables (Freitas & Leonard, 2011; Jeffreys, 2012; Ooms et al., 2013). While these non-academic variables will not be considered in this study, it seems necessary to include them in this literature review to further illuminate the elusiveness of predictor variables for nursing program completion and first-attempt NCLEX-RN pass rates.

Still, both pre-program and within program academic variables have been investigated with various and sometimes conflicting findings. Given the state of the current literature, the findings lack generalizability based upon demographics and program type.

These varied, non-generalizable findings provide a basis for this study in that it will add to the empirical literature possibly allowing for further triangulation of findings. This addition to current literature may further justify predictors of the criterion variables in order to attenuate the current and potentially worsening nursing shortage.

CHAPTER THREE: METHODS

Introduction

While research has greatly considered predictors of program progression and/or completion and first attempt NCLEX-RN success in Bachelor of Science in Nursing (BSN) programs (Kowitawakul et al., 2013; Simon et al., 2013), the study of associate degree programs remains important since this program type still produces the greatest number of graduates annually who take the National Council Licensure Exam for Registered Nurses (NCLEX Statistics from NCSBN, 2013). Moreover, associate degree nursing programs have been extensively studied in relation to program success and first attempt NCLEX-RN success (De Lima et al., 2011; Gilmore, 2008; Hadenfeldt, 2012; Raman, 2013).

The purpose of this retrospective, predictive correlation study was to test Schema Theory by correlating first attempt non-science co/prerequisite grades (English Composition I, English Composition II, General Psychology, Child Development, and Nutrition & Diet Therapy), successful completion of all non-science co/prerequisite courses prior to the first nursing course, and pre-entry GPA to student persistence and NCLEX-RN success in a traditional associate degree program in the South Atlantic region of the United States while controlling for gender and age. Persistence in nursing was defined as completion of the nursing program within six continuous semesters while NCLEX-RN success will be defined by the result of the NCLEX-RN on the first attempt. Logistic regression was employed to investigate relationships between the predictor variables and each criterion variable (completion of the associate degree nursing program within six semesters and first-attempt NCLEX-RN success). The design, research questions, hypotheses, study participants, setting, procedures, and the statistical analyses for this proposed study will now be discussed.

Design

A retrospective predictive correlation design was utilized for this study as the aim of this study was to examine relationships between the predictor and criterion variables while not implying causation (Warner, 2013). These predictor variables were non-science co/prerequisite course grades, completion of or not completing the non-science co/prerequisite courses prior to taking the first nursing course, and pre-entry GPA for the criterion variables of program completion. The predictor variables for the criterion variable of NCLEX-RN first attempt result were non-science co/prerequisite course grades and final GPA as determined by the degree granting institution. This retrospective methodology has been utilized in previous studies (Emory, 2013; Homard, 2013; Pryjmachuk et al., 2009; Tipton et al., 2008). In reference to correlation or predictive studies, some notate the predictor and criterion variables as independent and dependent (Polit & Beck, 2004). However, in this study, variables were referred to as predictor and criterion variables respectively and the variables will not be manipulated. Furthermore, this research design was appropriate since it utilized data that had already been collected and was not manipulated (LoBiondo & Haber, 2010). The usage of archival data and logistic regression in previously conducted similar studies (Abele et al., 2013; Alameida et al., 2011; Gilmore, 2008; Landry et al., 2010; Newton & Moore, 2009) further justified its usage in this study.

Research Questions

The research questions for this study will be:

RQ1: Is there a statistically significant relationship between first-attempt non-science co/prerequisite course grades and successful program completion for students in a

traditional associate degree nursing program while controlling for the demographic variables of gender and age?

RQ1a: Is there a statistically significant contribution from the demographic variables of gender and age to the model predicting successful program completion for students in a traditional associate degree nursing program?

RQ1b: Is there a statistically significant contribution from pre-entry GPA to the model predicting successful program completion for students in a traditional associate degree nursing program?

RQ1c: Does completion of all non-science co/prerequisite courses prior to taking the first nursing course significantly predict successful program completion for students in a traditional associate degree nursing program?

RQ2: Is there a statistically significant relationship between first-attempt non-science co/prerequisite course grades and first-attempt NCLEX-RN results for students in a traditional associate degree nursing program while controlling for the demographic variables of gender and age?

RQ2a: Is there a statistically significant contribution from the demographic variables of gender and age to the model predicting first-attempt NCLEX-RN results for students in a traditional associate degree nursing program?

RQ2b: Is there a statistically significant contribution from the final overall GPA as calculated by the degree-granting institution to the model predicting first attempt NCLEX-RN results for students in a traditional associate degree nursing program?

Null Hypotheses

H_{01}: There is no statistically significant relationship between first-attempt non-science co/prerequisite course grades and successful program completion for students in a traditional associate degree nursing program while controlling for the demographic variables of gender and age.

H_{01a}: There is no statistically significant contribution from the demographic variables of gender and age to the model predicting successful program completion for students in a traditional associate degree nursing program.

H_{01b}: There is no statistically significant contribution from pre-entry GPA to the model predicting successful program completion for students in a traditional associate degree nursing program.

H_{01c}: Completion of all non-science co/prerequisite courses prior to taking the first nursing course has no significantly predictive relationship to successful program completion for students in a traditional associate degree nursing program.

H_{02}: There is no statistically significant relationship between first-attempt non-science co/prerequisite course grades and first-attempt NCLEX-RN results for students in a traditional associate degree nursing program while controlling for the demographic variables of gender and age.

H_{02a}: There is no statistically significant contribution from the demographic variables of gender and age to the model predicting first-attempt NCLEX-RN results for students in a traditional associate degree nursing program.

H_{02b}: There is no statistically significant contribution from the final overall GPA as calculated by the degree-granting institution to the model predicting first-attempt NCLEX-RN results for students in a traditional associate degree nursing program.

Participants

Participants were obtained via convenience sampling since the data were archived and readily available (Gall et al., 2007). The students, upon entering the program, sign a blanket consent allowing for data collection and analyses related to their pre-admission data and academic progress. The consent indicates that any information utilized for research will be maintained as confidential and that no identifying information will be published (Gall et al, 2007). This confidentiality was maintained throughout the study and will be maintained as such as described later.

Throughout nursing education research, investigators have employed convenience sampling in correlational studies as they utilized archival data (Abele et al., 2013; Raman, 2013). The sample consisted of nursing students in a traditional associate degree program located in the South Atlantic region of the United States. The sample consisted of all students entering the program between August 2008 and January 2010, thereby providing 227 participants. Utilization of this timeframe dismissed the possibility of any student included in the study of having been eligible to take any version of the NCLEX-RN test plan other than the 2010 version. This is important since the blueprint of the test plan changed with the new version in 2013 (NCLEX-RN Examination Test Plan website, 2013). The sample included students who entered the program directly out of secondary education, students who had completed some college course work, students who had transferred from other institutions, and students who were seeking a second degree. Demographic inspection revealed that the participants were 81.1% (n=184) female and

18.9% (n=43) male. The National League for Nursing (National League for Nursing- Nursing Student Demographics website, n.d.) reported that the demographic breakdown nationally for associate degree nursing students was 85% female and 15% male between 2008 and 2009. Between 2009 and 2010, this national demographic was 84% female and 16% male (National League for Nursing- Nursing Student Demographics website, n.d.). Hence, the sample demonstrated a slightly higher percentage of male students than the national demographic for the timeframe of the study.

Warner (2013) indicated that an appropriate sample size is determined by the formula $104 + k$ where k is the number of predictor variables. Tabachnick and Fidell (2013) asserted that an appropriate number of cases for testing multiple correlations is $50 + 8m$ where m is the number of predictor variables. For testing individual correlations, $104 + m$ where m is the number of independent variables is sufficient (Tabachnick & Fidell, 2013). Hence, 109 students would be sufficient for testing individual predictors while 82 cases would be appropriate for testing multiple correlation. Warner (2013) further indicated that it is desirable to obtain considerably larger sample sizes than recommended by formulas. Therefore, the larger sample size of 227 was justified. Even after removal of cases with missing data and outliers, the final sample sizes were 216 and 177 for the successful program completion criterion variable and the first-attempt NCLEX-RN criterion variable respectively.

Setting

Student data from a traditional associate degree nursing program in the South Atlantic region of the United States were utilized. The institution was founded in the early 20th century and initially offered a diploma in nursing to its graduates. It is financially supported by a faith-based institution and is a department in the College of Health Professions at a local university.

The university currently grants an Associate of Science in Nursing and has done so since 1997. The school maintains approval by the state's Board of Examiners for Registered Professional Nurses and national accreditation from the Nurses and the Accreditation Commission for Education in Nursing (ACEN). The ACEN was formerly known as the National League for Nursing Accrediting Commission (NLNAC) until May 6, 2013 (ACEN website, 2013).

From 2008 until the present, the school has accepted 60 students twice a year in January and August. To be admitted into the school of nursing, the applicant must be enrolled in the affiliated university. High school applicants must have a minimum high school grade point average (GPA) of 3.00, a minimum ACT composite score of 21, and a minimum of a "C" in any college course taken. Other applicants must have a high school diploma or General Equivalency Degree (GED), a minimum of a "C" in any non-nursing course taken, and a minimum GPA of 2.00 in college courses taken at the affiliated university and on any other completed college work. Beginning with the class entering the program in January of 2013, applicants must take the Assessment Technologies Institute Test of Essential Academic Skills (ATI TEAS) prior to application. Applicants must attain a minimum of a "basic" level. Per the explanation of results on the ATI TEAS exam, this level indicates that these applicants display a "low level of overall academic preparedness necessary to support learning of nursing-related content" (Wolkowitz, n.d., p. 4).

