

A CORRELATIONAL STUDY ON CRITICAL THINKING IN NURSING AS AN OUTCOME
VARIABLE FOR SUCCESS

by

Rebecca Jean Porter

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

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ABSTRACT

Critical thinking is a required curricular outcome for nursing education; however, the literature shows a gap related to valid and reliable tools to measure critical thinking specific to nursing and relating that critical thinking measurement to meaningful outcomes. This study examined critical thinking scores, as measured by Assessment Technologies Institute (ATI) Critical Thinking Exam (CTE), to determine if a statistically significant predictive association existed between critical thinking scores, successful Associate of Science in Nursing (ASN) program completion, and National Certification Licensure Examination for Registered Nurses (NCLEX-RN®) pass rates. The research was conducted in a semi-urban, hospital-based, ASN program and included 550 students obtained by convenience sampling in a retrospective, predictive correlational study. Logistical analysis was conducted to determine if any relationships existed between the variables of interest while controlling for confounding variables such as nursing course grade point average (GPA) and preadmission ATI Test of Essential Academic Skills (TEAS) scores. Critical thinking was found to be a positive predictor of student success [program completion ($p = .012$); NCLEX success ($p = .002$)] as were TEAS [program completion ($p = .003$); NCLEX success ($p = .001$)] and nursing course GPA [NCLEX success ($p = .001$)]. However, cumulative effects for the three variables were not found to increase the predictive power of the model and none of the variables were deemed good predictors of failure.

Keywords: critical thinking, NCLEX-RN®, Assessment Technologies Institute, Associate of Science in Nursing

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List of Abbreviations

American Association of Colleges of Nursing (AACN)

Association of American Colleges and Universities (AACU)

Accreditation Commission for Education in Nursing (ACEN)

American College Testing (ACT)

Associate of Science in Nursing (ASN)

Assessment Technologies Institute (ATI)

Collegiate Assessment of Academic Proficiency Critical Thinking Test (CAAP)

Clinical Education Partners (CEP)

Critical thinking (CT)

Critical Thinking Exam (CTE)

Grade Point Average (GPA)

Health Resources and Services Administration (HRSA)

National Certification Licensure Examination 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)

Test of Essential Academic Skills (TEAS)

CHAPTER ONE: INTRODUCTION

Overview

Nursing has been chosen as the most trusted profession in public opinion polls since 1999 (Riffkin, 2014). This trust does not come without merit. Acceptance into a registered nursing program with subsequent completion is not an easy feat. Registered nursing schools offer rigorous curriculums driven by onerous standards mandated by national accrediting bodies. Prior to entry into registered nursing programs, students are often screened using standardized assessments in an effort to identify areas where they are deficient. Ideally, this process and the results of these assessments should be used to individualize instruction. Identification of at-risk students with early implementation of interventions would undoubtedly increase success for these students (Ahuna, Tinnesz, & VanZile-Tamsen, 2011). Prior research focused on pre-entry predictors of success for students (Diaz, Sanchez, & Tanguma, 2012; Harris, Rosenberg, & O'Rourke, 2014; Manieri, De Lima, & Ghosal, 2015; Newton & Moore, 2009; Ukpabi, 2008; Wolkowitz & Kelley, 2010); however, scant research has been performed on how the entry-level critical thinking skills of nursing students may affect their academic success (Romeo, 2010).

Thus, this study utilized A Model for the National Assessment of Higher Order Thinking (Paul & Nosich, 1992) as rationale for the need for a study to explore the potential relationship between critical thinking and nursing school success as measured by program completion and first-time NCLEX-RN® success. Furthermore, the general systems theory was examined as it relates to variables that could affect student success. A distinction does exist between Licensed Practical Nurses (LPN) and Registered Nurses (RN). This study specifically examined critical thinking as it relates to the RN student. Chapter One includes background information, the problem statement, the purpose statement, and the significance of this study, the research

question and hypotheses, identification of variables, definitions, research assumptions and potential limitations.

Background

Nursing is an art and science that relates to caring for others (Jasmine, 2009). Nursing schools are avenues to train individuals to provide care based on scientific principles while still attending to the “heart” of the patient (Hassmiller & Cozine, 2006). Unfortunately, the United States is in danger of not having enough nurses to care for its population (American Association of Colleges of Nursing [AACN], 2017b). Though a nursing shortage currently exists and has for some time, that number could grow to well over 250,000 by the year 2025 (Buerhaus, Staiger, & Auerbach, 2009). More recently, AACN (2017b) and the Bureau of Labor Statistics (2015) have projected the need for over 1 million replacement nurses by the year 2024.

The aging population, the increase in chronic disease of patients, the aging workforce, nursing faculty shortages, and nurse burnout are all cited as reasons for this potential nursing shortage disaster (AACN, 2017b; Jones & Morris, 2007; Ukpabi, 2008). Additionally, the Affordable Care Act, legislation that mandates healthcare accessibility for uninsured Americans, is projected to afford coverage to nearly 32 million more people. Though this is a positive, humane change in health care reform, it will undoubtedly lead to an exponential rise in demand for registered nurses (AACN, 2017b). These factors are the impetus for governmental incentives aimed at increasing the numbers of students entering the nursing profession (AACN, 2017b; Health Resources and Services Administration [HRSA], 2014); however, not all students who are willing to enter into healthcare fields are adequately prepared for the rigors of a nursing curriculum.

Critical thinking is an essential element of nursing education (Drennan, 2009; Shin, Jung, Shin, & Kim, 2006) and is deemed necessary by various nursing school bodies (AACN, 2017a; National League for Nursing [NLN], 2013). National accrediting bodies for schools of nursing have created outcome criteria stating nursing school graduates should possess strong critical thinking skills upon graduation (Drennan, 2009). The AACN identified the development of critical thinking as a core priority for nursing education at both undergraduate and postgraduate levels (AACN, 2017a). Additionally, the NLN (2013) stated that the “art of thinking” is imperative to safe, competent care in an ever-changing health care environment and must be incorporated throughout nursing education (§15). Finally, the National Council of State Boards of Nursing (NCSBN) is a collaborative organization that works with individual states to determine safe practice. In addition to its collaborative nature, the NCSBN developed the National Council Licensure Examination-Registered Nurses (NCLEX-RN®); an exam that is given at the end of all entry-level accredited nursing programs to measure nursing competencies (NCSBN, 2014a). Successful completion of the exam, at or above a minimum score, is required for all graduates prior to entry into practice. The exam, developed by the NCSBN, seeks to determine if graduates can critically think and thus, provide safe care (NCSBN, 2014a).

There is definite consensus within the nursing education community “that critical thinking is the cornerstone of the objectives and goals for nursing students” (Romeo, 2010, p. 378). It is also a well-founded assumption that strong critical thinking skills are an imperative quality for nurses to possess to be safe practitioners of care once in the workforce (Facione, 2011; Lee, 2007; Romeo, 2010; Rung-Chuang, 2010). This point is especially salient for students in technically based fields of study with the assumption that the technical content they learn during their training is often obsolete by the time they enter practice (Facione, 2011).

Unfortunately, many students do not come into higher education programs with the ability to think critically, thus the necessity of teaching this process may be especially important for those identified students (Facione, 2011).

Given these facts and that the aforementioned bodies have set standards that must be met in regard to critical thinking outcomes for successful program completion and entry into practice, nurse educators must critically examine curriculum. It is imperative educators make sure the standards are not only being incorporated, but that students are being evaluated appropriately based upon the criteria. An appropriate strategy to implement, therefore, is baseline critical thinking screenings for all students upon entry into nursing programs so that deficits can be identified early in the curriculum in an effort to increase success and retention (Ahuna et al., 2011).

The challenge for college professors teaching in nursing programs is a daunting one. Students are being strongly encouraged to enter nursing programs, but many do not possess the skills necessary to be successful (Flores, Matkin, Burbach, Quinn, & Harding, 2012). Despite the fact that students are coming to college less prepared and often lack solid critical thinking skills, schools are being penalized for attrition and/or low NCLEX-RN® passage rates (Heroff, 2009; McDowell, 2008; Roa, Shipman, Hooten, & Carter, 2011). Thus, a major task before nursing educators is to not only implement pedagogical strategies that will enhance nursing students' critical thinking skills in an effort to increase their success and make them safer practitioners of care (Lyons, 2008), but also to find meaningful ways to measure critical thinking specific to nursing and its effect on outcomes.

Multiple studies have been undertaken by nursing researchers in an effort to validate current pedagogical practice as a way to enhance the critical thinking skills of nursing students

(Chan, 2013; Kowalczyk, 2011); however, most instruments utilized to measure critical thinking outcomes related to these pedagogies are not discipline specific (Brunt, 2005). Studies have also been conducted on critical thinking and NCLEX-RN® performance, but many of these studies failed to utilize a nursing specific tool to measure critical thinking outcomes, as well (Frye, Alfred, & Campbell, 1999; Giddens & Gloeckner, 2005; Romeo, 2010). The Assessment Technologies Institute (ATI) developed a tool to measure critical thinking specific to nursing, which has been a focus of two studies, which produced mixed results (Lyons, 2008; Ukpabi, 2008).

The results of the Ukpabi (2008) study pointed toward a strong correlation between the ATI CTE and student success with a $p = .008$. However, while examining curricular strategies to promote critical thinking, Lyon's (2008) study incidentally uncovered findings indicative of lack of correlation between ATI CTE and student success with $p = .413$. Both studies suggested more research is needed to adequately predict nursing student success. The dearth of congruency in the studies' results is suggestive of the necessity for further research considering critical thinking as a predictor utilizing the ATI CTE to expand this knowledge base specific to nursing.

Certainly, the predominant thought is that nursing students should learn critical thinking while in the nursing program and should be measured as a program outcome. However, it also stands to reason that critical thinking should be measured at the onset of one's nursing education to determine if one is lacking in this component initially, as well. With a major emphasis being placed on improved retention rates with the intent of increasing nursing output to ease the current and projected nursing shortage, every effort must be made to identify at-risk students early in nursing programs (Ahuna et al., 2011; Davenport, 2007; Harris et al., 2014). Screening for critical thinking on admission to nursing programs could help identify at-risk students and allow

for early intervention, but again, valid and reliable nursing specific measurement tools are needed (Romeo, 2010). A question that must be asked, then, is critical thinking a predictor of success and, if so, how can the critical thinking abilities of nursing students best be measured? This is a much more arduous process than merely identifying the relevance of critical thinking skills in higher education.

What currently exists in the literature is a rich collection of definitions of critical thinking, a plethora of studies exploring management modalities geared toward increasing critical thinking, and a multitude of assessment techniques for measuring critical thinking. However, a consensus regarding the most efficacious measurement of critical thinking specific to nursing is yet to be determined. Furthermore, while many studies have considered the effects of specific instructional methods on critical thinking outcomes (Burrell, 2014; Kowalczyk, 2011; Niu, Behar-Horenstein, & Garvan, 2013; Ozturk, Muslu, & Dicle, 2008; Tiwari, Lai, So, & Yuen, 2006; Vogel, Geelhoed, Grice & Murphy, 2009; Yuan, Kunaviktikul, Klunklin, & Williams, 2008), only a few have examined entrance level critical thinking ability and success rate in nursing programs (Giddens & Gloeckner, 2005; Mahmoud, 2012). Prior research has been conducted on critical thinking as it relates to nursing school success, but the majority of the studies utilized critical thinking assessment tools geared toward education, in general, and not healthcare, specifically (Giddens & Gloeckner, 2005; Mahmoud, 2012).

The fact that critical thinking skills are specified by accrediting body outcomes and that they are undoubtedly needed for safe practice strengthens the argument that these outcomes require further exploration utilizing a nursing specific tool (Brunt, 2005; Lyons, 2008; Romeo, 2010; Shirrell, 2008). In contrast, the ATI CTE was created specifically for healthcare providers (Lyons, 2008) and has been used in two prior studies, but with mixed results (Lyons, 2008;

Ukpabi, 2008). Furthermore, only one study was found investigating ATI CTE as a specific predictor for NCLEX-RN® success (Ukpabi, 2008). The results of the Ukpabi study pointed toward a strong correlation between the ATI CTE and student success with $p = .008$. However, while examining curricular strategies to promote critical thinking, Lyon's study incidentally uncovered findings indicative of lack of correlation between ATI CTE and student success with a p score of 0.413 (2008). As stated earlier, the dearth of congruency in the studies' results is suggestive of the necessity for further research considering critical thinking as a predictor utilizing the ATI CTE to expand this knowledge base specific to nursing.

Paul (1993) developed the Model for the National Assessment of Higher Order Thinking, and posited that a "teacher's assessment of student reasoning... involves an assessment of the student's ability to handle the dimension of purpose in accord with relevant intellectual standards" (p. 154). This model takes into effect why higher order thinking (critical thinking) should be assessed, what constitutes a substantive assessment tool, the danger in not assessing critical thinking (i.e. failure), and four domains of critical thinking (elements of thought, abilities, affective dimensions, and intellectual standards). This study attempted to fill the aforementioned empirical gap by utilizing Paul's model of higher order thinking as rationale for the study via examination of the relationships between critical thinking as measured by the ATI CTE and student outcomes as measured by NCLEX-RN® passage rates and successful completion of an Associate of Science in Nursing (ASN) program within three years, while controlling for potentially confounding variables such as nursing course GPA and preadmission Test of Essential Academic Skills (TEAS) scores.

Furthermore, the general systems theory was examined as it relates to variables that could affect student success. Ludwig von Bertalanffy (1950) first introduced the idea that living things

should not be studied in the same manner as closed systems. Living organisms are influenced by multiple factors that cannot be studied independently thus inputs, throughputs and outputs must all be considered. In the case of this study, critical thinking skills, as measured by ATI CTE scores, and student intelligence, as measured by nursing GPA and preadmission TEAS scores, were the identified inputs. The primary throughput was the nursing school curriculum that remained stable for all students. Student success was the major output as measured by NCLEX-RN® passage rates and successful completion of an Associate of Science in Nursing (ASN) program within three years.

Problem Statement

The United States is facing a looming crisis related to the anticipated nursing shortage (AACN, 2017b; Heroff, 2009). Though the government is doing its best to offer incentives to increase the number of those willing to go into the nursing profession, students are often unprepared for the rigors of nursing programs, and thus, are unsuccessful. Many studies have been conducted investigating potential predictors of success in an effort to stave this issue (Heroff, 2009; Simon, McGinniss, & Krauss, 2013; Herrera & Blair, 2015), but no model has been completely effective in its attempt. Critical thinking, though deemed necessary by nursing accrediting bodies for safe, competent practice, has been grossly overlooked as a predictor of success. Though some studies have included critical thinking within the predictive model being tested (Jones & Morris, 2007), very few have utilized a nursing specific tool to measure the critical thinking component and those that did had conflicting results (Lyons, 2008; Ukpabi, 2008).

Ultimately, nursing educators need to know if strong critical thinking skills increase the likelihood that a student will successfully complete the course of study and pass the NCLEX-

RN®. However, how that outcome can best be measured remains unknown. Consequently, the problem addressed in this study was that there was a need to expand the empirically based research body of knowledge with the use of a nursing specific critical thinking assessment tool to determine if a predictive relationship existed between a student's critical thinking score and the likelihood that the nursing student would complete the identified ASN program in a timely manner and pass the NCLEX-RN® on the first attempt. Improving these scores will likely increase the output of safe, competent nurses in the work field (Brunt, 2005; Lyons, 2008, Romeo, 2010) and secure accreditation status for the nursing school (Heroff, 2009; McDowell, 2008). Furthermore, if critical thinking is found to have a predictive relationship with nursing school success, early identification of a student's deficit in this area will allow educators more time to implement empirically based strategies to improve critical thinking, thus improving retention and ultimately NCLEX-RN® passage rates (Ahuna et al., 2011; Heroff, 2009; Hopkins, 2008; McDowell, 2008).