Students must successfully complete 71 credit hours to graduate from the program. This meets the guidelines of 60 to 120 hours set forth by the United States Department of Education (USDOE website, 2008).

The program is designed to be completed in five semesters if the student is enrolled as full-time status. In this instance, the student will take four semesters of nursing courses while a

semester must be spent prior to program admission to the following courses or their equivalent: anatomy, chemistry, English Composition I, and general psychology. The curriculum is designed for students to complete the nursing courses in four semesters. However, the student may complete the nursing courses in five to six semesters if a part-time track is chosen or if he or she is readmitted after withdrawing from or failing a course.

If a nursing course is failed (an earned grade of less than 76%), or if the student withdraws prior to completion of the course, the student may apply for readmission. Readmission is considered based upon space availability, faculty recommendation, and the student's written plan for future success in the program. However, a student who withdraws from a course or fails to achieve a 76% in a second nursing course will not be reconsidered for readmission. Additionally, if a student fails to achieve a grade of "C" or better in any co/prerequisite course, he or she may not progress while still being subject to the requirements of graduating within six semesters. Table 1 and Table 2 indicate the co/prerequisite course requirements and the nursing courses required in the program.

Upon successful completion of the nursing program, the graduate must apply for licensure and registration with the board of nursing of the state wherein the graduate plans to practice (NCSBN, NCLEX Examinations website, 2013). The graduate must register online or via telephone to take the NCLEX-RN. Registration remains open for 365 days while the appropriate board of nursing determines eligibility (NCSBN, NCLEX Examinations website, 2013). When deemed eligible, the graduate receives an Authorization to Test (ATT) email detailing an approved testing window. The graduate must schedule and take the exam within this approved time frame (NCSBN, NCLEX Examinations website, 2013). The NCLEX-RN is administered via computer at an approved testing center determined at the time of scheduling.

Table 1

Co/Prerequisite Course Requirements for Students in the Identified Nursing Program

Course	Credits (hours)
Human Anatomy (Must be completed with a minimum of "C" prior to taking the first nursing course)	4
Human Physiology	4
Chemistry	3
Microbiology	4
Nutrition & Diet Therapy (Must be taken at the affiliated institution)	3
English Composition I	3
English Composition II	3
General Psychology	3
Child Development	3

Table 2

Required nursing courses for the identified nursing program completion

Course	Credits (hours)
Fundamentals of Nursing	8
Health Alteration I	8
Health Alteration II	8
Health Alteration III	6
Psychiatric Nursing	4
Maternal-Child Nursing	6
Academic Success for the ASN Student	1

Instrumentation

Archival data were utilized for the purposes of this study. The request for data was given in writing to the program director and the admissions secretary. This method is appropriate given the retrospective nature of the study. While some of the data was incomplete, since its initial collection was not for research purposes (Stage & Manning, 2003; White, 2013), the only incomplete data resulted from cases of which all of the non-science co/prerequisite courses had not been taken or cases of which the program was successfully completed but the NCLEX-RN had not been taken. The handling of missing data will be discussed with the Procedures section of the chapter.

Predictor Variables

The first predictor variable was the first attempt grade on each of the following non-science co/pre-requisite courses for this traditional associate degree nursing program: General Psychology, Child Development, English Composition I, English Composition II, and Nutrition & Diet Therapy. Beyond specific nursing content, accrediting bodies such as the National Council of State Boards of Nursing (NCSBN), ACEN, and each state nursing board require other science and general or non-science co/prerequisite courses (Keating, 2011). Operationally, the predictor variables were listed as A, B, C, D, F, or W. The grades of D, F, and W were grouped together as one level of the predictor variable as they all represent an unacceptable level for admission into or progression within the program. It should be noted, however, that each non-science co/prerequisite course grades are reported only as letter grades while the actual grading scales may vary slightly. The A-F grade scale is widely used and accepted in post-secondary education (Rojstaczer & Healy, 2012). This variable was coded with “3”, “2”, “1”, and “0” for A, B, C, and D, F, W respectively.

The second predictor variable was completion of all non-science co/prerequisite courses. This was operationally defined as having completed all of the non-science co/prerequisite courses prior to the first nursing course or not having completed all of the non-science co/prerequisite courses prior to the first nursing course. Students' entry knowledge is important so that they can apply their prior knowledge to learning new nursing material (Billings & Halstead, 2012). The application of previous knowledge rather than the concomitant learning of basic concepts in co-requisite courses may help students better grasp the new nursing concepts they are learning (Bartlett, 1932/1995). This was operationally defined dichotomously as either "no" or "yes" and coded with "0" for noncompletion prior to taking the first nursing course and "1" for completion prior to taking the first nursing course respectively.

The next predictor variable was GPA on a 4-point scale. Pre-entry GPA was utilized as a predictor when examining program completion. Pre-entry GPA was determined by the transcripts provided by each student's previous institution of enrollment. This generally was from the affiliated university. There were some from other universities or community colleges as well. In cases of the latter, the grades in the courses for which credit was granted were utilized for purposes of this study. However, if a student was admitted the semester after graduating high school, the high school GPA was utilized.

The reported GPA on the final submitted transcript for admission consideration was utilized. This may be noted as a limitation to the study. Final overall GPA as calculated by the degree-granting institution was utilized as a predictor variable when examining NCLEX-RN performance. The minimum value for the pre-entry GPA was 2.00 since the requisite GPA for entry is set at this level. Also, the final GPA for final overall GPA was 2.00 given that a student must maintain this level of achievement to remain enrolled in and to graduate from the program.

Control Variables

The variables to be controlled for in this study will be gender and age. This is appropriate because there have been studies utilizing demographic data in the past examining these variable for relationships with the criterion variables of program completion and first-attempt NCLEX-RN passage (Alameida et al., 2011; Homard, 2013; Kowitawakul et al., 2013; Landry et al., 2010). Age will be defined as the years of age provided by the college transcript in the students' files maintained in the admission secretary's office. Gender was dichotomously defined as female or male. This variable was operationally defined dichotomously and coded with "0" and "1" respectively.

Criterion Variables

The first criterion variable will be successful program completion within six semesters. This will be operationally defined dichotomously as either "no" or "yes" and coded with "0" and "1" respectively. This is an appropriate measure because completion within 150% of the minimum semester requirement is a factor in ACEN accreditation (ACEN website, 2013). This is the standard for accredited associate degree nursing programs and an attribute that is considered by students when they seek to attend schools of nursing.

The second criterion variable will be the result of the first-attempt of the NCLEX-RN. This will be operationally defined dichotomously as either "fail" or "pass" and coded with "0" and "1" respectively. This is an appropriate measure since this along with program completion is a measure of program quality (Giddens, 2009; Hadenfeldt, 2012; Simon et al., 2013).

The NCLEX-RN "assesses the knowledge, skills, and abilities that are essential for the entry-level nurse to use in order to meet the needs of clients requiring the promotion, maintenance or restoration of health" (NCLEX-RN Examination Test Plan website, 2013, p. 1).

The exam was changed from the State Board Test Pool Examination (SBTPE) in 1982 by the National Council of State Boards of Nursing (NCSBN) when it changed from a norm-referenced examination to a criterion-referenced examination (NCSBN, 2013c). Since 1994, the NCLEX-RN has been administered via computerized adaptive testing (CAT) in order to shorten examination length, increase availability of administrations, administer only items appropriate for a test taker's ability, and provide enhanced test item security. The candidate will take a minimum of 75 questions and a maximum of 265 questions via multiple formats (Roa, Shipman, Hooten, & Carter, 2011) to determine if he or she is well above or well below the passing standard with 95% certainty (NCSBN, 2013c). If a clear determination cannot be made with 75 questions, the computer continues to ask questions thereby honing in on the candidate's ability more precisely with each question. This occurs until a 95% certainty of the student's ability is determined, until the maximum number of questions is asked, or until time elapses (NCSBN, 2013c).

Given the evolving nature of nursing, the test plan must be reevaluated and changed periodically to assess the validity of the NCLEX-RN (Wendt, Kenny, & Brown, 2010). In analyzing the test plan, "Care is taken to ensure all administered tests are psychometrically sound, the content is valid, and the tests are legally defensible" (Woo & Dragan, 2012, p. 29). In doing this, the NCSBN diligently assesses for the potential biases such as gender or ethnic bias (Woo & Dragan, 2012).

The test plan is reevaluated every three years by the NCSBN and revised based upon four major areas of client needs: safe and effective care environment, health promotion and maintenance, psychosocial integrity, and physiological integrity (NCLEX-RN Examination Test Plan website, 2013). The test plan further assesses the following subcategories: management of

care, safety and infection control, basic care and comfort, pharmacological and parenteral therapies, reduction of risk potential, and physiological adaptation (NCLEX-RN Examination Test Plan website, 2013). The percentages of each of these major areas and their subcomponents are adjusted based upon a periodic practice analysis and expert opinion of the NCLEX Examination Committee (NCLEX-RN Examination Test Plan website, 2013). The most recent test plan update was implemented in April 2013 and was based upon the practice analysis of 12,000 recently licensed registered nurses (NCLEX-RN Examination Test Plan website, 2013). The explanation of the variables along with their theoretical support are itemized in Table 3.