Purpose Statement

Healthcare is an ever-changing, dynamic field of study that requires a great deal of critical thinking. Paul (1993) posited, in his Model for the Assessment of Higher Order Thinking, that:

The most inescapable imperative of the future is continuous change, change that involves complex adjustments to the increasingly complex systems that dominate our lives....the distinguishing characteristics of those who will not only survive but thrive in the future, will be abilities and traits, both intellectual and emotional, that entail excellence in evaluating and responding to the conditions of change. (p. xi)

Healthcare is becoming more and more demanding, and as such, is requiring higher order

thinking to be successful. Furthermore, the looming nursing shortage makes it imperative that educators discover ways to identify variables that could affect success for students wishing to enter into the nursing profession to increase the output of safe, competent providers (Heroff, 2009). Early identification of potential hindrances to success is needed so that nursing educators can implement evidence based teaching strategies to improve identified deficits early in the program if necessary (Ahuna et al., 2011; Davenport, 2007). Therefore, the purpose of this predictive, correlational study was to determine if there was a statistically significant predictive relationship between students' critical thinking, successful completion of an Associate of Science in Nursing (ASN) program, and pass rates on the National Certification Licensure Examination for Registered Nurses (NCLEX-RN®). Critical thinking was measured with the Assessment Technologies Institute (ATI) Critical Thinking Exam (CTE) and program completion was measured by finishing the ASN program within three years. The research was conducted in a semi-urban, hospital-based, ASN program located in southwestern West Virginia and included datum from 550 students obtained by convenience sampling. The researcher controlled for overall nursing GPA and preadmission Test of Essential Academic Skills (TEAS) scores where applicable.

The predictor variable, critical thinking, was generally defined as the ability to problem solve and utilize the decision making process to reason through health care scenarios as measured by ATI's Critical Thinking Exam. ATI's definition of critical thinking includes specific competencies including: interpretation, analysis, evaluation, inference, explanation, and self-regulation. Chapter Three will include a more in-depth look at the operational definition of critical thinking, including a breakdown of each of these competencies, as defined by ATI. The criterion variables, NCLEX-RN® passage rates and program completion, was defined as a

graduate's successful passage of the NCLEX-RN® exam on the first attempt (pass/fail) and the graduate's ability to complete the program in its entirety within three years (yes/no); nursing course GPA and preadmission TEAS scores (both potentially confounding variables) were statistically controlled in this study by nonparametric logistic regression statistical analysis (Creswell, 2007; Siegel, 1956).

Specifically, the purpose of this study was to examine if a predictive relationship exists between students' critical thinking as measured by the ATI CTE and student outcomes as measured by NCLEX-RN® passage rates and successful completion of an Associate of Science in Nursing (ASN) program within three years, while controlling for potentially confounding variables such as nursing course GPA and preadmission Test of Essential Academic Skills (TEAS) scores where applicable. Each of these variables are discussed at length and justified by literature in the variables section found later in this chapter.

Research Questions

Two research questions were proposed for this study:

RQ1: Is there a statistically significant predictive relationship between critical thinking skills as measured by ATI CTE and successful completion of an ASN program while controlling for preadmission TEAS scores?

RQ2: Is there a statistically significant predictive relationship between critical thinking skills as measured by ATI CTE and passage of the NCLEX-RN® while controlling for nursing course GPA and preadmission TEAS scores?

Null Hypotheses

To achieve the purposes of this study, nine null hypotheses were proposed:

H_{01.0}: There will be no statistically significant predictive relationship between three-year program completion rates of ASN students and critical thinking skills as measured by the ATI CTE.

H_{01.1}: There will be no statistically significant predictive relationships between three-year program completion rates of ASN students and preadmission TEAS scores.

H_{01.2}: There will be no statistically significant predictive relationships between three-year program completion rates of ASN students and critical thinking skills as measured by the ATI CTE while controlling for preadmission TEAS scores.

H_{01.3}: There will be no statistically significant predictive cumulative relationship discovered between critical thinking skills as measured by the ATI CTE and preadmission TEAS scores while exploring successful completion of an ASN program within a three-year time frame.

H_{02.0}: There will be no statistically significant predictive relationship between passage of the NCLEX-RN[®] and critical thinking skills as measured by the ATI CTE.

H_{02.1}: There will be no statistically significant predictive relationship between passage of the NCLEX-RN[®] and nursing course GPA.

H_{02.2}: There will be no statistically significant predictive relationships between passage of the NCLEX-RN[®] and preadmission TEAS scores.

H_{02.3}: There will be no statistically significant predictive relationships between passage of the NCLEX-RN[®] and critical thinking skills as measured by the ATI CTE while controlling for nursing course GPA and preadmission TEAS scores.

H_{02.4}: There will be no statistically significant predictive cumulative relationship between critical thinking skills as measured by the ATI CTE, nursing course GPA, and preadmission TEAS scores and first time NCLEX-RN[®] passage.

Identification of Variables

The variables of interest in the study were critical thinking scores (the predictor variable) as measured by ATI CTE scores, nursing school completion rates (criterion variable), and the result of each individual student's first attempt on the NCLEX-RN® (criterion variable). Potential confounding variables included student intelligence (as measured by nursing course GPA) and student scores on the preadmission ATI TEAS.

Critical Thinking

Critical thinking is an extremely important component of nursing curriculum (AACN, 2017a; NCSBN, 2014a; NLN, 2013). Prior research focused on the correlation between specific instructional modalities and improved critical thinking while a student is in a program, but few have considered a nursing specific tool to measure critical thinking and its consequent predictive attributes related to program and NCLEX-RN® success (Ukpabi, 2008). Critical thinking, for the purpose of this study, was generally defined utilizing a synthesis of the literature, the Model for the National Assessment of Higher Order Thinking (Paul, 1993) and the definition given by ATI CTE. This is discussed at length within Chapter Two in the related literature section.

The most important definitions of critical thinking specific to this study were those posed by ATI (2001) and Paul (1993). ATI suggested, “critical thinking is a dynamic, analytic process that results in reasoned decisions and judgments” (p. 1). According to ATI, critical thinking involves six competencies: interpretation, analysis, evaluation, inference, explanation, and self-regulation. This will be elaborated upon in the instrumentation section of Chapter Three. Paul (1993) stated “critical thinking is thinking about your thinking while you're thinking in order to make your thinking better” (p.91). He furthermore stated that critical thinking is “self improvement [in thinking] through standards [that assess thinking]” (p. 91). The operational

definition of critical thinking for the purpose of this study will be the student's ability to interpret, analyze, evaluate, infer, and explain healthcare information to make safe, competent decisions and judgments as measured by a standardized assessment tool, ATI CTE. Critical thinking was identified as an "input" when considering this study's relationship to the general systems theory.

Nursing School Completion

For the purpose of this study, nursing school completion was defined as a student's ability to successfully complete the ASN program within three years of matriculation. This definition was derived from accrediting body standards that state graduates should be able to complete the course of study within 150% of the stated program length (Accreditation Commission for Education in Nursing [ACEN], 2015). The standard length for an ASN program is two years. Nursing school completion was identified as an "output" when considering this study's relationship to the general systems theory.

NCLEX-RN®

The NCLEX-RN® is an exam that is given at the end of all entry-level accredited nursing programs to measure nursing competencies (NCSBN, 2014a). Successful completion of the exam, at or above a minimum score, is required for all graduates prior to entry into practice. The exam, developed by the NCSBN seeks to determine if graduates can critically think, and thus provide safe care (NCSBN, 2014a). NCLEX-RN® success is a primary measurement utilized by nursing schools and accrediting bodies to determine achievement of nursing program outcomes (ACEN, 2015). NCLEX-RN® success was identified as an "output" when considering this study's relationship to the general systems theory.

Nursing GPA

Though many studies have explored GPA (high school GPA, college GPA prior to nursing school admission, prerequisite science course GPA, etc.) in various manners for the purpose of educational predictive studies (Davenport, 2007; Hopkins, 2008), this study specifically explored nursing course GPA as a potential confounding variable related to the outcome of NCLEX-RN[®] success. Nursing course performance has been found to be a statistically significant predictor for NCLEX-RN[®] success in multiple studies (Alameida et al., 2011; Beeson & Kissling, 2001; Higgins, 2005; Lin, Fung, Hsiao, & Lo, 2003; Pitt, Powis, Levett-Jones, & Hunter, 2012; Shirrell, 2008; Tipton et al., 2008), thus was addressed in this study to make sure any effects noted were related to the proposed predictor variable, critical thinking, and not solely nursing course GPA. Nursing GPA was generally defined as the student's GPA upon graduation that included the following courses required by the nursing program where the proposed research occurred: NUR 120, NUR 220, NUR 230, NUR 225, NUR 235, and NUR 241. Nursing GPA was identified as an "input" when considering this study's relationship to the general systems theory.

Entrance TEAS

ATI offers a statistical package for student retention and remediation that, in addition to the CTE, includes a preadmission test called the Test of Essential Academic Skills (TEAS). As the title aptly states, this test measures skills deemed necessary to be successful in an academic program and includes assessment of mathematic, reading, English, and science abilities. The TEAS were "designed to measure the level of general academic preparedness of students entering a nursing program or to diagnose the strengths and weaknesses of admitted students immediately following entry into a nursing program" (ATI, 2009, p. 5). As such, this was

studied as a potentially confounding variable and statistically controlled for using logistic regression analysis. The TEAS include subsets for several subject areas including math, science, reading, and English. Several studies have investigated TEAS as a predictor for nursing success, but results have been varied as to whether it definitively is (McCarthy, Harris, & Tracz, 2014; Newton & Moore, 2009; Pitt et al. 2012). Entrance TEAS scores were identified as an “input” when considering this study’s relationship to the general systems theory.

Assumptions

Some assumptions that were made during this study were that the students performed to the best of their ability on the exams. Additionally, it was assumed that critical thinking can be adequately assessed utilizing a nursing specific tool. Finally, the assumption was made that critical thinking can be learned and that the utilization of higher-order thinking results in improved patient outcomes (Edwards, 2003; Riddell, 2007). Due to the utilization of nominal level data for the criterion variables, nonparametric logistic regression was utilized. Logistic regression does not require the researcher to make assumptions of normality, linearity, or homogeneity related to the predictor variables (Warner, 2013), thus those assumptions were not necessarily addressed.

Definitions

1. *Assessment Technologies Institute (ATI)* – ATI is a company that specializes in providing online educational materials and evidence-based standardized assessments to enhance outcomes in nursing education (ATI, 2016).
2. *Critical thinking* - Critical thinking involves a dynamic process whereby the thinker utilizes certain habits of mind to analyze and apply information to make reasoned

decisions and improve thought processes (ATI, 2001; Paul, 1993; Scheffer and Rubenfeld; 2000).

3. *National Certification Licensure Examination for Registered Nurses (NCLEX-RN®)* – The NCLEX-RN® is a psychometrically sound, standardized exam that evaluates knowledge of safe practice. This exam must be successfully completed at a passing standard by nursing school students prior to entry into practice (NCSBN, 2017).
4. *Nursing grade point average* – Nursing grade point average (GPA) is the cumulative grade for students in a nursing program that includes solely nursing courses and does not include general education or support classes. For the purpose of this study, nursing GPA included grades for NUR 120, NUR 220, NUR 225, NUR 230, NUR 235, and NUR 241 at the target school.
5. *Program completion* – Program completion refers to a student’s ability to finish a nursing program. This time frame was defined by the Accreditation Commission for Education in Nursing (ACEN) for the target school in this study. ACEN states that the amount of time it takes for a student to progress from the first day of class until graduation must be no more than 150% of the time the nursing program states as the normal length of the program (ACEN, 2017).
6. *Test of Essential Academic Skills (TEAS)* – TEAS is a standardized examination created by ATI that evaluates the foundational knowledge deemed necessary for entry level nursing students to be successful (ATI, 2016).

CHAPTER TWO: LITERATURE REVIEW

Overview

The United States is facing a looming crisis related to the anticipated nursing shortage (AACN, 2017b; Heroff, 2009). Though the government is doing its best to offer incentives to increase the number of those willing to go into the nursing profession, students are often unprepared for the rigors of nursing programs, and thus, are unsuccessful. Many studies have been conducted investigating potential predictors of success in an effort to stave this issue (Heroff, 2009; Simon, McGinniss, & Krauss, 2013; Herrera & Blair, 2015), but no model has been completely effective in its attempt. Critical thinking, though deemed necessary by nursing accrediting bodies for safe, competent practice, has been grossly overlooked as a predictor of success. Though some studies have included critical thinking within the predictive model being tested (Jones & Morris, 2007), very few have utilized a nursing specific tool to measure the critical thinking component and those that did had conflicting results (Lyons, 2008; Ukpabi, 2008).

The idea that critical thinking is an imperative life skill is not a novel notion. Ancient philosophers such as Aristotle and Socrates pontificated the importance of thinking through problems. Years later, Dewey would build upon the foundational tenets laid by these early philosophers as he wrote *My Pedagogic Creed* (1897). In this writing he spoke specifically to the impossibility of imparting all knowledge upon students, thus the importance of teaching a child how to think through unknowns

It is impossible to foretell definitely just what civilization will be twenty years from now.

Hence it is impossible to prepare the child for any precise set of conditions. To prepare him for the future life means to give him command of himself; it means so to train him

that he will have the full and ready use of all his capacities; that his eye and ear and hand may be tools ready to command, that his judgment may be capable of grasping the conditions under which it has to work, and the executive forces be trained to act economically and efficiently. (Dewey, 1897, Article One, paragraph 6)

Critical thinking has received a lot of “educational press” over the past few decades. Though Dewey paved the way for current day critical thinking theories and ideas, today’s educational system still struggles to adequately teach these principles. Educators, parents, government officials, accrediting bodies, college admission committee members, and employers all agree that the ability to reason through situations and decide on the most appropriate course of action is an imperative life skill (Rosefsky Saavedra & Opfer, 2012). Unfortunately, children in the United States are falling short when it comes to the development and implementation of critical thinking skills (Butler, 2012). As a result, colleges across the country have identified outcomes that suggest students should possess the ability to critically think upon leaving their campuses (Association of American Colleges and Universities [AACU], 2009). There is also little debate over the importance of implementing strategies to enhance these skills throughout multiple levels of curriculum and to adequately measure outcomes (AACU, 2009).

Nursing school is certainly no exception – though critical thinking is essential to nursing, students often come to programs lacking these imperative skills. Discussions related to critical thinking have resonated loudly within healthcare education communities (AACN, 2017a). As the current nursing shortage threatens to become even more severe, both governmental and educational leaders have been called upon to explore ways to increase nursing school enrollment, retention, and ultimately, output (AACN, 2017b; HRSA, 2014). Due to the complex nature and high stakes outcomes of nursing decisions, the importance of a strong critical thinking

component in nursing school curriculums, specifically, cannot be overstated (ACCN, 2017a). Nursing bodies have addressed this issue and have mandated critical thinking as a core component for all accredited nursing schools (AACN, 2017a; NCSBN, 2014a; NLN, 2013).

Many schools have implemented preadmission testing packets with the hope of identifying student deficits early in the program and intervening, if necessary, to increase the likelihood of success. Critical thinking has been grossly overlooked in this process, however, as it is seen mostly as an output measurement. Given the complexity of nursing school curriculums and the importance of producing graduates with strong critical thinking skills for safe practice, it stands to reason that measuring critical thinking abilities at the onset of a program would be an appropriate intervention. It also stands to reason that the tool utilized to measure critical thinking should be a tool specific to nursing. Likewise, exploring entry-level critical thinking scores to see if a relationship exists between a student's ability to critically think "like a nurse" and program success could identify at-risk students early in the curriculum. Early identification of errors in thinking would allow educators more opportunity to individualize instruction and increase each student's chance of success, thus improving retention and the output of safe, competent nurses (Ahuna et al., 2011).

Healthcare is an ever-changing, dynamic field of study that requires a great deal of critical thinking. Paul (1993) posited, in his Model for the Assessment of Higher Order Thinking, that:

The most inescapable imperative of the future is continuous change, change that involves complex adjustments to the increasingly complex systems that dominate our lives....the distinguishing characteristics of those who will not only survive but thrive in the future, will be abilities and traits, both intellectual and emotional, that entail excellence in

evaluating and responding to the conditions of change. (p. xi)

Healthcare is becoming more and more demanding, and as such, is requiring higher order thinking to be successful. Furthermore, the looming nursing shortage makes it imperative that educators discover ways to identify variables that could affect success for students wishing to enter into the nursing profession to increase the output of safe, competent providers (Heroff, 2009). Early identification of potential hindrances to success is needed so that nursing educators can implement evidence based teaching strategies to improve identified deficits early in the program if necessary (Ahuna et al., 2011; Davenport, 2007).

Ultimately, nursing educators need to know if strong critical thinking skills increase the likelihood that a student will successfully complete the course of study and pass the NCLEX-RN®. Specifically, the purpose of this predictive, correlational study was to determine if there was a statistically significant predictive relationship between students' critical thinking skills (as measured by the ATI CTE) and student outcomes [as measured by successful completion of an Associate of Science in Nursing (ASN) program within three years and pass rates on the National Certification Licensure Examination for Registered Nurses (NCLEX-RN®)]. Likewise, the problem addressed in this study was that there was a need to expand the empirically based research body of knowledge with the use of a nursing specific critical thinking assessment tool to determine if there is a predictive relationship between a student's critical thinking score and the likelihood that the nursing student will complete the ASN program in a timely manner and pass the NCLEX-RN® on the first attempt.

Improving these scores has the potential to increase the output of safe, competent nurses in the work field (Brunt, 2005; Lyons, 2008, Romeo, 2010) and secure accreditation status for the nursing school (Heroff, 2009; McDowell, 2008). Furthermore, a major impetus for this study

was related to the fact that if critical thinking could be significantly correlated to nursing school success, early identification of a student's deficit in this area would allow educators more time to implement empirically based strategies to improve critical thinking, thus improving retention and ultimately NCLEX-RN® passage rates (Ahuna et al., 2011; Heroff, 2009; Hopkins, 2008; McDowell, 2008).

Chapter Two includes information pertaining to the theoretical frameworks employed in this research study – A Model for the National Assessment of Higher Order Thinking and the general systems theory. An in-depth look at the literature undergirding the identified research problem is also incorporated. Specifically, a synopsis of the literature related to how the following variables relate to nursing student success is included: required nursing school curricular components, nursing course GPA, TEAS testing, nursing school time frame for completion, National Council of State Boards of Nursing (NCSBN), NCLEX-RN®, and critical thinking skills.

Theoretical Framework

A Model for the National Assessment of Higher Order Thinking

Commissioned by the United States Department of Education, Office of Educational Research and Improvement of the National Center for Education Statistics, Paul and Nosich (1992) developed a framework for critical thinking – A Model for the National Assessment of Higher Order Thinking. This model of critical thinking posits that a “teacher’s assessment of student reasoning . . . involves an assessment of the student’ ability to handle the dimension of purpose in accord with relevant intellectual standards” (p. 154). The model also takes into account why higher order thinking (critical thinking) should be assessed, what constitutes a substantive assessment tool, the danger in not assessing critical thinking (i.e. failure), and four

domains of critical thinking (elements of thought, abilities, affective dimensions, and intellectual standards). Ultimately, this model suggests that higher order thinking improves student outcomes.

Paul further developed this model in later years stating that to fully develop critical thinking thinkers must pass through various stages of thinking and take into account eight intellectual standards (Paul & Elder, 2001; Paul & Elder, 2008). These standards are: accuracy, precision, relevance, depth, breadth, logic and fairness (Paul & Elder, 2008). Though not specific to nursing, these theorists attempt to emphasize the fundamentals of critical thinking that pertain to all disciplines. One pertinent aspect of this framework is that is “scorns the idea of knowledge as the memorizing of bits and pieces of information” (Paul & Elder, 2001, p. 1) and recognizes that some disciplines cannot answer all questions in definitive ways. This is consistent with the fundamental ideology within nursing education (AACN, 2017a).

These tenets, proposed by Paul’s (1992) model of critical thinking, are especially important in healthcare fields where the quality of thinking simply cannot be sacrificed for improved retention, while attrition needs to be kept to a minimum to increase the output of care providers. This study attempted to validate the assumptions of Paul’s model (specifically, that higher order thinking improves outcomes) by determining if there was a relationship between critical thinking scores of entry-level ASN students and correlating those scores with student success, as measured by program completion and NCLEX-RN® success, while controlling for potentially variables such as nursing course GPA and preadmission TEAS scores.

General Systems Theory

Ludwig von Bertalanffy started a discussion within the sciences that, though the principles of systems in general could be utilized to study many things, not all systems are equal.

Theoretical frameworks prior to this notion did not take into account the diversity of living organisms or the variances open systems brought to the table. Closed systems, as identified by Bertalanffy, involved a definitive beginning and predictable end but could not account for the diversity of living organisms. Bertalanffy (1950) proposed that living things should not be studied in the same manner as closed systems, “A system is closed if no material enters or leaves it; it is open if there is import and export and, therefore, change of the components. Living systems are open systems, maintaining themselves in exchange of material with the environment. . . .” (p. 23). Living organisms are influenced by multiple factors that cannot be studied independently thus inputs, throughputs and outputs must all be considered. The general systems theory offers a firm foundation on which to base a study in nursing education. Students enter nursing programs with certain attributes such as critical thinking skills and intelligence (inputs), are exposed to curricular components (throughputs), and are evaluated by education outcomes such as program and NCLEX-RN® success (outputs).

Related Literature

Required Curriculum Component of Nursing Schools

It is imperative nurses learn how to take newly acquired knowledge and compare and contrast it with pre-existing knowledge, analyze it for validity and reliability, and apply it to different situations in unique and, often, unconventional ways in order to be competent and safe practitioners (Facione, 2011; Lee, 2007; Romeo, 2010; Rung-Chuang, 2010). Ultimately, nursing programs are responsible for ensuring students possess these imperative critical thinking skills prior to caring for the public. Critical thinking is an essential element in nursing education as deemed necessary by various nursing school accrediting bodies and research studies (Drennan, 2009; Jenkins, 2011; Jones & Morris, 2007; Lee, 2007; Shin et al., 2006).

The National League for Nursing (NLN) and the American Association of Colleges of Nursing (AACN) are examples of organizations that include critical thinking in the core competencies required of their nursing schools to meet accreditation standards (Drennan, 2009; Jenkins, 2011; Jones & Morris, 2007; Lee, 2007). Most recently, the Accreditation Commission for Education in Nursing (ACEN), formally the National League for Nursing Accrediting Commission (NLNAC), set forth its standards for accreditation (2015). These standards stem from ACEN's core values of accreditation that "emphasize learning, community, responsibility, integrity, value, quality, and continuous improvement through reflection and analysis" (ACEN, 2015, p. 6). These standards and core curriculum requirements were identified as "throughputs" when considering this study's relationship to the general systems theory.

Several issues exist with the mandate that nursing schools must ensure students possess strong critical thinking skills. First, consensus must be reached regarding a definition of critical thinking specific to nursing (Romeo, 2010; Scheffer & Rubenfeld, 2000). Secondly, there is some debate as to which method(s) of instruction are most appropriate for nursing (Banning, 2006; Riddell, 2007; Romeo, 2010; Rung-Chuang, 2010). Thirdly, there is concern regarding the absence of a reliable tool to measure a student's ability to critically think within the realm of nursing, thus, resulting in an outcome that is difficult, if not impossible, to quantify (Brunt, 2005; Giddens & Gloeckner, 2005; Harding, 2010; Jones & Morris, 2007; Romeo, 2010; Shin et al., 2006; Staib, 2003). Further research was needed to expand this knowledge base specific to nursing and to more fully answer these questions. One way to accomplish this was to implement a research study guided by a critical thinking model while utilizing a nursing specific tool to measure nursing outcomes.

Nursing Course Grade Point Average (GPA)

Many studies have explored GPA (high school GPA, college GPA prior to nursing school admission, pre-requisite science course GPA, etc.) in various manners for the purpose of educational predictive studies (Davenport, 2007; Hopkins, 2008). Nursing course performance, specifically, has been found to be a statistically significant predictor for NCLEX-RN® success in multiple studies (Alameida et al., 2011; Beeson & Kissling, 2001; Higgins, 2005; Lin et al., 2003; Pitt et al., 2012; Shirrell, 2008; Tipton et al., 2008). Adult health nursing courses (Alameida et al., 2011; Daley, Kirkpatrick, Frazier, Chung & Moser, 2003; Silvestri, L., Clark, M., & Moonie, S. 2013; Simon & Augustus, 2009; Simon et al., 2013) have especially shown great predictability of program success, as has receiving a “B” or higher in all nursing courses (Beeson & Kissling, 2001). As such, nursing course GPA was isolated as a potential confounding variable and was statistically controlled in the final analysis when investigating predictive correlations related to NCLEX-RN® success. Nursing GPA was identified as an “input” when considering this study’s relationship to the general systems theory.

One such study that delineated the impetus for control of nursing course GPA as a potentially confounding variable was conducted by Alameida, Prive, Davis, Landry, Renwanz-Boyle and Dunham (2011). This retrospective, descriptive study’s purpose was to determine if nursing student success could be linked to select academic variables. 589 students’ records were utilized in the final data analysis, including student demographics, select course grades, nursing program GPA, scores on a specialized standardized test (two versions of the same exam were utilized – Version 3.0 and Forms A and B), and NCLEX-RN® results. In addition to descriptive statistics, *t* test and one-way analysis of variance (ANOVA) comparisons were performed to differentiate demographic variables. Pearson’s *r* was calculated for all independent variables and

those with $r > .30$ in relation to the dependent variable (NCLEX-RN® success) were included in the final chi-square analysis and logistic regression equations. In addition to positive correlations with scores from both versions of the specialized standardized test, the researchers found nursing program GPA to be predictive of NCLEX-RN® success with the following Chi-square results ($\chi^2 = 187.26$, $df = 97$, $p < .001$ in the Version 3.0 group; $\chi^2 = 150.04$, $df = 69$, $p < .001$ in the Forms A and B group). Though critical thinking was not addressed as a variable for success in this study, the study findings outlined the predictive power of nursing course GPA that could have a confounding effect on the current study, thus needs illuminated.

Similarly, Trofino (2013) conducted a retrospective study exploring the relationship between variables affecting nursing student success. The study included 85 participants chosen through convenience sampling over three semesters. Results of logistic regression analysis indicated that two different nursing courses were predictive of student success as measured by NCLEX-RN® passage – pharmacology ($p = .001$) and medical-surgical nursing ($p = .03$). Furthermore, utilizing an odds ratio calculation, the researchers found that those students who were successful in either the pharmacology or the medical-surgical nursing course were 11 and 6 times more likely, respectively, to pass the NCLEX-RN®. Not surprisingly, the statistical significance between successful course completion and NCLEX-RN® passage increased as a student's grade in an individual nursing course increased (pharmacology, $p = .0003$; medical-surgical nursing, $p = .006$; psychiatric nursing, $p = .0004$; leadership, $p = .0004$; and advanced medical-surgical nursing, $p = .002$). Similarly, the odds ratio for a student that never had to repeat a nursing course revealed a three and a half times higher likelihood of passing NCLEX-RN® than those students who had to repeat at least one nursing course. This study gave further credence that nursing course GPA is a strong predictor of nursing school success. It also

strengthened the argument that early (prior to failure of a nursing course) identification and intervention for at-risk students is of paramount importance to increase the likelihood of NCLEX-RN® success.

Test of Essential Academic Skills (TEAS)

ATI offers a statistical package for student retention and remediation that, in addition to the CTE, includes a preadmission test called the Test of Essential Academic Skills (TEAS). As the title aptly states this test measures skills deemed necessary to be successful in an academic program and includes assessment of mathematic, reading, English, and science abilities. The TEAS were “designed to measure the level of general academic preparedness of students entering a nursing program or to diagnose the strengths and weaknesses of admitted students immediately following entry into a nursing program” (ATI, 2009, p. 5). Multiple studies have revealed a positive correlation between TEAS scores and nursing program success (Diaz et al., 2012; Manieri et al., 2015; McCarthy, Harris, & Tracz, 2014; Pitt et al., 2012). As such, this was studied as a potentially confounding variable and statistically controlled for using logistic regression analysis. Preadmission TEAS scores were identified as an “input” when considering this study’s relationship to the general systems theory.

The TEAS exam was developed through a multi-tier process. The developers first analyzed the educational objectives of high school graduates as deemed necessary by multiple states in the core subject areas of science, math, reading, and English. The objectives for each subject area were then grouped together. The sets of objectives were subsequently given to a group of nurse educators to determine if the objectives were indicative of the needs of the target audience (entry level nursing students). The designated nurse educators offered additional

objectives needed to evaluate the students in three of the subsets – one math, two reading, and three science objectives (ATI, 2009).

The objectives were further narrowed to make them more manageable by eliminating objectives cited by a single state. Some science, math, and English objectives were excluded if only two states referenced them, as well, but no reading objectives were removed during this tier of the process. If an objective obviously measured similar attributes in more than one area the objectives were consolidated to decrease the total number of objectives evaluated on the exam.

Finally, 196 objectives remained and each was sent to nursing educators to determine which were most important to evaluate the preparedness of entry level nursing students. Several different processes were utilized to narrow the final number of objectives to 115 – of which make up the current TEAS examination (ATI, 2009). The final product contains 170 multiple-choice questions: 42 in reading, 30 in mathematics, 48 in science, 30 in English, and 20 unscored pretest items. Applicants are given 209 minutes to complete the exam and results are scored as “Developmental”, “Basic”, “Proficient”, “Advanced”, or “Exemplary” (ATI, 2009).

In 2014, McCarthy, Harris, and Tracz conducted a retrospective, correlational study to analyze predictors of nursing student success as measured by successful passage of the NCLEX-RN®. 794 students met the participant criteria which included data pertaining to six pre-program predictors, five in-program predictors, and the student’s NCLEX-RN® result. In this study, TEAS scores comprised the bulk of the “pre-program predictors” analyzed for predictability, coupled with communication and pre-nursing GPA. Through canonical correlation analysis, all four subsets of the TEAS examination were found to be significant predictors of student success. Again, while critical thinking was not addressed as a predictor of success in this study, the study findings outlined the predictive power of TEAS scores that could have a confounding effect on

the current study, as well. Furthermore, McCarthy et al. (2014) recommended future studies to examine other standardized testing variables utilized within nursing programs that could predict student success other than the TEAS.

Similarly, Manieri, De Lima, and Ghosal (2015) designed a study to determine which pre-admission standardized statistical package was most predictive of student success. The researchers compared three different statistical packages and found two of them to positively correlate with student success as measured by program completion. The TEAS package was one of the two packages found to predict student success with a significance of $p = .004$. Again, these findings validated the need to statistically control for TEAS when exploring critical thinking as a variable of student success. The researchers recommended further studies exploring different variables as predictors of nursing student success.

Finally, Diaz, Sanchez, and Tanguma (2012) conducted an exploratory study to determine predictor variables for success during the first nursing course, Nursing Fundamentals, in a BSN program. The sample consisted of 174 (40 male and 134 female) Hispanic students: 68.4% being younger than 25; 78.7% identified as unmarried; 67.2% declared no dependents; and 72.4% related they were not working. Four main variables were addressed in the study: TEAS scores, pre-nursing GPA, the ATI CTE, and demographic variables. Binary logistic regression analysis was utilized to explore the two possible outcomes – passage or failure of the first nursing course – in relation to each variable. Significance level was set at $p < .05$. The only variable showing statistical significance for successful completion of Nursing Fundamentals by all students was TEAS scores, $p = 0.000$. Interestingly, when analyzed by gender, both TEAS scores ($p = 0.000$) and pre-nursing GPA ($p = .041$) were statistically significant predictors of first nursing course success by women. Study results were not reported for the non-statistically

significant variables but ATI CTE was not shown to be predictive in this study. These findings further strengthened the argument that TEAS are predictive of nursing student success, but indicated the need for further exploration of ATI CTE specifically related to program completion and NCLEX-RN® passage, not merely first course completion.