Table 3

Variable Explanation and Theoretical Support

Variable	Theory or Research	Data Source	Unit of Analysis
First-Attempt Non-Science Co/prerequisite Course Grades	Schema Theory (Bartlett, 1932/1995)	Transcripts provided in students' archived application files	A, B, C, D, F, W (D, F, and W will be grouped together as these represent unacceptable levels for admission into the program)
Completion Of All Non-Science Co/prerequisite Courses Prior To Taking The First Nursing Course	Gregory et al. (2013); Non-traditional Attrition Theory (Metzner & Bean, 1987)	Transcripts provided in students archived application files	Yes/No
Demographic Data - Age	General Systems Theory (Bertalanffy, 1950); Non-traditional Attrition Theory (Metzner & Bean, 1987)	Transcripts provided in students' archived application files	Years of age upon program entry
- Gender		Transcripts provided in students' archived application files	Male/Female

Table 3 Continued

Variable	Theory or Research	Data Source	Unit of Analysis
Overall Final GPA	General Systems Theory (Bertalanffy, 1950)	Transcripts provided in students' archived application files	
Program Completion	Schema Theory (Bartlett, 1932/1995)	Archived student records	Yes/No
First-Attempt NCLEX-RN Results	Schema Theory (Bartlett, 1932/1995)	Archived student records	Pass/Fail

Procedures

Written permission to collect data at the school of nursing was obtained. A letter was written to the director of the nursing school requesting permission to access the student records for purposes of research. Institutional Review Board (IRB) approval from Liberty University was obtained and permission to implement the research protocol was granted. Immediately after obtaining IRB approval from Liberty University, IRB approval from the school of nursing where data will be collected was sought. After an expedited review, permission to implement the intended protocol was granted based upon the previous Liberty University IRB approval. A formal request for the records was made in writing to the program director and admissions secretary at the targeted school of nursing. Upon approval, the academic records were provided to the principal investigator. Some information was provided on hard-copy spreadsheets and the student files were made available to the researcher. The files were provided to the researcher in a secure records room where the data were transcribed and entered into Microsoft Excel®. After obtaining the data, the files were relinquished back to the admission secretary. The students'

names were noted on the records. However, no personal or identifying data was or will be disclosed or published in order to maintain confidentiality and anonymity. These records contained first attempt grades for all of the co/prerequisite courses. Additionally, the records contained the demographic data of age and gender along with any history of prior healthcare experience, pre-entry GPA, and final overall GPA. Whether or not each student completed all of the non-science co/prerequisites was determined by reviewing the student grades and determining if each course was completed prior to the semester of entry into the nursing program. To further protect anonymity, the names were replaced with sequential case numbers beginning with 1 and ending with 227. The data transcribed into Microsoft Excel® format were imported into the Statistical Package for the Social Sciences (SPSS) Version 22. The hard copy data transcribed from the transcripts by the researcher were maintained in the researcher's office in a locked file cabinet. The researcher maintained the only key to this file cabinet. Confidentiality and anonymity of the digital data transcribed by the researcher was maintained on the researcher's personal password-protected Sony Vaio laptop computer. Only the researcher retained the password to this computer. Additionally, the data was backed up onto a dedicated portable USB thumb drive. When not directly in possession of the researcher, the thumb drive was maintained in the aforementioned file cabinet. The information was not made available to anyone other than the researcher and the committee. When the data was discussed, no names or identifying components were divulged. Again, any personal or identifying factors have not and will not be published to maintain anonymity. The hard copy data transcribed by the researcher will continue to be maintained in the researcher's personal file cabinet for a period of three years from the completion of the study. The transcribed digital data will continue to be maintained on a dedicated portable USB memory thumb drive. At the end of the three years, the

hard copy data will be shredded and disposed of in a secure document disposal bin. The digital data will be deleted from the dedicated portable USB memory thumb drive and the USB memory thumb drive will be destroyed and disposed of in an environmentally sound manner. The statistical analysis is discussed in the next section.

Data Analysis

Logistic regression will analyze each null hypothesis since each criterion variable is categorical, and more specifically, dichotomous (Polit & Beck, 2004; Warner, 2013). Logistic regression presents few restrictions and remains a viable option for investigation of all levels of predictors (Warner, 2013). Given that this study contains dichotomous criterion variables, it is appropriate for this study.

Utilizing SPSS® Version 22, the researcher conducted logistic regression analysis upon each criterion variable by entering the control variables of age and gender and the remaining covariates into blocks in order to construct a model. In contrast to linear regression, logistic regression relies on predicting into which category a subject will fall based upon a logarithmic model and provision of odds ratios whereas the former predicts a value of Y based upon X in linear model. Logistic regression demonstrates a model that is sigmoidal in nature while the linear regression provides a linear model (Warner, 2013).

Even though assumptions need not be as restrictive as other statistical analyses, assessing these assumptions may still possess value (Warner, 2013) and increase power (Tabachnick & Fidell, 2013). Wright (1995) asserted that variables in logistic regression must demonstrate the presence of an exhaustively exclusive dichotomous criterion variable with statistically independent scores and the inclusion of all relevant predictors while excluding irrelevant predictors when constructing the model. When conducting logistic regression, adherence to the

meeting of statistical assumptions remains flexible in that it is not necessary to have predictor variables demonstrate a normal distribution, a linear relationship to the criterion variable or an equal variance within groups (Tabachnick & Fidell, 2013). Even with these relaxed restrictions upon the assumptions, Tabachnick and Fidell (2013) recommend assessing ratio of cases to independent variables and any missing data, assessing for linearity between continuous predictor variables and the logit of the criterion variable, assessing for multicollinearity, and assessing for outliers in the solution in the absence of good model fit when conducting a logistic regression analysis. Tabachnick and Fidell (2013) and Warner (2013) also emphasize the importance of assessing for outliers within variables and making sound judgments on the methods of handling them.

Warner (2013) indicated that logistic regression is not as robust in the presence of less than five frequencies for any of the predictor variable cells. In the instance of having too few cases in relation to the predictor variables, it is recommended to combine categories within the predictor variable, delete the category, or delete the entire variable if it does not weigh heavily into the construction of the model (Tabachnick & Fidell, 2013). Each of the variables were analyzed and the frequencies within each predictor variable cell.

The presence a dichotomous criterion variable depletes the possibility of a true linear relationship between the predictor and criterion variables. Therefore, there are no assumptions of linearity between the variables themselves (Tabachnick & Fidell, 2013). Yet, a more stringent assumption of a linear relationship between the continuous predictor variables and the logit of the criterion variable persists (Warner, 2013). The Box-Tidwell transformation assessed the tenability of linearity of the logit assumption. To conduct the Box-Tidwell transformation, the researcher added a term comprised of a continuous predictor variable multiplied by its natural

logarithm to the regression equation. The absence of significance for this variable's coefficient implies tenability of the linearity of the logit. An acceptable level of significance is determined by dividing the overall level of significance, which is .05 for this study, by the number of terms generated by the transformation. If significance for any of the coefficients is evident, linearity of the logit is not tenable (Menard, 2010).

The researcher assessed for multicollinearity between the ordinal predictor variables (grades on each of the non-science co/prerequisites and completion of these courses prior to the first nursing course). Multicollinearity represents "the degree of intercorrelation among predictor variables" (Warner, 2013, p. 1100). It is important to have absence of multicollinearity in regression analyses since each level of the predictor variable may be a better individual predictor if it is less correlated with other predictor variables. In the presence of multicollinearity it becomes more difficult to appreciate each predictor's unique contributions to the regression model (Gall et al., 2007; Warner, 2013). Assessment of multicollinearity was achieved in this study by examining the tolerance values and the variance inflation factors of the predictor variables. Multicollinearity diagnostics were conducted in SPSS® to assess tolerance values and variance inflation factors. Tolerance can demonstrate values from 0 to 1. A criterion variable having a value of 0 represents perfect multicollinearity indicating that no further predictive can be added by this variable. A criterion variable with a tolerance value of 1 represents no correlation with other criterion variables (Warner, 2013). Hence, higher values are desired to deem the assumption tenable. The variance inflation factor (VIF) is the inverse of the tolerance value. To demonstrate absence of multicollinearity the tolerance values should be greater than .10 while the variance inflation factors should be less than 10 (Tabachnick & Fidell, 2013; Warner, 2013).

The researcher assessed for any missing data within each data set. Any case with missing data was excluded. The researcher first assessed for any missing data within the successful program completion data set. The only possible data to be missing from here would be grades in the non-science co/prerequisite courses given that a student may not have completed them before exiting the program prior to successful completion. When assessing for missing data within the first-attempt NCLEX-RN data set, the only data to possibly be missing was the indication of pass or fail on the NCLEX-RN first attempt given that all of the other data was necessary for the successful program completion which is requisite for a student to have taken the NCLEX-RN.

The researcher assessed for outliers through inspection of the standardized residuals. Standardized residual scores were calculated by SPSS® for each of the data sets. Warner (2013) asserted that it is important for the researcher to determine how he or she will handle the outliers within the data. For purposes of this study, cases were excluded when the standardized residual was less than -3.3 or greater than 3.3 as discussed by Warner (2013) given that 99% of the outliers should be within +3 and -3 standard deviations.

The level of significance for each null hypothesis was set at .05 given that this is a common and acceptable level in research (Cowles & Davis, 1982). Findings at this level of significance will not empirically solidify the rejection of a null hypothesis. Although, this may be achieved through replication and aggregation of all findings in this and future studies (Cohen, 1990).