Time Frame for Program Completion

For the purpose of the current study, nursing school completion was defined as a student's ability to successfully complete the ASN program within three years of matriculation. This definition was derived from accrediting body standards that state graduates should be able to complete the course of study within 150% of the stated program length (ACEN, 2015). The standard length for an ASN program is two years, but three is deemed acceptable. Nursing school completion was identified as an "output" when considering this study's relationship to the general systems theory.

It could be argued that in the face of a retention crisis in two-year higher education arenas [first to second year retention rates for public two-year programs is only 54.7% (American College Testing Program, 2015)], extension of graduation time is preferred over attrition. However, literature supports the assumption that students who fail a nursing course, thus extend program completion time, are at a higher risk for NCLEX-RN® failure (Herrera & Blair, 2015; Trofino, 2013). Conversely, students who progress normally and do not repeat courses are three and a half times more likely to pass NCLEX-RN® on the first attempt (Trofino, 2013).

As mentioned earlier, Trofino (2013) conducted a retrospective study exploring the relationship between variables affecting nursing student success. The study included 85 participants chosen through convenience sampling over three semesters. Results of logistic regression analysis indicated that two different nursing courses were predictive of student

success as measured by NCLEX-RN[®] passage – pharmacology ($p = .001$) and medical-surgical nursing ($p = .03$). Furthermore, utilizing an odds ratio calculation, the researchers found that those students who were successful in either the pharmacology or the medical-surgical nursing course were 11 and 6 times more likely, respectively, to pass the NCLEX-RN[®]. Not surprisingly, the statistical significance between successful course completion and NCLEX-RN[®] passage increased as a student's grade in an individual nursing course increased (pharmacology, $p = .0003$; medical-surgical nursing, $p = .006$; psychiatric nursing, $p = .0004$; leadership, $p = .0004$; and advanced medical-surgical nursing, $p = .002$). Similarly, the odds ratio for a student that never had to repeat a nursing course revealed a three and a half times higher likelihood of passing NCLEX-RN[®] than those students who had to repeat at least one nursing course. This study gave further credence to the argument that early (prior to failure of a nursing course) identification and intervention for at-risk students is of paramount importance to increase the likelihood of NCLEX-RN[®] success.

Though failure of a course is not the only reason a student would not matriculate in four semesters, it certainly is a factor to consider when exploring attrition and ultimate program success. Students who extend graduation time – due to repeating a course or needing to go part-time to be able to manage the study load – may have “at risk” characteristics on admission. This makes it even more imperative to identify and screen for high-risk criteria early in the program to enable interventions that can improve student success (Ahuna et al., 2011).

National Council of State Boards of Nursing

The National Council of State Boards of Nursing (NCSBN) is a non-profit organization formed in 1978 to unite state boards of nursing and provide support and counsel for these organizations to improve safe delivery of care (NCSBN, 2014b). Its mission is to “provide

education, service, and research through collaborative leadership to promote evidence-based regulatory excellence for patient safety and public protection” (NCSBN, 2014b, p. 17). One of the main ways the NCSBN works to accomplish its mission is by ensuring that nurses entering the workplace are competent, safe practitioners of care – that each nurse has the skills, knowledge and attitude necessary to fulfill the role of the registered nurse. The primary tool utilized to determine accomplishment of this goal is satisfactory completion of The National Council Licensure Examination for Registered Nurses (NCLEX-RN®). This exam, developed by the NCSBN, is evaluated on an ongoing basis for rigor and relevance. Test items are developed in part based on feedback obtained from survey results from entry-level nurses regarding content and concepts deemed essential for the entry-level nurse (NCSBN, 2014b).

The test plan is updated every three years based upon the current practice trends as determined by entry-level nurse surveys. Utilizing this information, the NCSBN determines if the passing standard should remain the same or change. The passing standard is measured in logits and data reveal an increase to the passing standard with all plan changes since 1998 with the exception of the 2001 test plan. According to the NCSBN (2015a), logits do not have a specific “meaning with regard to nursing content and in fact have an arbitrary zero point, but logits are practical because the probability of a correct response can easily be computed when the candidate’s ability and the item’s difficulty are known” (p. 18). Due to the increasing complexity of the healthcare environment it has been necessary to adjust the passing standard for the NCLEX-RN®, as well. The standard has gradually risen from -0.42 logits in 1998 to 0 logits in 2013. A new test plan will soon be available but the passing standard will not be changed (NCSBN, 2015a). The NCSBN (2015b) makes the decision to change the passing standard based on the following:

- The results of a standard setting exercise undertaken by the Panel of Judges. Currently, this exercise consists of a criterion-referenced standard setting method, with additional statistical result compromise procedures.
- A historical record of the passing standard and annual summaries of candidate performance on the NCLEX since the implementation of the CAT methodology in 1994.
- The results from the annual standard setting survey, which solicits the opinions of employers and educators regarding the competence of the current cohort of entry-level nurses.
- The educational readiness of high school graduates who expressed an interest in nursing. Currently, American College Testing service (ACT) provides this information. (¶2)

National Certification Exam Success

Another important aspect to consider is whether critical thinking truly improves the success of students. Within the context of nursing, literature supports the hypothesis that higher critical thinking ability positively correlates with nursing school and NCLEX-RN® success (Giddens & Gloeckner, 2005; Hoffman, 2008; Jones & Morris, 2007; Lyons, 2008; Roa et al., 2011; Romeo, 2010; Ukpabi, 2008). More research needed to be conducted, however, to assess specific parameters and assessment tools that address critical thinking as it relates to the practice of nursing (Brunt, 2005; Romeo, 2010). Further research was also needed utilizing nursing specific tools to assess for critical thinking (Brunt, 2005), specifically investigating correlations between critical thinking and outcomes, to ensure nursing curriculum is adequately fulfilling this need prior to high stakes testing and real-world application.

The National Council Licensure Examination for Registered Nurses (NCLEX-RN®) is an exam that is given at the end of all entry-level accredited nursing programs to measure nursing competencies (NCSBN, 2014a). Successful completion of the exam, at or above a minimum score, is required for all graduates prior to entry into practice. The exam, developed by the NCSBN seeks to determine if graduates can critically think, and thus provide safe care (NCSBN, 2014a). NCLEX-RN® success is a primary measurement utilized by nursing schools and accrediting bodies to determine achievement of nursing program outcomes (ACEN, 2015).

Passage rates for the NCLEX-RN® are reported annually for all nursing programs. The report includes the number of students taking the examination and passage rates for individual schools, states, and territories. Consumers may utilize this information when choosing schools of nursing, thus increased pressure is placed upon schools to have high board passage rates to make them more appealing to prospective students (Roa et al., 2011). According to the National Council of State Boards of Nursing (2015c), the average passage rate for the NCLEX-RN® in 2015 for all candidates educated in nursing schools within the United States was 84.53% (Diploma – 85.77%; Baccalaureate – 87.49%; Associate – 82%). NCLEX-RN® success was identified as an “output” when considering this study’s relationship to the general systems theory.

Critical Thinking in Nursing

Previous research has shown the importance of critical thinking in health care professions (Duchscher, 2003; Edwards, 2003; Finn, 2011; Mishoe, 2003). Though the scientific method has been utilized for years to promote critical thinking, human errors can, and do, still occur when utilizing this process. Critical thinking related to health care is distinct and errors in the process of reasoning can lead to poor outcomes (Institute of Medicine, 2000). It is for this reason it is

imperative nursing schools rise to meet the challenge of cultivating safe, critical thinkers who utilize the latest in critical thinking techniques to improve patient outcomes (Facione, 2011; Finn, 2011; Jones & Morris, 2007; Lyons, 2008). Critical thinking was identified as an “input” when considering this study’s relationship to the general systems theory.

Existing definitions of critical thinking. The earliest discussion of critical thinking can be traced back to Socrates as he “established the importance of seeking evidence, closely examining reasoning and assumptions, analyzing basic concepts, and tracing out implications not only of what is said but of what is done” (Paul, Elder, & Bartell, 2013, ¶2), known today as the Socratic Method. Since that time, however, multiple definitions of critical thinking have been developed. Some examples cited by Nosich (2012) are:

Critical thinking is skillful, responsible thinking that is conducive to good judgment because it is sensitive to context, relies on criteria, and is self-correcting; Critical thinking is thinking about your thinking, while you’re thinking, in order to make your thinking better; and Critical thinking is reasonable, reflective thinking that is focused on deciding what to believe or do. (p. 2)

Additionally, Facione (2011) discussed the results formulated from a panel of experts who came together to form an agreed upon definition of critical thinking in higher education and the core components of critical thinking. Facione delved into the reasons critical thinking is an important attribute and discussed modalities to improve skills in students such as questioning the evidence and identifying emotions; however, the information is not exclusive to nursing. The following is the definition the experts formulated:

We understand critical thinking to be purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the

evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based. CT is essential as a tool of inquiry. As such, CT is a liberating force in education and a powerful resource in one's personal and civic life. While not synonymous with good thinking, CT is a pervasive and self-rectifying human phenomenon. The ideal critical thinker is habitually inquisitive, well informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit. Thus, educating strong critical thinkers means working toward this ideal. It combines developing CT skills with nurturing those dispositions which consistently yield useful insights and which are the basis of a rational and democratic society. (Facione, 2011, p. 26)

Within the nursing community there is consensus "that critical thinking is the cornerstone of the objectives and goals for nursing students" (Romeo, 2010, p. 378). In a large landmark study, Scheffer and Rubenfeld (2000) compiled a consensus statement regarding the definition of critical thinking specific to nursing. Though not unanimously accepted by the nursing community, this definition has the greatest literature support to date (Drennan, 2010; Jenkins, 2011; Jones & Morris, 2007). According to Scheffer and Rubenfeld (2000), a definition that encompasses what critical thinking truly means to nursing is:

Critical thinking in nursing is an essential component of professional accountability and quality nursing care. Critical thinkers in nursing exhibit these habits of the mind: confidence, contextual perspective, creativity, flexibility,

inquisitiveness, intellectual integrity, intuition, open-mindedness, perseverance, and reflection. Critical thinkers in nursing practice the cognitive skills of analyzing, applying standards, discriminating, information seeking, logical reasoning, predicting and transforming knowledge. (p. 357)

These 10 habits of the mind and seven skills are those that should be present in a nurse exhibiting critical thinking. Further research is needed to pinpoint strategies that will foster these habits and skills in nursing students and to develop valid and reliable tools to measure critical thinking (Scheffer & Rubenfeld, 2000). Though these researchers paved the way by developing an initial definition of critical thinking specific to nursing, the literature still shows a significant gap of knowledge in this area (Facione, 2011; Jones & Morris, 2007; Romeo, 2010; Staib, 2003).

Two other definitions of critical thinking were of key importance to this study. One is the definition of critical thinking as posed by ATI (2001) that suggested, “critical thinking is a dynamic, analytic process that results in reasoned decisions and judgments” (p. 1). Assessment Technologies Institute fashioned its definition upon Facione’s, stating that critical thinking involves six competencies: interpretation, analysis, evaluation, inference, explanation, and self-regulation. Definitions as posed by ATI (2001) for the subscales are as follows:

- *Interpretation*: to understand, comprehend, decipher, explain the meaning of written materials, verbal and nonverbal communications, empirical data and graphics (p. 23)
- *Analysis*: to examine, organize, categorize or prioritize variables, such as signs and symptoms, evidence, facts, research finding, concepts, ideas, beliefs and point of view (p. 23)
- *Evaluation*: to assess the credibility of sources of information, to assess the strength of evidence, to assess the relevance significance, value or applicability of information

in relation to a specific situation and to assess information for biases, stereotypes and clichés (p. 24)

- *Inference*: to draw conclusions based on evidence, to differentiate between conclusions/hypotheses that are logically or evidentially necessary and those that are merely possible or probable, and to identify knowledge gaps or needs (p. 24)
- *Explanation*: to explain, in writing or orally, the assumptions and reasoning processes followed in reaching conclusion and to justify one's reason/conclusions in terms of evidence, concepts, methodologies or contextual considerations (p. 25)
- *Self-regulation*: to continuously monitor, reflect and question one's own thinking; to reconsider interpretations or judgments as appropriate based on further analysis of facts or added information; and to examine one's own views with sensitivity to the possible influence of personal biases or self-interest (p. 25)

The second is the definition of critical thinking as presented by Paul (1993) that is much more vague. Paul stated “critical thinking is thinking about your thinking while you're thinking in order to make your thinking better” (p.91). He furthermore stated that critical thinking is “self improvement [in thinking] through standards [that assess thinking]” (p. 91). Paul's Model for the National Assessment of Higher Order Thinking includes multiple criteria for a valid assessment of critical thinking. Two that both validated the need for and helped frame this study were that the tool should assess critical thinking in a manner that allows for improvement of instruction and that it should have the ability to measure “the achievement of students against national standards” (p. 118). Furthermore, several critical thinking assessment tools are critiqued later in Chapter Two – the California Critical Thinking Skills Test, the California Critical Thinking Disposition Inventory, the Collegiate Assessment of Academic Proficiency Critical

Thinking Test, the Watson and Glaser Critical Thinking Appraisal, and the Assessment Technologies Institute Critical Thinking Exam.

Retention and the effects of early intervention. Recruiting and accepting appropriate candidates for nursing school slots is only half the battle. Once students have been accepted into a program, the weight of retaining students falls on the faculty of the school. As the current and looming nursing shortage was addressed earlier, it is for obvious reasons that educators must be well informed on retention strategies and do all within their power to help nursing students succeed. Many studies have been conducted assessing nursing student retention models (Beauvais, 2014; Gazza & Hunker, 2014; Jeffreys, 2015). It is important to note that though critical thinking is considered an academic predictor of success (Jeffreys, 2015; Rogers, 2010) it has been grossly understudied in the nursing community utilizing a nursing specific tool. If a nursing specific tool can be utilized to appropriately measure critical thinking skills of entry level students and efficacious strategies are employed early to enhance these skills, it stands to reason that retention of these students will improve.

Early intervention for at-risk student populations has been found to be a key strategy to improve retention in nursing students (Davenport, 2007; Harris et al., 2014; Jeffreys, 2007; Jeffreys, 2015; Ramsburg, 2007; Williams, 2010). Faculty engagement and advising have been cited as useful strategies to help with retention of students, as well as remediation packets that are individually geared toward student performance (Davenport, 2007). Likewise, inclusion of remediation specifically tailored to students with low critical thinking scores upon admission has the potential to improve success. This could especially be beneficial if students are identified early and tracked throughout the entire length of the program (Harris et al., 2014).

Additionally, at-risk students have benefitted from specifically designed programs that include information related to learning style inventories, productive study habits, test taking strategies, time management, coping skills, problem solving techniques, and critical thinking strategies (Harris et al., 2014; Jeffreys, 2015). Furthermore, academic support services such as small group study sessions and one-on-one faculty to student conferences have shown promise in early identification and retention of at-risk students (Ramsburg, 2007). Post-test reviews where rationales for both correct and incorrect answer choices are explained tend to increase understanding of missed concepts and aid in retention, as well (Ramsburg, 2007).

Early identification, at or before program entry, of student attributes that could potentially adversely affect student outcomes is of utmost importance. This would allow educators an opportunity to proactively intervene, rather than waiting until crisis, thus increase a student's chance at success (Harris et al., 2014; Ramsburg, 2007). Lack of critical thinking skills warrants close consideration as a high-risk category for incoming students, thus was explored in this study.

Strategies for developing critical thinking. Two important aspects to consider regarding critical thinking and its relationship to nursing are: does it truly improve the success of students and does it ultimately make them safer nurses? Literature exists that implies both are true, therefore it is imperative nursing education leaders be concerned with setting goals that will accomplish these outcomes and planning the most efficacious methods to reach those goals. Literature supports the implementation of faculty development programs to enhance the educator's ability to create and implement critical thinking exercises within the curriculum (Chan, 2013; Rogers, 2010). Additionally, specific teaching strategies have been shown to

improve critical thinking skills of nursing students, discussed below, thus should be utilized when appropriate.