Nagelkerke R^2 and Cox and Snell R^2 were reported in each regression analysis. However, they are not seen as true measures of the true effect size. They are often referred to as a pseudo R^2 since there is no linear relationship between the predictor and criterion variables and they usually severely underestimate or overestimate the effect size but are similarly comparable to a

true multiple *R* (Warner, 2013). Yet, these values are still considered in determining the fit of a regression model when implementing binary logistic regression. Odds ratios regarding outcomes of each criterion variable as a function of the predictor variable were determined and represented the effect size (Warner, 2013). The odds ratio is the "change in odds of being in one of the categories of outcome when the value of a predictor increases by one unit" (Tabachnick & Fidell, 2013, p. 463). Odds ratios with levels greater than 1 indicate an increase of odds for the outcome being evaluated while levels less than 1 indicate a decrease in odds for the outcome being evaluated (Tabachnick & Fidell, 2013).

When assessing for relationships and predictive ability of the identified predictor variables in relation to the criterion variable of successful completion, binary logistic regression was chosen by the researcher within SPSS®. The data were entered in 2 blocks. In analyzing the successful program completion criterion variable, age and gender were entered into the first data block since they are causally prior to the other predictor variables and are being controlled for (Tabachnick & Fidell, 2013). The researcher sought to determine if these variables contributed to the prediction model. The non-science co/prerequisite course grades, whether or not the student completed these courses prior to taking the first nursing course in the program, and pre-entry GPA were entered into the second block as predictor variables.

When considering the NCLEX-RN performance criterion variable, age and gender as the control variables were once again entered into the first data block since they were causally prior to the predictor variable of the grades in the non-science co/prerequisite courses (Tabachnick & Fidell, 2013). As with the previous criterion variable examining program completion, the research sought to determine if these variables contributed to the NCLEX-RN prediction model. The grades in the non-science co/prerequisite courses along with the final overall GPA as

calculated by the degree-granting university were entered into the second block. The data produced by SPSS® was then analyzed and reported by the researcher. Table 4 demonstrates the hierarchical entry order of the predictor variables for analysis of the program completion criterion variable while Table 5 demonstrates hierarchical entry order of the predictor variables for analysis of the first-attempt NCLEX-RN result criterion variable. Additionally, Table 6 itemizes and explains the statistical analyses utilized in the study.

Table 4

Hierarchical Data Entry Blocks for Program Completion Variable

Hierarchical Data Entry Blocks	Variables
Block 1	Demographic Data Age at time of program entry Gender
Block 2	Non-science co/prerequisite course grades Completion of non-science co/prerequisite courses prior to taking the first nursing course Pre-entry GPA

Table 5

Hierarchical Data Entry Blocks for NCLEX-RN Performance Variable

Hierarchical Data Entry Blocks	Variables
Block 1	Demographic data Age at time of program entry Gender
Block 2	Non-science co/prerequisite course grades Final overall GPA

Table 6

Data Analysis with Explanations

Data Analysis	Purpose
Box-Tidwell Transformation	Assesses for linearity of the logit of the criterion variable (Menard, 2011)
Logistic Regression	Evaluates the strength of relationship between predictor and criterion variables in multiple steps in order to control for the effects of temporally antedated or previously understood contributions to the regression model (Tabachnick & Fidell, 2013)
Odds Ratios	Assesses how criterion variables will be affected by a one-unit change in the predictor variable (Tabachnick & Fidell, 2013)
Inspection of Residuals	Assesses the data for outliers (Tabachnick & Fidell, 2013)
Tolerance Values	Assesses multicollinearity between the predictor variables (Warner, 2013)
Variance Inflation Factor	Assesses multicollinearity between the predictor variables (Warner, 2013)

CHAPTER FOUR: FINDINGS

Introduction

This study assessed for relationships between the first-attempt grades in non-science co/prerequisite courses (English Composition I, English Composition II, General Psychology, Child Psychology, and Nutrition & Diet Therapy) and both successful program completion and first-attempt NCLEX-RN performance for students in a traditional associate degree nursing program in the South Atlantic region of the United States. This study controlled for the demographic variables of age and gender in relation to both criterion variables. Further examination investigated the potential relationships between pre-entry GPA and completion or noncompletion of the non-science co/prerequisite courses prior to taking the first nursing course upon the first criterion variable of successful program completion. Regarding first-attempt NCLEX-RN performance, the researcher investigated potential relationships between the first-attempt NCLEX-RN performance and the grades in the non-science co/prerequisite courses and the overall GPA as determined by the degree granting university.

Research Questions

The following questions guided this study:

RQ1: Is there a statistically significant relationship between first-attempt non-science co/prerequisite course grades and successful program completion for students in a traditional associate degree nursing program while controlling for the demographic variables of gender and age?

RQ1a: Is there a statistically significant contribution from the demographic variables of gender and age to the model predicting successful program completion for students in a traditional associate degree nursing program?

RQ1b: Is there a statistically significant contribution from pre-entry GPA to the model predicting successful program completion for students in a traditional associate degree nursing program?

RQ1c: Does completion of all non-science co/prerequisite courses prior to taking the first nursing course significantly predict successful program completion for students in a traditional associate degree nursing program?

RQ2: Is there a statistically significant relationship between first-attempt non-science co/prerequisite course grades and first-attempt NCLEX-RN results for students in a traditional associate degree nursing program while controlling for the demographic variables of gender and age?

RQ2a: Is there a statistically significant contribution from the demographic variables of gender and age to the model predicting first-attempt NCLEX-RN results for students in a traditional associate degree nursing program?

RQ2b: Is there a statistically significant contribution from the final overall GPA as calculated by the degree-granting institution to the model predicting first attempt NCLEX-RN results for students in a traditional associate degree nursing program?

Hypotheses

The following are the null hypotheses:

H_{01}: There is no statistically significant relationship between first-attempt non-science co/prerequisite course grades and successful program completion for students in a traditional associate degree nursing program while controlling for the demographic variables of gender and age.

H_{01a}: There is no statistically significant contribution from the demographic variables of gender and age to the model predicting successful program completion for students in a traditional associate degree nursing program.

H_{01b}: There is no statistically significant contribution from pre-entry GPA to the model predicting successful program completion for students in a traditional associate degree nursing program.

H_{01c}: Completion of all non-science co/prerequisite courses prior to taking the first nursing course has no significantly predictive relationship to successful program completion for students in a traditional associate degree nursing program.

H_{02}: There is no statistically significant relationship between first-attempt non-science co/prerequisite course grades and first-attempt NCLEX-RN results for students in a traditional associate degree nursing program while controlling for the demographic variables of gender and age.

H_{02a}: There is no statistically significant contribution from the demographic variables of gender and age to the model predicting first-attempt NCLEX-RN results for students in a traditional associate degree nursing program.

H_{02b}: There is no statistically significant contribution from the final overall GPA as calculated by the degree-granting institution to the model predicting first-attempt NCLEX-RN results for students in a traditional associate degree nursing program.

Descriptive Statistics

The researcher conducted descriptive statistical analysis on each data set prior to performing logistic regression on three data sets. Two data sets were analyzed when investigating variables related to successful program completion. One regression with the

outliers retained and one with the outliers excluded were conducted and reported in this study. Outliers were determined by inspecting the standard residuals < -3.3 and > 3.3. The researcher conducted a third regression to analyze potential relationships between the predictor variables and first-attempt NCLEX-RN results. The number of cases for the NCLEX-RN results was less than those in the regression analyzing program completion since only those completing the program successfully may take the NCLEX-RN. The rationale for opting to retain or exclude outliers in this study is discussed in greater detail in the subsequent section explaining the assumption testing and data screening.

When the researcher conducted the regression analysis investigating successful program completion with the outliers excluded, there were 216 cases. The sample excluding the outliers was 81.0% (n = 175) female and 19.0% (n = 41) male while the sample demonstrated a mean age upon entry into the program of 26.50 (*SD* = 6.99) years. The mean pre-entry GPA was 3.08 (SD = .48) and 67.6% (n = 146) did not complete the non-science co/prerequisites prior to taking the first nursing course. Additionally, 32.4% (n = 70) did complete these co/prerequisites prior to taking the first nursing course. Finally, 82.4% (n = 178) successfully completed the program while 17.6% (n = 38) did not successfully complete the program.

When the researcher retained the outliers < -3.3 and > +3.3 pertaining to the successful program completion variable, this method provided 218 cases for analysis. There sample was 81.2% (n = 177) female and 18.8% (n = 41) male while the sample demonstrated a mean age upon entry into the program of 26.43 (SD = 6.99) years. The mean pre-entry GPA was 3.08 (*SD* = .47) and 67.9% (n = 148) did not complete the non-science co/prerequisites prior to taking the first nursing course while 32.1% (n = 70) did

complete these co/prerequisites prior to taking the first nursing course. Finally, 81.65% (n = 178) successfully completed the program while 18.35% (n = 40) did not successfully complete the program. The demographic and variable data regarding the program completion variable with the outliers excluded are presented in Table 7 while these data with the retention of outliers are presented in Table 8.

In analyzing the first-attempt NCLEX-RN result variable, there were 177 cases. One case was excluded due to that individual not taking the NCLEX-RN at the time of the data collection. There were outliers with standard residuals <-3.3 and >3.3. However, the outliers were retained for this study. This rationale is also discussed in the subsequent section explaining the assumption testing and data screening. The gender breakdown of this sample was 80.8% (n = 143) female and 19.2% (n = 34) male while the sample demonstrated a mean age upon entry into the program of 26.20 (SD = 6.79) years. The mean overall GPA as calculated by the degree granting institution was 3.00 (*SD* = .42) and 94.9% (n = 168) passed the NCLEX-RN on the first attempt while 5.1% (n = 9) were not successful on the first attempt of the NCLEX-RN. The demographic and variable data regarding the first-attempt NCLEX-RN result variable are presented in Table 9.