Explicit instruction. It has been found that explicit, rather than implicit, teaching is more efficacious regarding skills (Marin and Halpern, 2011). These researchers found numerous studies to support the use of explicit teaching, citing high effect sizes for critical thinking skills in programs where teaching was targeted toward specific instruction and repetition of skills, rather than concentrating on logic and intelligence. Bensley, Crowe, Bernhardt, Buckner, and Allman (2010) found similar results and discovered that students taught with explicit instruction showed statistically significant gains in critical thinking specific to argument analysis.

It has also been proposed that traditional models of instruction should be switched to allow for more explicit instruction:

Instead of listening to lectures at school and doing problems at home, students can read content as homework and at school work on problems in groups which the teacher poses thought-provoking questions and coaches explicitly on development of higher-order thinking. (Rosefsky & Opfer, 2012, p. 10)

Literature supports several specific ways to intentionally teach critical thinking: modeling, use of exemplars, collaborative problem-solving activities, and specific, guided frameworks for critical thinking analysis (Lloyd & Bahr, 2010). Provision of specific instructions on how to go about critical thinking, coupled with inclusion of real-world scenarios to practice the steps, can produce dramatic gains regarding acquisition and application of critical thinking skills.

Active learning. Though memorization of facts is important in the field of nursing, it is the application of those facts that truly matters. Multiple studies have found that students who are engaged in the learning process and who are taught to problem solve, perform considerably

better on a multitude of assessments (Nokes, Dole, & Hacker, 2007; Snyder & Snyder, 2008). Instruction, then, should not necessarily be tailored around content to be learned, but should focus on the concepts of how to learn (Snyder & Snyder, 2008). Unfortunately, there are some barriers to this process. First, faculty may be reluctant to change and balk at incorporating active learning strategies. They may lack the training and resources to fully implement the strategies, as well. Additionally, students often lack the motivation required to learn critical thinking skills and may be reluctant to participate in active learning strategies (Kowalczyk, Hackworth, & Case-Smith, 2012).

Various strategies can be incorporated into instruction to encourage active learning. Questioning techniques, case studies, simulation exercises and journaling are all strategies that can be utilized to encourage active participation (Edwards, 2003). These activities also allow the student to practice implementation of critical thinking skills in non-threatening environments.

Questioning. Questioning has been found to be an efficacious strategy to increase critical thinking skills of students (Haynes & Baily, 2003; Seker & Komur, 2008). Moreover, integrating questioning techniques across the curriculum improves the student's ability to habitually implement critical thinking in context (Burrell, 2014). Utilizing critical questioning techniques not only fosters immediate critical reflection, it instills a process of thinking that can be applied to situations independently in the future (Jenkins, 2011; Riddell, 2007). The ultimate goal of questioning is to make students be questioners, as well. Critical thinkers do not blindly accept information that is given to them; rather they question validity, independently seek answers, and delve for deeper understanding (Chan, 2013).

Paul and Elder (2006), leaders in the critical thinking movement, have advocated for the use of questioning as an evidence based method of honing one's ability to critically think.

Socratic questioning can be accomplished through spontaneous, unplanned discussions. For example, a teacher might ask a student to expound upon what was meant by a particular statement, or ask the student to provide evidence of why it is true. “Such spontaneous discussions provide models of listening critically as well as exploring the beliefs expressed” (Paul, 1993, p. 335).

Exploratory questioning is another method that can be utilized to hone critical thinking skills. This type of questioning allows the teacher to discover what the student already knows or believes about a topic (Paul, 1993). Exploratory questioning, specifically, can be utilized to capitalize upon adult learner attributes to acknowledge the importance of the adult learner’s life experiences. Additionally, recognizing the student’s desire for learning to be relevant has the propensity to increase engagement in the learning process.

Finally, questioning can be issue-specific (Paul, 1993). In nursing education this could be implemented by providing a specific patient scenario and questioning how the student would respond or carry out the nursing process given the information provided. This higher order thinking could create an environment wherein the student must synthesize information to find various solutions and support each with evidence.

In today’s high tech world questioning can be accomplished in many ways other than direct questioning in a classroom. Virtual chat rooms and discussion boards are excellent mediums to pose specific questions and allow students time to ruminate and respond. Whether questioning takes place in a “live” or “virtual” context, educators must guide students through the critical thinking process initially to ensure understanding of the steps and rationale of the activity (Haynes & Baily, 2003).

Case studies, concept mapping, simulation, and problem-based learning. A plethora of hands-on, student-centered, active learning strategies exist to help students think holistically about issues, process and analyze situations, and apply previously learned knowledge in meaningful ways. Case studies, the development of concept maps, participation in simulation based activities, and group or educator led problem based learning modules are all excellent activities that can be interspersed throughout in an effort to increase critical thinking skills across horizontal and vertical curricular threads (Chang, Chang, Kuo, Yang, & Chou, 2011; Kowalczyk et al., 2012).

Case studies are an active learning pedagogy that, when designed and implemented effectively, assist students to analyze and synthesize important information, concepts, and constructs utilizing real-life situations. Case studies have been shown to assist in the development of a student's higher order thinking across disciplines when employed with intentionality by educators (Lee, 2007). Utilization of case studies requires students to build upon previously acquired knowledge, integrate new data, and apply solutions to different situations (Kaddoura, 2011). Effective case studies should: have clearly defined objectives related to the concepts being evaluated; welcome discussion and defense of answers that are different than those expected by the teacher; occur in a safe, open learning environment; engage the entire class, if possible; and end with a summary of the key points that are most critical to the learning activity (Billings & Halstead, 2005).

Concept maps are an evidence-based teaching strategy utilized in nursing education and have been shown to increase critical thinking in nursing students (Burrell, 2014). Concept maps, also known as care maps, provide students a platform for "organizing, analyzing, and synthesizing patient information and linking data to health care concepts" (Burrell, 2014, p. 55).

The use of concept maps as a critical thinking teaching strategy has been shown to improve retention and application of information specifically related to health promotion, client education, and safety (Maneval, Filburn, Deringer, & Lum, 2011), all incredibly important outcomes for nursing students.

Simulation has also been found to increase critical thinking skills in nursing students by allowing them to react and respond to real life situations in a safe environment. Simulated learning environments provide scenarios wherein the student must respond and apply the nursing process, concepts of critical thinking and clinical judgment to make on-the-spot decisions regarding care of a patient. During these scenarios the student must analyze and synthesize previous knowledge with current assessment to choose the most appropriate actions.

Debriefing after simulation activities is of utmost importance to the learning process and the acquisition of improved critical thinking performance (Billings & Halstead, 2012).

Debriefing involves discussion of the student's performance, critical appraisal of peers' performances, discourse over identified concepts, and expression of thoughts and emotions. (Burrell, 2014). Simulation activities should include both active components (geared at stimulating the cognitive domain) and reflective components (tailored toward activation of the affective domain) to have the biggest effect on the student's critical thinking growth process (Staib, 2003).

Journaling. Journaling is an excellent resource to foster critical thinking in students. Journaling can be linked to a specific assignment or an overall curriculum experience. Journaling allows students to process situations and experiences and to expound upon strengths and weaknesses, to discuss ways the project could've been completed differently, and/or to

reflect upon emotions conjured during the experience (Lloyd & Bahr, 2010). Journaling can be completely unstructured or can be guided through a specific set of questions.

Critical Thinking Measurement Tools

If something is deemed important enough to incorporate into curriculum, it stands to reason that those outcomes should be measured. Teachers and administrators alike must be abreast of the most current, evidence based assessment strategies available so that outcomes can be measured in a valid and reliable manner. An agreed upon definition of critical thinking specific to the student population is an essential starting point for determining the most reliable and valid ways to assess these skills (Stassen, Herrington, & Henderson, 2011). Multiple tools exist to measure critical thinking outcomes. Though none are exclusively utilized for nursing, ATI does claim that its CTE measures critical thinking outcomes specific to nursing (ATI, 2009). A few are specific to healthcare, in general, as well. The following section discusses some of the common tests that currently exist and claim to measure a student's ability to critically think. They have been utilized to measure outcomes of specific strategies as mentioned in the previous section and to predict success within nursing programs, in general.

California Critical Thinking Skills Test (CCTST) and California Critical Thinking Disposition Inventory (CCTDI). Two commonly utilized critical thinking measurement tools are the CCTST and the CCTDI. These tests, developed by Facione (1990), examine the student's ability to analyze, evaluate and infer from a given set of data or stated situation. The inference portion evaluates a student's ability to draw conclusions and make decisions appropriately. There are seven subsets measured by the tests: truth-seeking, open-mindedness, analyticity, systematicity, self-confidence, inquisitiveness, and maturity (Wagensteen, Johansson, Bjorkstrom, & Nordstrom, 2010). Both have been utilized in numerous research

studies related to healthcare programs in general and have been shown through a meta-analysis to be moderately correlated with health care trainee success, though the correlation for CCTDI was slightly weaker than that of the CCTST (Ross, Loeffler, Schipper, Vandermeer, & Allan, 2013). Multiple studies have utilized these tools to ascertain their predictive power within nursing and have returned inconclusive results (Giddens & Gloeckner, 2005; Hicks, 2003; Mahmoud, 2012; Stewart & Dempsey, 2005). Many of these studies cited the need for a nursing specific tool to achieve more meaningful results (Beckie, 2001; Giddens & Gloeckner, 2005; Hicks, 2003; Stewart & Dempsey, 2005).

Collegiate Assessment of Academic Proficiency Critical Thinking Test (CAAP). The CAAP is used to measure a student's ability to analyze and evaluate arguments. It is a multiple choice test and provides comparative, normative data for students at similar higher education institutions at the same academic level (Wagensteen et al., 2010). Though some studies have found the CAAP to correlate with success when combined with other variables such as overall and science class GPA, the CAAP has not been shown to be independently predictive of nursing school success (Shirrell, 2008).

Watson and Glaser Critical Thinking Appraisal (WGCTA). This test was developed in 1942 and the latest form available is from 1980. The norms for this test are limited and, by many standards, out of date. The exam works under the assumption that critical thinking consists of attitudes, knowledge and skills. The five scores available for students are: inference, recognition, deduction, interpretation, and evaluation. The WGCTA assesses general critical thinking skills, not discipline specific (Wagensteen et al., 2010). It has been utilized in numerous research studies related to healthcare programs in general and has been shown through a meta-analysis to be moderately correlated with health care trainee success (Ross et al., 2013).

Though it has been widely used in nursing curriculum its efficacy and predictive power specific to nursing has been questioned (Giddens & Gloeckner, 2005; Riddell, 2007; Wagensteen et al., 2010).

Assessment Technologies Institute Critical Thinking Exam. Finally, the ATI CTE was created specifically to evaluate healthcare professional critical thinking outcomes. The ATI CTE seeks to measure the following variables within the context of healthcare: interpretation, analysis, evaluation, inference, explanation, and self-regulation (ATI, 2001). Studies have found mixed results utilizing this test, warranting further research to validate its reliability (Lyons, 2008; Ukpabi, 2008). A concern with the exam is that though the ATI CTE touts itself as being a test specific to healthcare professionals, the test is closely related to the other tests mentioned above (Newton & Moore, 2008).

One specific study by Lyons (2008) utilized the ATI CTE to measure outcomes of nursing students in a study on problem-based learning. The researcher employed a pre-test treatment comparative group design including 54 associate-degree nursing students. The students were randomly assigned to either a control group, where traditional lecture was employed to deliver information, or to the treatment group, where problem-based learning (PBL) case scenarios were utilized to disseminate information. The researcher applied logistic regression analysis to the data to determine if the use of the PBL teaching method and ATI CTE scores were statistically significant predictors of NCLEX-RN® success. This study did not show critical thinking, as measured by ATI's exam, or PBL as a teaching method, as statistically significant factors in NCLEX-RN® success ($p < .365$).

Conversely, a study by Ukpabi (2008) did show a statistically significant correlation between increased critical thinking scores, as measured by ATI, and successful passage of the

NCLEX-RN®. The study employed a convenience sample of 39 nursing school graduates exploring 18 different variables as potential predictors of success. In this study, 11 of the 18 variables were found to be statistically significant predictors of NCLEX-RN® success, ATI CTE revealing the third highest significance value of all variables ($p = .008$). Interestingly, when correlational statistics were explored between variables related to student success, a strong correlation was noted between ATI CTE and TEAS ($r = .78$).

Additionally, an exploratory descriptive study conducted by Newton and Moore (2013) investigated critical thinking skills in basic BSN and accelerated ASN students utilizing ATI CTE. Though the study did not explore the predictive power of critical thinking as it relates to nursing student success, the researcher did uncover data revealing that nursing students tend to score highest in certain subsets of the exam – self-regulation, specifically. The study, involving 283 first-semester nursing students, also found that students with prior degrees tended to score higher on the entrance ATI CTE than their non-degree holding peers. Finally, Newton and Moore found that most nursing students involved in the study entered the nursing program with above average critical thinking dispositions, as measured by the ATI CTE. These findings further delineate the significance of early identification of students with deficient critical thinking skills to allow time for intervention, thus an increased chance at program success.

Due to the discrepancies among study results, more studies needed to be designed and conducted to validate the assumptions of Paul's (1993) Model for the National Assessment of Higher Order Thinking that states an assessment tool should be able to assess critical thinking in a manner that allows for improvement of instruction and that it should have the ability to measure "the achievement of students against national standards" (p. 118). Though the model's emphasis is on the infusion of critical thinking into curriculum and adequate assessment, it does

infer that critical thinking has a high probability of determining success and that higher order thinking improves student outcomes, in general.

With this thought in mind, the need to find a tool that can accurately assess a student's ability to critically think in an effort to validate the assumption that higher order thinking does improve outcomes is of utmost importance. Previous studies have cited the need for a "subject-specific measure" to increase the likelihood that a statistically significant correlation may be found between critical thinking and student success (Shirrell, 2008, p. 34). As such, a tool specific to nursing was best suited for this study and the ATI CTE best fit that description.

Summary

Accrediting bodies of nursing schools set standards that must be met for schools to maintain accreditation. The development of students who are critical thinkers is one standard that is consistent regardless of the accrediting body being examined. Administrators and educators in college nursing programs have a grave responsibility to ensure that the curriculum in place is both rigorous and dynamic so that it can adequately address this mandated outcome. Educators must be constantly examining if what is being done is producing the desired outcomes and, if not, what can be changed to ensure success?

As educators seek to implement changes to improve outcomes they must first determine what critical thinking truly is (specific to the nursing profession); how should it be taught; and how will it be effectively and accurately measured? Most importantly, though, is does it even matter? Has critical thinking been empirically shown to improve outcomes? Previous studies have shown mixed results related to this and point to the need for further examination of this question (Giddens & Gloeckner, 2005; Lyons, 2008; Jones, 2007; Romeo, 2010; Shirrell, 2008).

According to the Model for the National Assessment of Higher Order Thinking (Paul, 1993), student success should be able to be correlated to critical thinking ability. Discipline specific studies are needed to validate this model (Shirrell, 2008). Likewise, the general systems theory supports the assumption that a student success, the study's identified "output" measured by program completion and NCLEX-RN® success, may be affected by numerous "inputs". For the purpose of this study those input variables were the student's ability to critically think, as measured by ATI CTE, and the student's intelligence, as measured by nursing GPA and preadmission TEAS scores.

The study utilized the Model of the National Assessment of Higher Order Thinking as rationale for the study while applying the general systems theory by measuring critical thinking skills of entry-level ASN students with a nursing specific tool and correlating those scores with student success. The prevailing thought for the study was if correlation between critical thinking scores and student outcomes could be determined, educators would be better equipped to implement individualized instruction for students lacking in higher ordered thinking upon entry into nursing programs, thus improve retention and the output of safe, competent nurses (Ahuna et al., 2011; Davenport, 2007; Hopkins, 2008; Pitt et al., 2012).

CHAPTER THREE: METHODS

Overview and Design

The purpose of this nonexperimental, multivariate predictive correlational study was to examine the model of critical thinking as posed by the Model for the National Assessment of Higher Order Thinking (Paul, 1993) to assess for relationships between the predictor variable, critical thinking [as measured by the Assessment Technologies Institute (ATI) Critical Thinking Exam (CTE)], and the criterion variables, student outcomes (as measured by NCLEX-RN® passage rates and successful completion of an ASN program within three years), controlling for potentially confounding variables such as overall nursing GPA and preadmission Test of Essential Academic Skills (TEAS) scores where applicable, for 550 students at a semi-urban nursing school in southwestern, West Virginia. An ex-post facto design was utilized to retrospectively analyze transcripts from students over the course of seven years to determine entry level ATI CTE scores, preadmission TEAS scores, nursing course GPA, program completion, and NCLEX-RN® success. Nonparametric logistical regression was used to test for relationships between these variables due to the nominal level data of the criterion variables (Gall et al., 2007; Warner, 2013). Chapter Three will present the study design, the research questions and hypotheses, the participants and the setting, as well as the instruments, procedures, and analyses utilized for the study.

The premise for this research study was to retrospectively evaluate a specific variable to determine if it was a reliable predictor of nursing student success. Since the goal of this study was to “identify predictive relationships,” a predictive, correlational research design was utilized (Shaughnessy et al., 2003, p.123). Though correlational research seeks to predict relationships, due to the fact that the predictor variable data were gleaned retrospectively, thus could not be

manipulated, the research design was nonexperimental in nature and cannot be said to *prove* causation (Campbell & Stanley, 1963; Polit & Beck, 2004). Consequently, the results of the research are not reported as the predictor variable “caused” or “did not cause” the criterion variables, but that it did or did not “predict” it in a significant way.

Critical thinking scores of students were assessed to determine if those scores were predictive of nursing school success, while considering the potentially confounding variables of nursing course GPA and preadmission TEAS scores. Correlation studies are useful to “measure the degree and direction of the relationship between two or more variables and to explore possible causal factors” (Gall et al., 2007, p. 336). For this reason, correlational statistics were appropriate for this study.

Gall, Gall, and Borg (2007) highlighted how multiple variables can be studied both simultaneously and individually, to examine relationships. Several contemporary studies utilized retrospective predictive correlation to predict NCLEX-RN® success. One such study by Trofino (2013) explored the relationship between multiple student variables and NCLEX-RN® success. Age ($p = .08$), normalized pre-entrance math scores from either the ACT, SAT, or TEAS examinations ($p = .03$); pharmacology course grades ($p = .0003$); and advanced medical-surgical course grades ($p = .002$) were all positively correlated with success as measured by passage of the NCLEX-RN®. Repetition of nursing courses (with an odds ratio of .29 deemed by the researcher to be statistically significant) was found to be negatively correlated with student success as measured by passage of the NCLEX-RN®. Conversely, students who never failed a nursing course were three and a half times more likely to pass the exam (Trofino, 2013).

Similarly, Simon, McGinniss, and Krauss (2013) explored the relationship between scores on the NLN Readiness Exam and student factors such as individual course grades, overall

GPA, course transfer credits, and age. In this study overall pre-entrance GPA ($P = .001$), as well as specific course grades in Chemistry ($P = .020$) and Biology ($P = .003$), were found to be significant predictors of success as measured by NLN Readiness Exam scores. The first nursing course (NUR 1) was found to be a significant predictive of success ($P = .009$), as well. The use of this research design for similar studies strengthened the argument for its utilization in the current research study in which retention and success of nursing students was explored by examining a predictive variable and two potentially confounding variables that had the potential to affect outcomes as measured by two criterion variables.

Research Questions

Two research questions were proposed for this study:

RQ1: Is there a statistically significant predictive relationship between critical thinking skills as measured by ATI CTE and successful completion of an ASN program while controlling for preadmission TEAS scores?

RQ2: Is there a statistically significant predictive relationship between critical thinking skills as measured by ATI CTE and passage of the NCLEX-RN[®] while controlling for nursing course GPA and preadmission TEAS scores?

Null Hypotheses

To achieve the purposes of this study, nine null hypotheses were proposed:

H_{01.0}: There will be no statistically significant predictive relationship between three-year program completion rates of ASN students and critical thinking skills as measured by the ATI CTE.

H_{01.1}: There will be no statistically significant predictive relationships between three-year program completion rates of ASN students and preadmission TEAS scores.

H_{01.2}: There will be no statistically significant predictive relationships between three-year program completion rates of ASN students and critical thinking skills as measured by the ATI CTE while controlling for preadmission TEAS scores.

H_{01.3}: There will be no statistically significant predictive cumulative relationship discovered between critical thinking skills as measured by the ATI CTE and preadmission TEAS scores while exploring successful completion of an ASN program within a three-year time frame.

H_{02.0}: There will be no statistically significant predictive relationship between passage of the NCLEX-RN[®] and critical thinking skills as measured by the ATI CTE.

H_{02.1}: There will be no statistically significant predictive relationship between passage of the NCLEX-RN[®] and nursing course GPA.

H_{02.2}: There will be no statistically significant predictive relationships between passage of the NCLEX-RN[®] and preadmission TEAS scores.

H_{02.3}: There will be no statistically significant predictive relationships between passage of the NCLEX-RN[®] and critical thinking skills as measured by the ATI CTE while controlling for nursing course GPA and preadmission TEAS scores.

H_{02.4}: There will be no statistically significant predictive cumulative relationship between critical thinking skills as measured by the ATI CTE, nursing course GPA, and preadmission TEAS scores and first time NCLEX-RN[®] passage.

Participants and Setting

The participants for this study were students from an ASN program in a semi-urban, Appalachian community. The participants were predominantly White with less than 1% identifying as other ethnicities. This is in alignment with the lack of cultural diversity within the community at large. Due to the homogeneity of the group, data related to race were not included

in the study. Regarding gender, the population for the study included 550 students – 439 (80%) female and 111 (20%) male, consistent with the current student body make-up. The gender make-up in this study was actually above the national average where men comprise approximately 9.6% of the total nursing population (Landivar, 2013). The study sample was obtained utilizing a single stage, convenience design. Convenience sampling “involves selecting respondents primarily on the basis of their availability and willingness to respond” (Shaughnessy et al., 2003, p. 132).

IRB approval was initially obtained from Liberty University. Afterward, site authorization from the target university was received via written consent and an enrollment list for each semester for the past seven years was obtained from the school’s admission secretary to ascertain student names for inclusion in the study. The sampling frame was homogenous as only one school registrar was involved in the process.

Non-random, convenience sampling was utilized since the data were being collected for a specific purpose and because the specified data were readily accessible by the researcher (Polit & Beck, 2004; Shaughnessy et al., 2003). The study took place retrospectively and included results from all students meeting the inclusion criteria that were admitted between August 2006 and August 2013, totaling 550 students. Since logistic regression was employed for this study, a minimum of 20 to 1 case-to-variable ratio was utilized to ensure an adequate sample size and increase the plausibility that the data were valid (Hosmer & Lemeshow, 2000). Assuming that the sample was representative of the population being studied (Shaughnessy et al., 2003) a sample size this large should have increased the power and significance of the null hypotheses. Significance for this study was set at the $p < .05$ level and power at .80. In general, power was not a problem because the sample size was greater than 100 (Hosmer & Lemeshow, 2000;

Szapkiw, A, 2011). Warner (2013) suggests a sample size of at least 153 for the above noted alpha and power levels. Additionally, the researcher utilized the equation $N \geq 104 + m$, where m = the number of predictor variables, to make sure that the sample size was adequate to elicit sufficient power (Tabachnick & Fidell, 2013).

The study was conducted in a semi-urban, hospital-based, privately funded ASN program in southwestern West Virginia. Historically, 60 new students are admitted each semester, from an applicant pool of approximately 150, utilizing a competitive point system that includes: pre-existing healthcare experience (specifically prior experience as a Licensed Practical Nurse); ACT and preadmission TEAS scores (a minimum score is required for both and the higher the score the more points obtained); and applicable college course grades obtained prior to admission (more points are awarded for higher grades and if a class must be repeated the awarded points are cut in half). Four courses are required prior to entry into the program: anatomy, chemistry, English Composition I, and introduction to psychology.

These four pre-entry classes must be passed with a “C” or better or admission will not be granted regardless of points. Five other specific courses (English Composition II, physiology, microbiology, developmental psychology, and diet therapy) may be taken and count toward the admission points. These classes are required for degree attainment, but may be completed prior to entry into the nursing program if the student wishes to boost their points. Finally, any math or science course at a higher level than the required courses may be taken to obtain points, as well. The current enrollment is approximately 220 students (accounting for students in all levels of the program).

The nationally (ACEN) and state (West Virginia Board of Examiners [WVBOE]) accredited program consists of four traditional semesters in which students are required to

complete 72 hours for degree completion. Those hours include: Nursing specific courses (NUR 120 – Introduction to Nursing; NUR 220 – Health Alterations I; NUR 230 – Health Alterations II; NUR 241 – Health Alterations III; NUR 235 – Maternal/Child Nursing; and NUR 225 – Psychiatric Nursing); prerequisite courses such as Chemistry and Anatomy; and co-requisite support classes such as diet therapy, English, anatomy, physiology, and developmental psychology.

The program is housed in a relatively new (2009) state-of-the-art facility with wireless technology, smart boards, individualized study rooms, and four computer labs with 24 computers in each lab. Preadmission TEAS testing and ATI CTE all take place in the facility and are administered via proctored computerized testing. Proctors are faculty at the school. The TEAS test is administered prior to entry into the program, whereas the ATI CTE is administered once admission is granted but before the first class day. Students are responsible for contacting the school to set up testing dates. Students who produce appropriate (per the school policy) documentation of a learning disability are placed in an individualized study room with a hall proctor available. The NCLEX-RN® examination is not administered at the school, but at tertiary testing centers contracted out by the NCSBN.

Instrumentation

ATI CTE

The main instrument utilized in the study was the CTE administered by ATI. It was used to objectively measure critical thinking skills, the predictor variable identified in the study, of the nursing students in an effort to correlate those attributes with program completion and NCLEX-RN® success while controlling for potentially confounding variables such as nursing course GPA and preadmission TEAS scores. The construct validity for this exam was established by “an

extensive review of the literature regarding critical thinking theory” (ATI, 2001, p. 22). The developers for the exam utilized information gleaned from the work of Facione and Facione (1996), well-respected researchers in the field of critical thinking, to develop the critical thinking model. Definitions established by ATI and utilized in the CTE stemmed from this work, as well as from the esteemed Delphi project sponsored by the American Philosophic Association (ATI, 2001). Finally, all items on the exam were evaluated by experts in the field of critical thinking to determine their suitability for the model (ATI, 2001) prior to inclusion.

The ATI CTI assessment model is based upon the above-mentioned definitions and expert input. Multiple competencies are measured including: interpretation, analysis, evaluation, inference, explanation, and self-regulation (Lyons, 2008, p. 2). The test has been found to have, “A global alpha of .69 and a standardized item alpha of .70 for all items in first-time examinees” (ATI, 2001; Jones & Morris, 2007, p. 112). A study performed by Ukpabi (2008) did show a statistically significant correlation between increased critical thinking scores, as measured by ATI, and successful passage of the NCLEX-RN[®]. In that study, the ATI CTE was a statistically significant predictor of NCLEX-RN[®] success with a $p = .008$. However, additional studies needed to be performed utilizing this tool because Lyons (2008) did not find the tool to be a statistically significant predictor of NCLEX-RN[®] success.

ATI (2001) has “put in place several procedures to assure the highest degree of validity for the scores of this instrument” (p. 22). The construct validity was established by an extensive review of the literature and incorporation of pertinent critical thinking theory (ATI, 2001). The test contains 40 items, and experts evaluated all items in the area of critical thinking specific to nursing. The expert panel evaluated the content validity of each item as well. Each item was evaluated based upon appropriateness and relevance to critical thinking in nursing.

Representative sample schools were asked to participate in alpha and beta validation of the tool and changes were made based on item analysis. Test items were then blueprinted to ensure all items pertained to the six subscales of the exam: interpretation, analysis, evaluation, inference, explanation, and self-regulation. Definitions as posed by ATI (2001) for the subscales are as follows:

- *Interpretation*: to understand, comprehend, decipher, explain the meaning of written materials, verbal and nonverbal communications, empirical data and graphics (p. 23)
- *Analysis*: to examine, organize, categorize or prioritize variables, such as signs and symptoms, evidence, facts, research finding, concepts, ideas, beliefs and point of view (p. 23)
- *Evaluation*: to assess the credibility of sources of information, to assess the strength of evidence, to assess the relevance significance, value or applicability of information in relation to a specific situation and to assess information for biases, stereotypes and clichés (p. 24)
- *Inference*: to draw conclusions based on evidence, to differentiate between conclusions/hypotheses that are logically or evidentially necessary and those that are merely possible or probable, and to identify knowledge gaps or needs (p. 24)
- *Explanation*: to explain, in writing or orally, the assumptions and reasoning processes followed in reaching conclusion and to justify one's reason/conclusions in terms of evidence, concepts, methodologies or contextual considerations (p. 25)
- *Self-regulation*: to continuously monitor, reflect and question one's own thinking; to reconsider interpretations or judgments as appropriate based on further analysis of

facts or added information; and to examine one's own views with sensitivity to the possible influence of personal biases or self-interest (p. 25)

The ATI CTE is administered via proctored computerized testing at the school of nursing. Proctors are faculty at the school. The ATI CTE is administered once admission is granted but before the first class day. Students who produce appropriate (per the school policy) documentation of a learning disability are placed in an individualized study room with a hall proctor available. For data analysis, CTE composite scores were recorded as continuous data.

ATI TEAS

ATI offers a statistical package for student retention and remediation that, in addition to the CTE, includes a preadmission test called the Test of Essential Academic Skills (TEAS). As the title aptly states this test measures skills deemed necessary to be successful in an academic program and includes assessment of mathematic, reading, English, and science abilities. The TEAS were “designed to measure the level of general academic preparedness of students entering a nursing program or to diagnose the strengths and weaknesses of admitted students immediately following entry into a nursing program” (ATI, 2009, p. 5). Multiple studies have revealed a positive correlation between TEAS scores and nursing program success (Diaz et al., 2012; Manieri et al., 2015; McCarthy, Harris, & Tracz, 2014; Pitt et al., 2012). As such, this was studied as a potentially confounding variable and statistically controlled for using logistic regression analysis.

The TEAS examination includes subsets for several subject areas including math, science, reading, and English. There are 170 multiple-choice questions: 42 in reading, 30 in mathematics, 48 in science, 30 in English, and 20 unscored pretest items. Applicants are given 209 minutes to complete the exam and results are scored as “Developmental”, “Basic”,

“Proficient”, “Advanced”, or “Exemplary” (ATI, 2009). A minimum score of “Basic” is required for entry into the program.

Preadmission TEAS testing takes place in the school of nursing and is administered via proctored computerized testing. Proctors are faculty at the school. The TEAS test is administered prior to entry into the program and students are responsible for contacting the school to set up testing dates and for paying for the exam. Students who produce appropriate (per the school policy) documentation of a learning disability are placed in an individualized study room with a hall proctor available. All other students are placed in a 24-person capacity computer lab with individual monitors and keyboards. Questions on the exam are randomized to deter cheating.

The TEAS exam was developed through a multi-tier process. The developers first analyzed the educational objectives of high school graduates as deemed necessary by multiple states in the core subject areas of science, math, reading, and English. The objectives for each subject area were then grouped together. The sets of objectives were subsequently given to a group of nurse educators to determine if the objectives were indicative of the needs of the target audience (entry level nursing students). The designated nurse educators offered additional objectives needed to evaluate the students in three of the subsets – one math, two reading, and two science objectives (ATI, 2009).

The objectives were further narrowed to make them more manageable by eliminating objectives cited by a single state. Some science, math, and English objectives were excluded if only two states referenced them, as well, but no reading objectives were removed during this tier of the process. If an objective obviously measured similar attributes in more than one area the objectives were consolidated to decrease the total number of objectives evaluated on the exam.