Table 7

Descriptive Statistics for Program Completion Variable with Outliers Excluded

Variables	
Participants	N
	216
Age	*M (SD)*
	26.50 (6.99)
Gender	n (%)
Male	41 (19.0)
Female	175 (81.0)
Grades in Non-Science Co/prerequisite courses	n (%)
English Composition I	
A	98 (45.4)
B	80 (37.0)
C	29 (13.4)
D, F, or W	9 (4.2)
English Composition II	
A	92 (42.6)
B	68 (31.5)
C	32 (14.8)
D, F, or W	24 (11.1)
General Psychology	
A	85 (39.4)
B	82 (38.0)
C	30 (13.9)
D, F, or W	19 (8.8)
Child Psychology	
A	101 (46.8)
B	77 (35.6)
C	26 (12.0)
D, F, or W	12 (5.6)
Nutrition and Diet Therapy	
A	116 (53.7)
B	75 (34.7)
C	21 (9.7)
D, F, or W	4 (1.9)

Table 7 Continued

Variables	
Completed All Non-Science Co/prerequisites Before the First Nursing Course	n (%)
Yes	70 (32.4)
No	146 (67.6)
Pre-entry GPA	*M (SD)*
	3.08 (.48)
Program Completion	N (%)
Successfully Completed	178 (82.4)
Did Not Successfully Complete	38 (17.6)

Table 8

Descriptive Statistics for Program Completion Variable with Outliers Retained

Variables	
Participants	N
	218
Age	*M (SD)*
	26.43 (6.99)
Gender	n (%)
Male	41 (18.8)
Female	177 (81.2)
Grades in Non-Science Co/prerequisite courses	n (%)
English Composition I	
A	98 (45.0)
B	82 (37.6)
C	29 (13.3)
D, F, or W	9 (4.1)
English Composition II	
A	94 (43.1)
B	68 (31.2)
C	32 (14.7)
D, F, or W	24 (11.0)
General Psychology	
A	85 (39.0)
B	84 (38.5)
C	30 (13.8)
D, F, or W	19 (8.7)
Child Psychology	
A	102 (46.8)
B	77 (35.3)
C	27 (12.4)
D, F, or W	12 (5.5)
Nutrition and Diet Therapy	
A	118 (54.1)
B	75 (34.4)
C	21 (9.6)
D, F, or W	4 (1.8)

Table 8 Continued

Variables	
Completed All Non-Science Co/prerequisites Before the First Nursing Course	n (%)
Yes	70 (32.1)
No	148 (67.9)
Pre-entry GPA	*M (SD)*
	3.08 (.47)
Program Completion	N (%)
Successfully Completed	178 (81.7)
Did Not Successfully Complete	40 (18.3)

Table 9

Descriptive Statistics for First-Attempt NCLEX-RN Results Variable

Variables	
Participants	N
	177
Age	*M (SD)*
	26.20
	(6.79)
Gender	n (%)
Male	34 (19.2)
Female	143 (80.8)
Grades in Non-Science Co/prerequisite courses	n (%)
English Composition I	
A	86 (48.6)
B	62 (35.0)
C	20 (11.3)
D, F, or W	9 (5.1)
English Composition II	
A	79 (44.6)
B	56 (31.6)
C	26 (14.7)
D, F, or W	16 (9.0)
General Psychology	
A	77 (43.5)
B	63 (35.6)
C	23 (13.0)
D, F, or W	14 (7.9)
Child Psychology	
A	82 (46.3)
B	65 (36.7)
C	20 (11.3)
D, F, or W	10 (5.6)
Nutrition and Diet Therapy	
A	103 (58.2)
B	60 (33.9)
C	13 (7.3)
D, F, or W	1 (.6)

Table 9 Continued

Variables	
Final Overall GPA as Calculated by the Degree-Granting Institution	*M (SD)*
	3.00 (.42)
First-Attempt NCLEX-RN Result	N (%)
Pass	168 (94.9)
Fail	9 (5.1)

Results

Assumption Tests and Data Screening

In analyzing the first research question and its subquestions regarding successful program completion, there were 227 cases in the initial data set. After this initial analysis, nine cases were determined to have missing data resulting in 218 cases for data analysis. The missing data resulted from nine students not taking all of the co/prerequisite courses for the first time prior to exiting the program before successful completion thereby resulting in their exclusion. Prior to running the descriptive statistics, the researcher calculated standardized residuals for this data set. Inspection of these residuals revealed two cases demonstrating values of less than -3.3 while there were no cases greater than +3.3. Exclusion of the two cases with values less than -3.3 provided 216 cases for the study. This exclusion was appropriate given the previously discussed method of exclusion (Warner, 2013). However, both data sets with retention and exclusion of the outliers were reported in this study.

Each sample size was deemed adequate by exceeding Warner's (2013) recommendations suggesting a minimum sample size of $104 + k$ where k is the number of predictor variables. This sample sizes also exceeded the assertion of Tabachnick and Fidell

(2013) indicating that an appropriate number of cases for this regression is *50 + 8m* where *m* is the number of predictor variables. The study of the criterion variable regarding successful program completion required a minimum of 109 based upon Warner's assertion or 90 based upon Tabachnick and Fidell. The sample size in this portion of the study exceeded the calculated minimum requirements. Moreover, there were not less than five frequencies in any of the predictor variable cells negating the necessity of collapsing or deleting variables in attempting model construction.

Linearity between the predictor variables and criterion variables was not assessed as it is not necessary in logistic regression. The researcher did however assess for linearity of the logit of the criterion variable, a more critical assumption in regression analyses, via the Box-Tidwell transformation. To conduct the Box-Tidwell transformation, the researcher created terms consisting of each continuous variable and its natural logarithm and conducted binary regression in SPSS (Menard, 2010). The significance of the results were reviewed to validate linearity of the logit. An appropriate level of significance for this analysis was determined by dividing the existing α level by the number of terms in the regression results (Tabachnick & Fidell, 2013). The results of the Box-Tidwell transformation provided 15 terms while $\alpha = .05$. Therefore, a reasonable level of significance in this case would be $\alpha = .003$. Upon inspection of the coefficients, none demonstrated significance at this level. The assumption of linearity of the logit was deemed tenable.

The researcher conducted analysis for multicollinearity between the predictor variables in the data sets investigating the successful program completion criterion variable in SPSS® by examining the tolerance values and variance inflation factors (VIF). The

tolerance values remained high with no tolerance level demonstrating a value of less than .734. This value should be greater than .10 to demonstrate absence of multicollinearity. As tolerance values approach a value of 1, a lesser likelihood of multicollinearity exists. The VIF remained low, as expected, given that it is the inverse of the tolerance value. No VIF greater than 1.362 was evident in the analysis. This value should be less than 10 to indicate absence of multicollinearity. The assumption of absence of multicollinearity was deemed tenable.

In analyzing the second research question and its subquestions regarding first-attempt NCLEX-RN success, there were 178 cases in the initial data set. Only those cases demonstrating successful program completion were included in this initial data set as completion of the program was requisite for a subject to have taken the NCLEX-RN. Upon inspection of missing data, one case had not taken the NCLEX-RN at the time of the data collection. This case was excluded leaving 177 cases upon which to calculate standardized residuals. Prior to running the descriptive statistics, the researcher calculated standardized residuals for this data set. Inspection of these residuals revealed six cases demonstrating values less than -3.3 while there were no cases greater than +3.3. Exclusion of the six cases with values less than -3.3 would have resulted in only three (1.8%) cases demonstrating failure thereby violating one of the assumptions warning against having less than five cases within a cell. It is recommended when this occurs to attempt to omit the variable or collapse the categories to pool a larger sample group. However, being dichotomous, no way existed to collapse the categories. Furthermore, no additional cases or data were available to augment existing data in order to increase the sample size given that only subjects taking the 2010 NCLEX-RN test plan version were investigated. Hence, these

outliers were not excluded and were maintained as part of the data set for analysis. The researcher will address this in the Discussion section of this study.

The sample size of 177 for analyzing this criterion variable of first-attempt NCLEX-RN result was deemed adequate by Warner's (2013) recommendations suggesting a minimum sample size of $104 + k$ where k is the number of predictor variables. This sample size also exceeded the assertion of Tabachnick and Fidell (2013) indicating that an appropriate number of cases for this regression is $50 + 8m$ where m is the number of predictor variables. This study required a minimum of 108 cases based upon Warner's assertion or 82 based upon Tabachnick and Fidell. The sample size in this portion of the study exceeded the calculated minimum requirements.

Once again, linearity between the predictor and criterion variables were not assessed given it is not necessary to meet this assumption with logistic regression. The researcher conducted the Box-Tidwell transformation for the data set analyzing the first-attempt NCLEX-RN variable criterion variable via the previously described method. The results of this Box-Tidwell transformation provided 14 terms while $\alpha = .05$. Therefore, a reasonable level of significance in this case would be $\alpha = .004$. Upon inspection of the coefficients, none demonstrated significance at this level. The assumption of linearity of the logit was deemed tenable.

The researcher conducted analysis for multicollinearity between the predictor variables in the data set investigating the first-attempt NCLEX-RN result criterion variable in SPSS® by examining the tolerance values and variance inflation factors (VIF). The tolerance values once again remained high with no tolerance level demonstrating a value of

less than .781. As well, the VIF remained low with no value greater than 1.281 in the analysis. Each of these values demonstrated absence of multicollinearity.