Finally, 196 objectives remained and each was sent to nursing educators to determine which were most important to evaluate the preparedness of entry level nursing students. Several different processes were utilized to narrow the final number of objectives to 115 – of which make up the current TEAS examination (ATI, 2009). For data analysis, TEAS composite scores were recorded as continuous data.

Nursing Course Grade Point Average

Though many studies have explored GPA (high school GPA, college GPA prior to nursing school admission, pre-requisite science course GPA, etc.) in various manners for the purpose of educational predictive studies (Davenport, 2007; Hopkins, 2008), this study specifically examined nursing course GPA as a potential confounding variable. Nursing course performance has been found to be a statistically significant predictor for NCLEX-RN® success in multiple studies (Alameida et al., 2011; Beeson & Kissling, 2001; Higgins, 2005; Lin et al., 2003; Pitt et al., 2012; Shirrell, 2008; Tipton et al., 2008). Adult health nursing courses (Alameida et al., 2011; Daley et al., 2003; Silvestri et al., 2013; Simon & Augustus, 2009; Simon et al., 2013) have especially shown great predictability of program success, as has receiving a “B” or higher in all nursing courses (Beeson & Kissling, 2001).

As such, nursing course GPA was isolated as a potential confounding variable and was statistically controlled in the final analysis when investigating predictive correlations related to NCLEX-RN® success. This process improved the likelihood that any noted effects were related to the proposed predictor variable, critical thinking, and not solely nursing course GPA. Nursing course GPA was generally defined as the student’s GPA upon graduation that included the following courses required by the nursing program where the research occurred: NUR 120, NUR 220, NUR 230, NUR 225, NUR 235, and NUR 241. The grading scale utilized throughout the

program is: A = 90 – 100; B = 80 – 89; C = 76 – 79; D = 66 – 75; F = 65 or lower. For data analysis, GPA was recorded as ordinal data. To accomplish this, the student's actual numerical GPA was rounded to the nearest whole number and recorded as: 0 = F, 1 = D, 2 = C, 3 = B, and 4 = A average.

NUR 120, Introduction to Nursing, is an 8-credit course that introduces students to the nursing role and to the use of the nursing process in assisting adult patients to meet basic needs. Lab experiences are included to facilitate development of the student nurse's role as a provider of patient centered care. It is the first class students take upon admission into the nursing program. In addition to the theory and clinical component of this course, students are offered seminars on test taking strategies, nursing care plan development, and drug calculations.

NUR 220, Health Alterations I, is an 8-credit course that focuses on nursing care of adult patients responding to potential and actual health alterations in the gastrointestinal, urinary, and reproductive systems. Infection control and care of the patient with diabetes are also introduced as core concepts in this course that continue throughout the curriculum. It is the first of three adult medical-surgical classes and includes a lab component where students care for patients in various health care settings. This course is offered in the 2nd semester of the 4-semester program and is generally taken concurrently with NUR 225.

NUR 230, Health Alterations II, is a 7-credit course. The focus of this course is also on nursing care of adult patients with health alterations of specific physiological systems. The body systems covered in this course include musculoskeletal, neurosensory, respiratory, hematology, vascular, and endocrine. Role requirements and processes utilized in managing groups of patients are introduced in this course, as students begin caring for multiple patients in the acute

care setting. This course is generally taken in the 3rd semester of the 4-semester program and taken concurrently with NUR 235.

NUR 225, Psychiatric Nursing, is a 4-credit course that focuses on the role of the professional nurse in caring for clients with alterations in psychosocial functioning. Clinical experience provide opportunities to utilize the nursing process in providing care to clients in the psychiatric setting. This course is taken concurrently with NUR 220 for students on the full-time track.

NUR 235, Maternal-Child Nursing, is a 6-credit course with a focus on the nursing role utilized in promoting health and caring for the child bearing family and pediatric clients. Clinical experiences are included in the course, as well, and take place in hospital, clinic, and community settings. This course is taken concurrently with NUR 230 for students on the full-time track.

NUR 241, Health Alterations III, is a 9-credit course. This is the capstone course and is taken in the last semester of the program, the 4th semester for students who have matriculated in traditional fashion. The focus in this course is on nursing care of adult clients with health alterations of the cardiac system, as well as the patient requiring intensive care. The theory portion of this course culminates with a unit related to management concepts important to the working nurse. After the theory portion is complete, students are required to complete over 200 hours of directly supervised clinical time in the acute care setting. The students are supervised by specially trained Clinical Education Partners (CEPs) – nurses working full-time in the hospital setting – as well as by faculty members of the school.

Program Completion

For the purpose of this study, nursing school completion was defined as a student's ability to successfully complete the ASN program within three years of matriculation. This definition was derived from accrediting body standards that state graduates should be able to complete the course of study within 150% of the stated program length (ACEN, 2015). The standard length for an ASN program is two years, but three is deemed acceptable. Datum for this variable was dichotomous and was recorded as "yes" the student completed the program or "no" the student did not complete the program and coded for statistical analysis as "1" or "0", respectively.

NCLEX-RN®

The NCLEX-RN® is an exam that is given at the end of all entry-level accredited nursing programs to measure nursing competencies (NCSBN, 2014a). Successful completion of the exam, at or above a minimum score, is required for all graduates prior to entry into practice. The passing standard is measured in logits and according to the NCSBN (2015a), logits do not have a specific "meaning with regard to nursing content and in fact have an arbitrary zero point, but logits are practical because the probability of a correct response can easily be computed when the candidate's ability and the item's difficulty are known" (p. 18). As such, students do not receive a numerical score; scores are simply reported to the student as "pass" or "fail". Datum for this variable was dichotomous and was recorded as "pass" or "fail" and coded for statistical analysis as "1" or "0", respectively.

Procedures

Prior to IRB approval, the researcher obtained consent from the identified nursing school to collect student data, including preadmission TEAS scores, CTE scores, nursing course grades,

program completion status, and NCLEX-RN® results (pass/fail). Upon entry into the nursing school in question, all students are asked to sign a consent stating any and all student data can be used in current and/or future studies if utilized for educational research purposes. This consent assures students that information will be kept confidential. Once permission to collect data was given, the researcher also acquired a copy of the student consent template for record keeping purposes.

Additionally, as part of the school's admission requirements, all students entering the nursing program take the CTE and the TEAS prior to the first class day and the scores are documented on the student's permanent record. These tests have been administered to all students entering the program for the duration of the study's timeframe. This allowed for a rich pool of convenience data from which to draw.

After approval was obtained for data collection from the identified nursing school and consent was granted from the IRB from Liberty University, the researcher obtained a roster of students that were admitted each semester for the previous seven years from the school's admissions secretary. An electronic database was established based upon the obtained roster and names were numerically coded for anonymity in an Excel file. This Excel file was kept on the personal laptop computer of the researcher and the computer was with the researcher or in the researcher's locked office at all times. Additionally, the computer was password protected with a password known only by the researcher.

Once the Excel database was established for all students admitted during the previous seven years, the researcher pulled records for the identified students alphabetically. Student records were kept in a confidential, secure locked room. Access to the room was restricted and the researcher was only granted access for data collection related to the identified students in the

database. The researcher recorded and aggregated demographic information related to gender, student nursing course grade point averages, CTE scores, TEAS scores, program completion status, and first time NCLEX-RN® exam status for each student. Table 1 and Table 2 explain which data were utilized, the level of data for each variable, where the data were found, and in which manner the data were collected and recorded.

The data were readily available in student records kept in a secure, locked, limited-entry file room. Once information for a student was entered into the Excel file format, the student record was returned to file cabinet in the locked room. Data collection and aggregation mostly occurred in the locked records room. If a record was removed from the room it was kept with the researcher at all times and returned to the locked room promptly.

Students who did not have all required information in their file were excluded from the study so that the existing body of knowledge was complete and cohesive. The exception to this was students without an NCLEX-RN® result or students who did not have grades for all nursing courses indicating they did not complete the program. These students were placed in a separate batch to explore program completion related to critical thinking scores. Once aggregated, the student names were removed from the Excel file to ensure anonymity. The data, identified solely by numbers, were analyzed utilizing SPSS® Version 24 via logistic regression analysis to ascertain relationships among the variables. As noted previously, all data were kept on a password-protected laptop computer owned by the researcher.

Table 1

Predictor Variables

Data	Data Type	Data Source	Coding
CT scores	Continuous	Student records	Raw scores
TEAS scores	Continuous	Student records	Raw scores
Nsg GPA	Ordinal	Student records	0 = F 1 = D 2 = C 3 = B 4 = A

Table 2

Criterion Variables

Data	Data Type	Data Source	Coding
NCLEX-RN [®] Success	Dichotomous	Student records	1 = pass 1 st attempt 0 = fail 1 st attempt
Program Completion	Dichotomous	Student records	1 = yes 0 = no

Data Analysis

Nonparametric binomial logistical regression was utilized to determine if any statistically significant relationships existed among the variables in an effort to test each null hypothesis.

Logistical regression is preferred when the criterion variables are measured using nominal level data, as is the case in this study: NCLEX-RN[®] success (pass/fail) and Nursing Program

Completion (yes/no). This type of data analysis explores how one or more predictor variables

can be used to predict a criterion variable. It is also useful at determining what percentage of

variance within the criterion variable can be explained by the predictor variable(s) (Tabachnick

& Fidell, 2013; Polit & Beck, 2004). For these reasons, logistical regression was employed to test each null hypothesis.

Significance for this study was set at the $p < .05$ level and power at .80. In general, power should not have been a problem because the sample size in this study was greater than 100 (Hosmer & Lemeshow, 2000; Szapkiw, A, 2011). Warner (2013) suggested a sample size of at least 153 for the above noted alpha and power levels. Additionally, the researcher utilized the equation $N \geq 104 + m$, where m = the number of predictor variables, to make sure that the sample size was adequate to elicit sufficient power (Tabachnick & Fidell, 2013). Effect size was examined utilizing NagelkerkeR². Though this test is not a true indication of effect size its use to determine proper model fit is widely accepted with logistic regression where true linear relationships do not exist between the predictor and criterion variables (Warner, 2013). The researcher also utilized odds ratios to represent effect size for the study (Warner, 2013).

Logistic regression does not require the researcher to make assumptions of normality, linearity, or homogeneity related to the predictor variables, thus these were not necessarily explored (Warner, 2013). However, in an effort to increase power and reliability, the following assumptions were made for this logistic regression study: the outcome variable must be dichotomous; outcome variables should be independent of one another; the final model should include all pertinent predictors, but none that are not significant; and members can only belong to one of the dichotomous criterion categories (Warner, 2013, p. 1008).

Several limitations related to logistic regression studies were addressed, as well. Too few data may occur in a particular cell during analysis resulting in misinformed predictions. Multicollinearity may be present between variables that could result in large standard errors in the data analysis. Outliers may result in a poor fit model with consequent poor study correlation.

Finally, though no linearity is necessary among variables in logistic regression studies, it is assumed that a linear relationship exists between predictor and criterion variables in logit form (Tabachnick & Fidell, 2013).

During data analysis, cells with less than five entries can skew results and result in conclusions being drawn from small portions of the sample (Warner, 2013). Tabachnick and Fidell (2013) recommended combining or deleting categories if this transpires, but this cannot occur in this study because each category was independently pertinent. For example, if over the seven years of proposed data, only two students were unsuccessful on the NCLEX-RN®, this data could not be ignored. It was decided that if a cell in the final data analysis contained fewer than five entries, the researcher would critically examine the best way to handle the occurrence based upon the circumstances. An adequate overall sample size decreased the likelihood of this limitation and no cell contained fewer than five entries in the final analysis.

Similarly, by examining variance inflation factors and tolerance values, the detrimental effects of multicollinearity were diminished (Tabachnick & Fidell, 2013; Warner, 2013). A small tolerance value is indicative of a pre-existing linear relationship between the predictor variables, thus would add nothing to the final predictive model. Tolerance can range from 0 to 1, where 0 represents a perfect linear relationship between the variables and 1 denotes no prior correlation. The closer the tolerance value is to 1 the less likely multicollinearity will be an issue, however values greater than .1 are generally acceptable to show absence of multicollinearity (Warner, 2013). Conversely, variance inflation factors are the opposite of tolerance values with higher numbers showing larger degrees of multicollinearity. To abate the issue of multicollinearity, variance inflation factors should be less than 10 (Tabachnick & Fidell, 2013).

Outliers were identified utilizing standardized residuals and a decision was made as to what should be done with the data in regard to this study (Tabachnick & Fidell, 2013). According to Warner (2013) most data should fall within the -3 to +3 standard deviation mark, therefore, that range was utilized in the final determination of datum inclusion for the current study. Finally, a Box Tidwell Transformation Test was performed to determine any linear relationships among the predictor variables and the log odds of the criterion variables.

Further limitations included the lack of generalizability. The study took place in one nursing school; therefore, the results may not be applicable to all students in every demographic or geographical area. As suggested by Gall, Gall, and Borg (2007) the researcher took great pains to adequately describe the research sample in an effort to help others infer the results to other populations. Another limitation was the use of convenience sampling, which has the propensity to weaken the reliability of results (Gall et al., 2007; Warner, 2013). Finally, there were confounding variables such as nursing course GPA and preadmission TEAS scores that could have accounted for the ATI CTE scores, the nursing school completion rates, or the NCLEX-RN® passage rates. Logistic regression analysis was conducted to attempt to control for these potentially interfering variables (Polit & Beck, 2004; Tabachnick & Fidell, 2013). Though the study design attempted to account for these, it is not possible to completely eliminate the effects of certain confounding variables (Gall et al., 2007).

CHAPTER FOUR: FINDINGS

Overview

This study examined the relationships between students' critical thinking skills and student success in a semi-urban, hospital-based, privately funded Associate of Science in Nursing (ASN) program in southwestern West Virginia. Specifically, student critical thinking was measured by Assessment Technologies Institute's Critical Thinking Exam (ATI CTE). Student outcomes were measured by successful completion of an ASN program within three years and pass rates on the National Certification Licensure Examination for Registered Nurses (NCLEX-RN®). Further relationships were explored to determine if students' pre-entry Test of Essential Academic Skills (TEAS) scores or nursing course GPA were confounding variables or if these variables could add depth to the final predictive model. This chapter includes a recapitulation of the research questions and null hypotheses proposed for this study; a discussion regarding the analysis of pertinent descriptive statistics; as well as an in-depth discourse pertaining to the findings of each research question and null hypothesis.

Research Questions

Two research questions were proposed for this study:

RQ1: Is there a statistically significant predictive relationship between critical thinking skills as measured by ATI CTE and successful completion of an ASN program while controlling for preadmission TEAS scores?

RQ2: Is there a statistically significant predictive relationship between critical thinking skills as measured by ATI CTE and passage of the NCLEX-RN® while controlling for nursing course GPA and preadmission TEAS scores?

Null Hypotheses

To achieve the purposes of this study, nine null hypotheses were proposed. Four subsets were derived from the first research questions and five subsets from the second research question:

H_{01.0}: There will be no statistically significant predictive relationship between three-year program completion rates of ASN students and critical thinking skills as measured by the ATI CTE.

H_{01.1}: There will be no statistically significant predictive relationships between three-year program completion rates of ASN students and preadmission TEAS scores.

H_{01.2}: There will be no statistically significant predictive relationships between three-year program completion rates of ASN students and critical thinking skills as measured by the ATI CTE while controlling for preadmission TEAS scores.

H_{01.3}: There will be no statistically significant predictive cumulative relationship discovered between critical thinking skills as measured by the ATI CTE and preadmission TEAS scores while exploring successful completion of an ASN program within a three-year time frame.

H_{02.0}: There will be no statistically significant predictive relationship between passage of the NCLEX-RN[®] and critical thinking skills as measured by the ATI CTE.

H_{02.1}: There will be no statistically significant predictive relationship between passage of the NCLEX-RN[®] and nursing course GPA.

H_{02.2}: There will be no statistically significant predictive relationships between passage of the NCLEX-RN[®] and preadmission TEAS scores.