Null hypotheses $H_{01,}$ $H_{01a,}$ $H_{01b,}$ and H_{01c} addressed the successful program completion variable. For these hypotheses, the researcher conducted logistic regression analysis via SPSS® upon each data set (with outliers excluded and outliers retained) by entering the predictor variables of age upon entry into the program and gender into the first block as they were controlled for in the study. The variable of gender was identified as categorical for proper syntax within SPSS®. The grades in each of the non-science course co/prerequisites, whether or not the co/prerequisites were successfully completed prior to beginning the first nursing course, and the pre-entry GPA were entered into the second block. The variable of whether or not the student successfully completed all of the non-science course co/prerequisites prior to taking the first nursing course was identified as categorical for proper syntax within SPSS®.

Null hypotheses $H_{02,}$ $H_{02a,\ and}$ H_{02b} addressed the first-attempt NCLEX_RN result variable. As with the previous null hypotheses, the researcher conducted logistic regression analysis via SPSS® upon each data set (with outliers excluded and outliers retained) by entering the predictor variables of age upon entry into the program and gender into the first block as they were controlled for in the study. The variable of gender was identified as categorical for proper syntax within SPSS®. The researcher entered the grades in each of the non-science course co/prerequisites and final overall GPA as calculated by the degree-granting institution into the second block.

Null Hypothesis H_{01}

This null hypothesis asserted first-attempt non-science co/prerequisite courses as defined in this study had no significant relationship to successful completion in a traditional associate degree nursing program. The grades in these courses were entered into the second block of the regression analysis along with pre-entry GPA and whether or not the student completed all of the non-science co/prerequisite courses prior to beginning the first nursing course. This step of data entry followed the first block of data entry controlling for the demographics of age and gender. The analysis of the second block represented the final prediction model. The researcher conducted regression analyses with both the outliers excluded and retained.

In the second data block consisting of the grades in the non-science co/prerequisite courses, whether or not the student completed all of the non-science co/prerequisite courses prior to beginning the first nursing course and the preadmission GPA with the outliers excluded, the omnibus test of model coefficients demonstrated significance of the model, X^2 (9, N = 216) = 29.565, p = .001. In comparison to the constant only model, the Hosmer and Lemeshow analysis demonstrated adequate model fit once again as the findings were not significant within this particular analysis, X^2 (8, N = 216) = 8.510, p = .385. This final model explained 12.8% or 21.1% of the variance as evidenced by Cox and Snell R^2 and Nagelkerke R^2 respectively when the outliers were excluded.

A very small change in correctly classified cases into either the successfully completed or did not successfully complete outcome dichotomy was appreciated with the final model. The constant only model demonstrated an 82.4% correct prediction rate with no increase in predictive accuracy at the first block of data entry while the final model

predicted correctly only 82.9%. The model predicted noncompletion in only 13.2% of cases while prediction for successful program completion was 97.8% accurate.

The only variable demonstrating significance within the final model when the outliers were excluded was the grade in the Nutrition and Diet Therapy course, X^2 (1, N = 216) = 13.814, p = .000. The results indicated that for every increase in letter grade in the Nutrition and Diet Therapy course, students were 2.76 times more likely to successfully complete the program. The final regression coefficient table with the exclusion of outliers demonstrates the results of the regression analysis for the successful program completion criterion variable.

Upon inspection of this second block of data entry consisting of the aforementioned variables of first-attempt grades in the non-science co/prerequisite courses, pre-entry GPA, and whether or not the student completed the non-science co/prerequisite courses prior to taking the first nursing course with the outliers retained, the omnibus test of model coefficients demonstrated significance of the model, X^2 (9, N = 218) = 24.314, p = .004 in comparison to the constant only model. The Hosmer and Lemeshow analysis demonstrated adequate model fit once again as the findings were not significant within this particular analysis, X^2 (8, N = 218) = 2.915, p = .940. This final model explained 10.6% or 17.2% of the variance as evidenced by Cox and Snell R^2 and Nagelkerke R^2 respectively when the outliers were retained.

A very small change in correctly classified cases into either the successfully completed the program or did not successfully complete the program outcome dichotomy was appreciated with the final model. The constant only model demonstrated an 81.7% correct prediction rate with no increase in predictive accuracy at the first block of data entry

while the final model predicted correctly only 82.1%. The model predicted noncompletion in only 10.0% of cases while prediction for successful program completion was 98.3% accurate.

The only variable demonstrating significance within the final model was the grade in the Nutrition and Diet Therapy course, X^2 (1, N = 218) = 11.637, p = .000. The results indicated that for every increase in letter grade in the Nutrition and Diet Therapy course, students were 2.43 times more likely to successfully complete the program. Given this similar finding when the outliers were either excluded or retained, the researcher rejected this null hypothesis.

Null Hypothesis H_{01a}

This null hypothesis asserted the control variables of age and gender did not significantly contribute to the prediction of successful program completion in a traditional associate degree nursing program. Upon inspection of the first block of data entry consisting of the control variables of age and gender when the outliers were excluded, the omnibus test of model coefficients was not found to be significant, X^2 (2, N = 216) = 1.308, p = .520 in comparison to the constant only model. However, the Hosmer and Lemeshow analysis did demonstrate adequate fit at this step as the findings were not significant within this particular analysis, X^2 (8, N = 216) = 8.068, p = .427. At this step, the model did not explain any variance in the outcome variable as evidenced by a Cox and Snell R^2 value of .006 (0.6%) and Nagelkerke R^2 value of .01 (1%). When excluding the outliers, the researcher did not reject the null hypothesis based upon the findings.

Upon inspection of the first block of data entry consisting of the control variables of age and gender when the outliers were retained, the omnibus test of model coefficients was

not found to be significant, X^2 (2, N = 218) = .675, p = .714 in comparison to the constant only model. However, the Hosmer and Lemeshow analysis did demonstrate adequate fit at this step as the findings were not significant within this particular analysis, X^2 (8, N = 218) = 8.276, p = .407. At this step, the model did not explain any variance in the outcome variable as evidenced by a Cox and Snell R^2 value of .003 (0.3%) and Nagelkerke R^2 value of .005 (0.5%). When retaining the outliers, the researcher did not reject this null hypothesis.

Null Hypothesis H_{01b}

This null hypothesis asserted there was no significant contribution of the pre-entry GPA to the model predicting successful program completion in a traditional associate nursing degree program. In the regression, this relationship was analyzed in the second block of data entry along with the grades in the non-science co/prerequisite courses and whether or not the student completed all of these courses prior to taking the first nursing course with both the outliers excluded and retained. Pre-entry GPA did not significantly contribute to the model predicting successful program completion in a traditional associate degree nursing program, X^2 (1, N = 216) = 1.473, p = .225 when the outliers were excluded and X^2 (1, N = 218) = .979, p = .432 when the outliers were retained. The researcher did not reject this null hypothesis.

Null Hypothesis H_{01c}

This null hypothesis asserted completion of all non-science co/prerequisite courses prior to taking the first nursing course did not contribute to successful program completion for students in a traditional associate degree nursing program. In the regression, this relationship was analyzed in the second block of data entry along with the grades in the

non-science co/prerequisite courses and pre-entry GPA with both the outliers excluded and retained. Completion of all non-science co/prerequisite courses prior to taking the first nursing course did not significantly contribute to the model predicting successful completion of a traditional associate degree nursing program, X^2 (1, N = 216) = 1.690, p = .194 when the outliers were excluded and X^2 (1, N = 218) = 1.174, p = .279 when the outliers were retained. Based upon these findings, the researcher did not reject this null hypothesis. The regression analyses regarding the program completion variable with the exclusion of outliers and the retention of outliers are summarized in Table 10 and Table 11 respectively.

Table 10

Binary Logistic Regression Predicting Successful Program Completion (Outliers Excluded)

	B	SE	Wald	*df*	*p*	Odds Ratio	95% CI for Odds Ratio	
							Lower	Upper
Age	-.044	.028	2.421	1	.120	.957	.905	1.102
Gender	-.063	.497	.016	1	.899	.939	.354	2.486
Complete Co/Prerequisite courses prior to beginning nursing courses	-.535	.412	1.690	1	.194	.585	.261	1.312
English Composition I	.119	.241	.244	1	.621	1.126	.703	1.805
English Composition II	.162	.204	.631	1	.427	1.176	.788	1.755
General Psychology	.244	.226	1.174	1	.279	1.277	.821	1.987
Child Psychology	-.316	.246	1.647	1	.199	.729	.450	1.181
Nutrition and Diet Therapy	1.014	.273	13.814	1	.000	2.758	1.615	4.708
Pre-entry GPA	.502	.413	1.473	1	.225	1.651	.735	3.712
Constant	-.151	1.489	.598	1	.439	.316		

Table 11

Binary Logistic Regression Predicting Successful Program Completion (Outliers Retained)

	B	SE	Wald	*df*	*p*	Odds Ratio	95% CI for Odds Ratio	
							Lower	Upper
Age	-.030	.028	1.176	1	.278	.970	.919	1.025
Gender	-.138	.485	.081	1	.775	.871	.337	2.251
Complete Co/Prerequisite courses prior to beginning nursing courses	-.431	.398	1.174	1	.279	.650	.298	1.418
English Composition I	.161	.233	.478	1	.489	1.174	.744	1.853
English Composition II	.086	.198	.187	1	.665	1.090	.739	1.607
General Psychology	.277	.218	1.612	1	.204	1.319	.860	2.022
Child Psychology	-.264	.235	1.256	1	.262	.768	.484	1.218
Nutrition and Diet Therapy	.886	.260	11.637	12	.001	2.426	1.458	4.037
Pre-entry GPA	.403	.407	.979	1	.322	1.496	.673	3.324
Constant	-1.143	1.456	.616	1	.432	.319		

Null Hypothesis H_{02}

This null hypothesis asserted there was no significant relationship between first-attempt non-science co/prerequisite grades and first-attempt NCLEX-RN results. The researcher entered the grades in non-science co/prerequisite courses and the final GPA as calculated by the degree granting institution into the second data block following the entry

of the control variables of age and gender into the first block. At this step, the omnibus test of model coefficients demonstrated significance of the model, X^2 (8, N = 177) = 4.423, p = .817 in comparison to the constant only model. The Hosmer and Lemeshow analysis did demonstrate adequate model fit in this final modal as the findings were not significant within this particular analysis, X^2 (8, N = 177) = 5.117, p = .745. Given this data was entered into the second and final block, the results here represent the final model. This final model explained 2.5% or 7.5% of the variance as evidenced by Cox and Snell R^2 and Nagelkerke R^2 respectively. No change in ability to correctly classify cases into either the pass or fail outcome dichotomy was appreciated with the final model. The constant only model and the final model both demonstrated a 94.9% correct prediction rate indicating this model did not predict any failures. This correct prediction rate was identical to the overall pass rate of the sample. Additionally, none of the predictor variables demonstrated significance in the final model. Based upon these findings, the researcher did not reject the null hypothesis.

Null Hypothesis H_{02a}

This null hypothesis asserted age and gender did not significantly contribute to a model predicting first-attempt NCLEX-RN results for students in a traditional associate degree nursing program. Upon inspection of the first block of data entry consisting of the control variables of age and gender, the omnibus test of model coefficients was not found to be significant, X^2 (2, N = 177) = 1.568, p = .457 in comparison to the constant only model. The Hosmer and Lemeshow analysis did demonstrate adequate fit at this step as the findings were not significant within this particular analysis, X^2 (8, N = 177) = 15.127, p = .057. This finding was nearly significant, however, which would have indicated a poor model fit had it

been significant. At this step, the model explained only a nominal variance in the outcome variable as evidenced by a Cox and Snell R^2 value of .009 (0.9%) and Nagelkerke R^2 value of .027 (2.7%). Given these results, the researcher did not reject this null hypothesis.

Null Hypothesis H_{02b}

This null hypothesis asserted there was no significant contribution form the final overall GPA as calculated by the degree-granting institution into a model predicting first-attempt NCLEX-RN results for students in a traditional associate degree nursing program. This data was entered into the second block of the regression analysis along with the grades in the non-science co/prerequisite courses as mentioned above. The final overall GPA as calculated by the degree-granting institution did not demonstrate a significant contribution to predicting first-attempt NCLEX-RN results, X^2 (1, N = 177) = 1.107, p = .313. The researcher did not reject this null hypothesis. The regression analysis regarding the first-attempt NCLEX-RN result variable is summarized in Table 12.

Table 12

Binary Logistic Regression Predicting First-Attempt NCLEX-RN Result

	B	SE	Wald	*df*	*p*	Odds Ratio	95% CI for Odds Ratio	
							Lower	Upper
Age	.068	.070	.956	1	.328	1.071	.934	1.228
Gender	-.539	1.106	.237	1	.626	.583	.067	5.097
English Composition I	-.038	.487	.006	1	.938	.963	.370	2.502
English Composition II	-.301	.454	.441	1	.506	.740	.304	1.800
General Psychology	.427	.409	1.088	1	.297	1.533	.687	3.418
Child Psychology	-.250	.392	.407	1	.524	1.284	.596	2.766
Nutrition and Diet Therapy	-.159	.554	.082	1	.775	.853	.288	2.528
Post GPA	.656	.651	1.107	1	.313	1.928	.538	6.905
Constant	-.507	3.208	.025	1	.875	.603		

Additional Analysis

The retention or exclusion of outliers in the construction of the predictive model resulted in only a 0.6% increase in correctly classified cases into either the successful program completion or unsuccessful program completion categories. Additionally, Nutrition and Diet Therapy remained the only statistically significant predictor of successful program completion when the outliers were retained or excluded. There was no change in the decision to reject or not reject the null hypotheses. The researcher only rejected the null hypothesis stating that grades in the non-science co/prerequisite courses would not

significantly predict successful program completion. Both analyses were reported in this study to demonstrate the absence of effect resulting from exclusion or retention of the outliers.

CHAPTER FIVE: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Discussion

This retrospective, predictive correlation study examined the relationship and predictive ability of non-science co/prerequisite grades (English Composition I, English Composition II, General Psychology, Child Development, and Nutrition & Diet Therapy), successful completion of all non-science co/prerequisite courses prior to the first nursing course, and pre-entry GPA to successful completion of a traditional associate degree program in the South Atlantic region of the United States while controlling for age and gender. It also investigated potential relationships and predictive ability of the same non-science co/prerequisite courses and final overall GPA for first-attempt NCLEX-RN performance within the same program. Successful program completion was defined as completion of the nursing program within six continuous semesters while NCLEX-RN performance was defined by the result of the NCLEX-RN on the first attempt.

General Systems Theory by Bertalanffy (1950, 1968) explained the purpose of this study. Healthcare is affected by the input of nurses into its system. The input of nurses into this system results from the output of nursing programs. Nursing programs' output is driven by the input of students. This input relies on student throughput of performance which is supported by the scaffolding of their prior knowledge.

Schema Theory (Bartlett, 1932/1995) was tested in this study. It describes the scaffolding of prior knowledge and its value in fomenting new knowledge. Schema Theory asserts that new knowledge is built upon a sound structure of prior knowledge. For the purposes of testing this theory, students' successful program completion and success on the first-attempt of the NCLEX-RN represented the new knowledge described in Schema

Theory while the grades in the non-science co/prerequisite courses represented the scaffolding.

The primary research questions asked if the non-science co/prerequisite courses significantly predicted successful program completion and first-attempt NCLEX-RN results in a traditional associate degree program. Findings suggesting the affirmative would support Schema Theory as higher grades in these courses would result in successful program completion and successful NCLEX-RN first-attempts. While only one predictor, Nutrition and Diet Therapy, significantly predicted successful program completion, no significant predictors of NCLEX-RN results were identified upon data analysis. Therefore, the researcher cannot wholly support Schema Theory based upon the findings of this study. More studies investigating these types of courses and their ability to predict successful program completion and NCLEX-RN results may provide a more definitive rationale to support this theory.

Similar research in nursing education has been widely conducted to examine correlations and potential predictors of both successful program completion and first-attempt NCLEX-RN performance. The predictor variables of pre-admission aptitude exams, pre-admission GPA, and particular course grades among many other variables have been studied in relation to the aforementioned outcome variables. This study differs from the previous research in this area in that there has been little if any research examining only the non-science co/prerequisite courses in relationship to these outcome variables. The high financial and social costs of nursing student attrition and first-attempt NCLEX-RN failure compel nursing programs to identify predictors of success. Not only can predictors be utilized when considering admission into a nursing program, but it may assist nurse

educators to identify students at risk for program attrition or NCLEX-RN failure in order to provide remediation to offset those risks. This section discusses the summary of the findings and hypothesis analysis, theoretical analysis, implications for practice, limitations, and suggestions for future research.

Conclusions

Two regression analyses, one examining successful program completion and one examining first-attempt NCLEX-RN results, were conducted for this study. After controlling for age and gender, grades in the non-science co/prerequisite courses, whether or not these courses were completed prior to taking the first nursing course and pre-entry GPA were entered into the analysis examining successful program completion. Age and gender did not significantly contribute to the model predicting successful program completion in either step of the analysis. As well, completion of the non-science co/prerequisites prior to taking the first nursing course, and pre-entry GPA did not contribute to this model. The only non-science co/prerequisite course demonstrating significance was Nutrition and Diet Therapy. This course represented the only significant predictor within the final model. However, as noted in previous studies, the model predicted completion 97.8% of the time while only predicting unsuccessful program completion 13.2% of the time. Identification of those at risk for not passing the first-attempt NCLEX-RN may provide a better opportunity for faculty to improve program pass rates.

The null hypotheses asserting that there would be no statistically significant contribution from age, gender, and pre-entry GPA to the model predicting successful program completion were not rejected. The null hypothesis stating that the grades in the non-science co/prerequisite courses would not statistically predict successful program

completion was rejected thereby supporting the notion that grades in the non-science co/prerequisite courses would significantly predict successful program completion. The findings indicated that for every one increase in letter grade in Nutrition and Diet Therapy, the odds of a student successfully completing the program was 2.76 times more likely. While this finding may provide implications for practice, it may demonstrate bias since the population for the study is culturally and ethnically homogenous. Additionally, this is the only non-science co/prerequisite course that must be taken at the affiliated university and credit cannot be transferred in from any other institution. These will be discussed in the limitations and suggestions for future research.

Age and gender were entered as control variables into the regression analysis examining potential predictors of first-attempt NCLEX-RN results. These demographics did not contribute significantly to the prediction model. The grades in the non-science co/prerequisites and final overall GPA did not demonstrate significance when entered into the analysis. Given these results, the null hypotheses indicating that age and gender, final overall GPA, and grades in the non-science co/prerequisite courses would not significantly predict first-attempt NCLEX-RN results were not rejected.

Implications

Nutrition and Diet Therapy provided the only statistically significant predictor of successful program completion in this study. The question abounds regarding whether nutrition and diet therapy is best taught as its own course in the nursing curriculum or if it is best to thread the concepts of nutrition and diet therapy throughout the curriculum. The findings of this study suggest that offering it as its own course may be beneficial in predicting successful program completion. But beyond predicting program success, it is

important to understand how graduates can apply this knowledge in their eventual practice as registered nurses.

Yalcin, Cihan, Gundogdu, and Ocakci (2013) indicated that practicing nurses lack knowledge related to nutrition and that nurses indicated nutrition was not emphasized in their nursing school curricula. It was suggested that clinical experience related to nutrition therapy was not as valuable as formal nutrition education. These findings resulted in advising nursing programs to evaluate their curricula in order to better address nutrition (Yalcin et al., 2013). Buxton and Davies (2013) suggested similarly as a result of their research. In assessing practicing nurses' knowledge regarding nutrition, those who were female, those who worked as a nurse prior to attending university, and those who had a dedicated nutrition course in their initial nursing education demonstrated the highest level of knowledge regarding education.

Implications for practice are aimed at how a nursing program chooses to provide nutrition and diet therapy in their curricula. The findings of this study as well as the studies by Yalcin et al. (2013) and Buxton and Davies (2013) suggest that it be taught as its own course. This assertion is further supported by the theoretical frameworks that guide and provide purpose for this study: General Systems Theory (Bertalanffy, 1950) and Schema Theory (Bartlett, 1932/1995) respectively. The output of the graduates' knowledge of nutrition and diet therapy serve as the input affecting their program completion and eventual care provided to their patients. The scaffolding provided by the knowledge gained from a dedicated nutrition and diet therapy course serves as a foundation for students to apply new knowledge. They can then apply the concepts of nutrition and diet therapy throughout their nursing education and to the care they will eventually deliver.

An additional implication resulting from this study rests in the consideration of Nutrition and Diet Therapy as either a science course or a non-science course. While Nutrition and Diet Therapy was classified as a non-science course for the purposes of this study as a result of the course identifier at the university where it was offered, this assertion may warrant further investigation. As previously discussed, the Nutrition and Diet Therapy course was the sole predictor of successful program completion in this study. When reviewing previous studies, even though the findings were often conflicting and non-generalizable, many of the identified predictors were based in the biological science courses (Gilmore, 2008; Seago et al., 2013; Simon et al., 2013). Given the commonality of significant prediction capability between biological science course grades and Nutrition and Diet Therapy, it may be prudent to consider Nutrition and Diet Therapy as a biological science and weight them equivalently in the consideration of admissions into nursing programs and in the identification of at-risk students already in nursing programs. This suggested implication originated from the researcher's introspection as he personally considered Nutrition and Diet Therapy to be a non-science course upon commencement of this study. However, given the findings of this study and the consideration of them amid previously identified biological science course predictors, the researcher is challenged to maintain his thoughts as such.

Limitations

The first limitation to this study was that the research focused on one institution and one program type thereby limiting generalizability. This institution is also in a nearly ethnically homogenous portion of the South Atlantic region of the United States. The findings of the study demonstrate bias toward the culture and values of this homogenous

group thereby limiting generalizability. Previous authors have noted this limitation in studies similar to the one being proposed (Abele et al., 2013; Raman, 2013). Since studies examining the non-science co/prerequisite courses are limited, this single institution study examining these variables may provide a basis of replication in the future.

Also, with this study being conducted in one institution, it was therefore conducted in a culturally and ethnically homogenous region. The findings may demonstrate ethnic and cultural bias.

The convenience retrospective design represents a potential limitation. Newton and Moore (2009) noted this as a potential limitation in a similar study. However, this design is the most appropriate to utilize since the dependent variables are retrospective.

Omitted variable bias may also serve as a threat to validity (Hox & Roberts, 2011). This study did not account for previously earned degrees by the students nor did it account for previous healthcare and/or practical experience. While these may have some effects upon the results, this study only analyzed particular academic variables and the demographic variables of age and gender.

One of the assumptions mentioned in the Introduction section indicated that it was assumed all of the data was correct. In the data set analyzing predictors of program completion there were nine cases with missing data. The missing data resulted from an absence of non-science co/prerequisite course grades of subjects who were unsuccessful in the program prior to completing all of these courses for the first time. In analyzing predictors of NCLEX-RN results, one of the cases had not taken the NCLEX-RN at the time of data collection. Even though the sample size was adequate for this study, removal of these cases may represent a limitation to this study.

The pre-entry GPA entered into the data analysis was determined from the GPA noted on the transcript provided by the applicant utilized in the admission decision. While the majority of the transcripts were from the nursing program's affiliated university, course credits may have been transferred in from other institutions as equivalent credit. Additionally, transcripts from other institutions may have been submitted for consideration of admission while some pre-entry GPAs were entered as high school GPAs for those students entering the program directly from high school. This variation may represent a limitation to this study.

The final limitation to be discussed involves the Nutrition and Diet Therapy course. This course represented the sole significant predictor in this study and it significantly predicted successful program completion. The limitation rests with the fact that the Nutrition and Diet Therapy course investigated in this study was the only course required to be taken at the affiliated university. Students cannot receive credit for this course from transferred credits. Being that this course is provided for the nursing students, it may be biased in its presentation thereby revealing this limitation.

Recommendations for Future Research

Some suggestions for future research are derived from the limitations of this study. Future studies replicating the methods and analysis of this study are evident for several reasons. While the sample size was adequate, a multisite study may further generalize or refute the findings in this study given that this study utilized only one institution. This study examined only a traditional associate degree program. With the increased demand for BSN prepared nurses to meet the care and safety needs of an increasingly larger population (AACN- Nursing Shortage website, 2011; Harris et al., 2014), future research should

examine traditional and RN-to-BSN programs in an attempt to identify predictors of successful program completion and first-attempt NCLEX-RN success. Moreover, replication of this study in a more culturally and ethnically diverse region may provide generalizability and negate any bias related to homogenous cultural and ethnic values.

This study examined potential predictors of first-attempt NCLEX-RN success among those taking only the 2010 NCLEX-RN test plan. This limited the researcher to the identification of findings related to that test plan. This test plan has been changed to the 2013 NCLEX-RN test plan wherein upon which the passing standards increased (NCLEX-RN Examination Test Plan website, 2013). Any identified predictors from replicated studies, as this study did not identify any predictors, may not be as applicable to the 2013 NCLEX-RN test plan. Therefore, studies investigating predictors of success on the 2013 NCLEX-RN test plan should be conducted prior to the test plan change in 2016 in order to provide more applicable data for the current test plan. This ongoing research strategy could be implemented every three years when the test plan changes.

Finally, suggested future research focuses upon this study's sole identified predictor of successful program completion: Nutrition and Diet Therapy. Studies examining successful program completion and first-attempt NCLEX-RN success based upon whether this course is delivered independently as its own offering or threaded throughout the nursing curriculum may provide insight for those programs initiating or revising a nursing curriculum. As well, general nutrition courses that are not specially designed for nursing students or that are transferred from other institutions than where the nursing curriculum is delivered provides an additional opportunity for future research.

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APPENDICES

Appendix A: Request for Permission to Collect Data

Joey Trader
[redacted]

[redacted]

[redacted]

I am currently pursuing a doctorate in education (Ed.D.) through Liberty University in Lynchburg, Virginia. I am in the dissertation proposal phase for a study investigating potential relationships between grades in non-science co-/prerequisite courses and associate degree nursing program completion as well as first-attempt NCLEX-RN results. As a requirement of this process, I must provide proof of permission to collect data from the targeted institution prior to petitioning the IRB at Liberty University. This permission must be in writing on institutional letterhead. I, therefore, respectfully request permission to access archived student data for those entering the nursing program at [redacted] from August 2005 until August 2011.

I appreciate your consideration of this matter. If there are any further questions or needs for clarification, please do not hesitate to contact me. I look forward to hearing from you.

Sincerely,

Joey Trader

Joey Trader, RN, MSN, CNE

Appendix B: Permission to Collect Data

Letterhead removed to maintain anonymity

Joey Trader
[redacted]

July 8, 2014

Mr. Trader:

This is in response to your request to collect data from archived student files for those entering the nursing program [redacted] from August 2005-August 2011. You have permission to access those records for the purpose of investigating potential relationships between grades in non-science co-/prerequisite courses required for the nursing program and nursing program completion and first attempt NCLEX-RN results.

If I can assist you in your doctoral endeavors, please do not hesitate to ask. I wish you the best in your efforts.

Sincerely,

[redacted]

Appendix C: Blanket Consent to Utilize Data Students Sign Upon Entering the Nursing Program

Institution name removed to maintain anonymity

PERMISSION TO USE DATA FORM

In an effort to improve courses and programs, faculty at ********** are regularly evaluating test scores, student opinions and evaluations. Group information is compiled and used for evaluation, while individual student information is kept confidential. We request permission to use your data as needed. Please remember, all student information is kept confidential.

I, _____, give my permission for ********** to use my test and/or course data to evaluate and revise courses and/or programs.

Signature: _____

Date: _____

Appendix D: Liberty University IRB Exemption/Approval

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

November 5, 2014

Joey Trader
IRB Exemption 2009.110514: Non-Science, Co-/Prerequisite Course Grades as Predictors of Associate Degree Nursing Program Completion and First-Attempt NCLEX-RN Performance

Dear Joey,

The Liberty University Institutional Review Board has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study to be exempt from further IRB review. This means you may begin your research with the data safeguarding methods mentioned in your approved application, and that no further IRB oversight is required.

Your study falls under exemption category 46.101 (b)(4), which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:

> (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

Please note that this exemption only applies to your current research application, and that any changes to your protocol must be reported to the Liberty IRB for verification of continued exemption status. You may report these changes by submitting a change in protocol form or a new application to the IRB and referencing the above IRB Exemption number.

If you have any questions about this exemption, or need assistance in determining whether possible changes to your protocol would change your exemption status, please email us at irb@liberty.edu.

Sincerely,

LIBERTY
UNIVERSITY.

Liberty University | Training Champions for Christ since 1971