H_{02.3}: There will be no statistically significant predictive relationships between passage of the NCLEX-RN[®] and critical thinking skills as measured by the ATI CTE while controlling for nursing course GPA and preadmission TEAS scores.

H_{02.4}: There will be no statistically significant predictive cumulative relationship between critical thinking skills as measured by the ATI CTE, nursing course GPA, and preadmission TEAS scores and first time NCLEX-RN[®] passage.

Descriptive Statistics

This study included students admitted to the aforementioned nursing program from August 2006 through August 2013. The total number of students admitted during this time period was difficult to determine due to inadequate admission roster records. First day of class rosters were utilized to formulate the database for this study, totaling 598 students. No data were available on 21 of the students, no grades were recorded, and no file found in the records room; therefore, these names were eliminated. The remaining 577 names were entered into an Excel spreadsheet. Once data were collected, 25 names were eliminated because they were names of licensed practical nursing (LPN) students who were granted permission to skip the first semester nursing course, NUR 120, so complete data sets were not possible. The remaining 552 student data sets were explored to determine completeness, as well. Two cases were excluded because the students had not taken the NCLEX-RN[®] at the time of the study. Ultimately, 550 students were included in the study.

The initial database involved 550 students, 431 female (78.4%) and 119 male (21.6%). Two sets of logistical regression were completed with the data set – one to address the research question related to program completion and one to address the research question related to NCLEX-RN[®] success. Of the 550 students in the initial database, 54 did not complete the

program, representing 9.8% of the total sample. Of the 54 who did not complete the program, 16 were male (13.4% of the total male sample), and 38 were female (8.8% of the total female sample). The remaining 496 students in the data pool were utilized for analysis related to NCLEX-RN® success. Of the 496 students taking the NCLEX-RN®, 467 were successful on the first attempt; 372 were female (79.7%), and 95 were male (20.3%). There were 29 NCLEX-RN® failures, eight males (representing 7.8% of the total male sample related to NCLEX-RN® success) and 21 females (representing 5.3% of the total female sample related to NCLEX-RN® success). See Table 3 for raw data related to the descriptive statistics for gender in this study.

Specifically examining the predictor variable, GPA, six nursing course grades were explored. Inclusion criteria for the NCLEX group specified complete grade sets. There were 550 students with grades recorded for NUR 120; 523 for NUR 220; 514 for NUR 225; 513 for NUR 230; 502 for NUR 235; and 502 for NUR 241. These numbers attest to attrition during program progression. The mean GPA for the sample was 2.77, with the median being 2.83 and a standard deviation of .59.

Regarding the predictor variable CTE, there were six separate subtests that comprised the composite score. There were 550 student scores for this exam with a mean score of 72.40, a median score of 72.5, and a standard deviation of 9.03. The final set of predictor variables utilized to answer the research questions was in relation to TEAS scores. The composite score for this exam was derived from scores of five subtests. There were 550 students included in this data set, as well. The mean score for the TEAS composite was 74.28, the median score was 74.71, and the standard deviation was 8.64. See Table 4 for raw data related to the descriptive statistics for the predictor variables in this study.

Table 3

Descriptive Statistics for Demographic and Criterion Variables

Variable	N
Participants	550
Female	431
Male	119
Program Completion	496
Female	393
Male	103
NCLEX-RN [®] Success	467
Female	372
Male	95

Table 4

Descriptive Statistics for Predictor Variables

Variable	N	Mean	Median	SD
Critical thinking scores				
Composite	550	72.40	72.5	9.03
TEAS scores				
Composite	550	74.28	74.71	8.64
GPA				
Cumulative	550	2.77	2.83	.59

Results

Assumption Tests

As discussed in Chapter Three, logistic regression does not require the researcher to make assumptions of normality, linearity, or homogeneity related to the predictor variables (Warner, 2013). However, there are still several assumptions that must be satisfied in order to deem the

results of a logistic regression study statistically sound. Assumption testing for logistic regression will be discussed in this section, as they are the same for each research question and the corresponding null hypotheses.

First, in a logistic regression study, the outcome, or criterion variable(s), must be dichotomous and the results only capable of fitting into one of the two categories (Warner, 2013). For each null hypothesis in this study, one of two criterion variables was utilized separately or in tandem. They were NCLEX-RN[®] success (pass/fail) and program completion (yes/no), thus both were dichotomous and included independence of observations. Second, the predictor variables must be measured on a continuous or nominal scale (Warner, 2013). For this study the predictor variables, CT and TEAS, were both measured utilizing continuous scales, while GPA was measured on an ordinal scale. A third assumption is that there will be adequate cases per entry. During data analysis, cells with less than five entries can skew results and result in conclusions being drawn from small portions of the sample (Warner, 2013). Examining the descriptive statistics for this study, there were no cells with fewer than five cases. Ultimately, the smallest cell encapsulated 29 cases, accounting for NCLEX-RN[®] failures. Each of the largest cells contained 550 cases, which included results for TEAS, GPA, and CT scores.

There were also assumptions that needed to be met related to how well the data fit into the chosen logistic regression model. First, a linear relationship between the continuous predictor variables, CT and TEAS scores, and the logit transformation of the criterion variables, NCLEX-RN[®] success and program completion, was explored (Tabachnick & Fidell, 2013). A Box Tidwell Transformation Test was performed via SPSS[®] Version 24 software to determine any linear relationships among the predictor variables and the log odds of the criterion variables (Menard, 2010). For the first research question, related to program completion, CT and TEAS

scores were both found to be linearly related to the logit of the criterion variable without the need for Bonferroni correction (Warner, 2013). For the second research question related to NCLEX-RN® success, CT and TEAS scores were again found to be linearly related to the logit of the criterion variable even in the absence of Bonferroni correction.

Table 5

Box-Tidwell Related to Program Completion

	<i>p</i>
CT composite by natural log transformation of CT composite	.689
TEAS composite by natural log transformation of TEAS composite	.325
Constant	.008

Table 6

Box-Tidwell Related to NCLEX-RN® Success

	<i>p</i>
CT composite by natural log transformation of CT composite	.486
TEAS composite by natural log transformation of TEAS composite	.438
Constant	.364

Next, the absence of multicollinearity between predictor variables was established to decrease the likelihood of large standard errors occurring during data analysis (Tabachnick & Fidell, 2013). This assumption was explored via tolerance values and variance inflation values, where a small tolerance value was indicative of a pre-existing linear relationship between the predictor variables, thus would add nothing to the final predictive model. Tolerance can range from 0 to 1, where 0 represents a perfect linear relationship between the variables and 1 denotes no prior correlation. The closer the tolerance value is to 1 the less likely multicollinearity will be an issue, however values greater than .1 are generally acceptable to show absence of

multicollinearity (Warner, 2013). Conversely, variance inflation factors are the opposite of tolerance values with higher numbers showing larger degrees of multicollinearity. To abate the issue of multicollinearity, variance inflation factors should be less than 10 (Tabachnick & Fidell, 2013). Utilizing SPSS®, tolerance values and variance inflation factors were explored for each predictor variable in this study. The findings support the absence of multicollinearity among the predictor variables as noted in Table 7.

Table 7

Assessment of Multicollinearity Between Predictor Variables with TV and VIF

	Tolerance Values			Variance Inflation Factors		
	GPA	CT	TEAS	GPA	CT	TEAS
GPA	-----	.811	.811	-----	1.234	1.234
CT	.968	-----	.968	1.033	-----	1.033
TEAS	.951	.951	-----	1.051	1.051	-----

Finally, outliers had to be identified to ensure a good model fit. Outliers were identified via SPSS® by exploring standardized residuals (Tabachnick & Fidell, 2013). According to Warner (2013) most data should fall within the -3 to +3 standard deviation mark; therefore, that range was utilized in the final determination of datum inclusion for the current study. Using the aforementioned cutoff values, there were no identified outliers for the variables related to program completion or NCLEX-RN®, thus all cases were included in the final analysis for each null hypothesis.

Research Question One Hypotheses

Four null hypotheses stemmed from the first research question: Is there a statistically significant predictive relationship between critical thinking skills as measured by ATI CTE and successful completion of an ASN program while controlling for preadmission TEAS scores? The first and second null hypotheses sought to determine predictive relationships between one

dichotomous criterion variable and one continuous predictor variable. Binomial logistic regression was utilized to analyze these relationships. The third and fourth null hypotheses related to research question one sought to determine the confounding or cumulative relationship between one dichotomous criterion variable and two continuous level predictor variables. Logistic regression was again employed to explore this cumulative effect, as well as the variance explained at each step.

Null Hypothesis H_{01.0}. This null hypothesis asserted that there would be no statistically significant predictive relationship between three-year program completion rates of ASN students and critical thinking skills as measured by the ATI CTE. Significance for this null hypothesis was set at the $p < .05$ level and power at .80. Warner (2013) suggested a sample size of at least 153 for the above noted alpha and power levels. Additionally, the researcher utilized the equation $N \geq 104 + m$, where m = the number of predictor variables, to make sure that the sample size was adequate to elicit sufficient power (Tabachnick & Fidell, 2013). There was a total of 550 cases included in the analysis of this hypothesis, thus power was deemed adequate. Chi square for the Omnibus Tests of Model Coefficients was 6.207, $p = 0.013$, making the model statistically significant. The researcher also explored the Hosmer and Lemeshow Test values and found the test not significant, $p = 0.444$, again displaying good model fit. Cox and Snell R Square and Nagelkerke R Square values were 0.011 and .024, respectively, representing 1.1 – 2.4% of the variance.

The model correctly predicted 90.2% of the cases. However, when exploring completion versus noncompletion, the model did not correctly identify any students who did not complete the program solely based upon the critical thinking score. This represents extremely poor negative predictive value. The model did predict 100% of the students who successfully

completed the program, representing excellent positive predictive value. Critical thinking scores were predictive of program success, $p = .012$, thus rejecting the null hypothesis. According to this model, an increase in the critical thinking score by one unit would represent an increase in the likelihood of the student successfully completing the program by one unit, as well.

Table 8
Critical Thinking Model Predicting Program Completion

	<i>B</i>	SE	Wald	<i>df</i>	<i>p</i>	Odds Ratio	95% CI for Odds Ratio	
Constant	-.510	1.075	.225	1	.635	.600		
CT Comp	.038	.015	6.323	1	.012	1.039	1.008	1.07

Null Hypothesis $H_{01.1}$. This null hypothesis asserted that there would be no statistically significant predictive relationships between three-year program completion rates of ASN students and preadmission TEAS scores. Significance for this null hypothesis was set at the $p < .05$ level and power at .80. Warner (2013) suggested a sample size of at least 153 for the above noted alpha and power levels. Additionally, the researcher utilized the equation $N \geq 104 + m$, where m = the number of predictor variables, to make sure that the sample size was adequate to elicit sufficient power (Tabachnick & Fidell, 2013). There were a total of 550 cases included in the analysis of this hypothesis, thus power was deemed adequate. Chi square for the Omnibus Tests of Model Coefficients was 9.022, $p = 0.003$, making the model statistically significant. The researcher also explored the Hosmer and Lemeshow Test values and found the test not significant, $p = 0.983$, again displaying good model fit. Cox and Snell R Square and Nagelkerke R Square values were 0.016 and .034, respectively, representing 1.6 – 3.4% of the variance.

The model correctly predicted 90.2% of the cases. However, when exploring completion versus noncompletion, the model did not correctly identify any students who did not complete

the program solely based upon the TEAS score. This represents extremely poor negative predictive value. The model did predict 100% of the students who successfully completed the program, representing excellent positive predictive value. TEAS scores were predictive of program success, $p = .003$, thus rejecting the null hypothesis. According to this model, an increase in the TEAS score by one unit would represent an increase in the likelihood of student being successful in the program by one unit, as well.

Table 9
TEAS Model Predicting Program Completion

	<i>B</i>	SE	Wald	<i>df</i>	<i>p</i>	Odds Ratio	95% CI for Odds Ratio	
Constant	-1.328	1.164	1.302	1	.254	.265		
TEAS Comp	.049	.016	9.052	1	.003	1.050	1.017	1.084

Null Hypothesis $H_{01.2}$. This null hypothesis asserted that there would be no statistically significant predictive relationship between three-year program completion rates of ASN students and critical thinking skills as measured by the ATI CTE while controlling for TEAS scores. Significance for this null hypothesis was set at the $p < .05$ level and power at .80. Warner (2013) suggested a sample size of at least 153 for the above noted alpha and power levels. Additionally, the researcher utilized the equation $N \geq 104 + m$, where m = the number of predictor variables, to make sure that the sample size was adequate to elicit sufficient power (Tabachnick & Fidell, 2013). There were a total of 550 cases included in the analysis of this hypothesis, thus power was deemed adequate. Chi square for the Omnibus Tests of Model Coefficients was 10.771, $p = 0.005$, making the model statistically significant. The researcher also explored the Hosmer and Lemeshow Test values and found the test not significant, $p = 0.623$, again displaying good model

fit. Cox and Snell R Square and Nagelkerke R Square values were 0.019 and .041, respectively, representing 1.9 – 4.1% of the variance.

The model correctly predicted 90.2% of the cases. However, when exploring completion versus noncompletion, the model did not correctly identify any students who did not complete the program solely based upon the model that included both critical thinking and TEAS. This represents extremely poor negative predictive value. The model did predict 100% of the students who successfully completed the program, representing excellent positive predictive value. For this model, critical thinking scores were not predictive of program completion, $p = .185$, while TEAS scores were, $p = .032$, thus the researcher did not reject the null hypothesis.

Null Hypothesis H_{01.3}. This null hypothesis asserted there would be no statistically significant predictive cumulative relationship discovered between critical thinking skills as measured by the ATI CTE and preadmission TEAS scores while exploring successful completion of an ASN program within a three-year time frame. Significance for this null hypothesis was set at the $p < .05$ level and power at .80. Warner (2013) suggested a sample size of at least 153 for the above noted alpha and power levels. Additionally, the researcher utilized the equation $N \geq 104 + m$, where $m =$ the number of predictor variables, to make sure that the sample size was adequate to elicit sufficient power (Tabachnick & Fidell, 2013). There were a total of 550 cases included in the analysis of this hypothesis, thus power was deemed adequate. Chi square for the Omnibus Tests of Model Coefficients was 10.771, $p = 0.005$, making the model statistically significant. The researcher also explored the Hosmer and Lemeshow Test values and found the test not significant, $p = 0.623$, again displaying good model fit. Cox and Snell R Square and Nagelkerke R Square values were 0.019 and .041, respectively, representing 1.9 – 4.1% of the variance.

The model correctly predicted 90.2% of the cases. However, when exploring completion versus noncompletion, the model did not correctly identify any students who did not complete the program solely based upon the model that included both critical thinking and TEAS. This represents extremely poor negative predictive value. The model did predict 100% of the students who successfully completed the program, representing excellent positive predictive value. For this model, critical thinking scores were not predictive of program success, $p = .185$, while TEAS scores were, $p = .032$. Additionally, when exploring cumulative effects this model did not predict better than exploring TEAS or CT independently; each predicted 90.2% correctly. The overall model was predictive as noted by the Omnibus Tests of Model Coefficients above and the explained variance was slightly higher with the cumulative model versus the each predictor variable independently, thus the null hypothesis was rejected.

Table 10
Cumulative Model Predicting Program Completion

	<i>B</i>	SE	Wald	<i>df</i>	<i>p</i>	Odds Ratio	95% CI for Odds Ratio	
Constant	-2.201	1.340	2.699	1	.100	.111		
CT Comp	.023	.017	1.759	1	.185	1.023	.989	1.058
TEAS Comp	.039	.018	4.605	1	.032	1.039	1.003	1.077

Research Question Two Hypotheses

Five null hypotheses stemmed from the research question: Is there a statistically significant predictive relationship between critical thinking skills as measured by ATI CTE and passage of the NCLEX-RN® while controlling for nursing course GPA and preadmission TEAS scores? The first three null hypotheses of research question two sought to determine predictive relationships between one dichotomous variable and one continuous or one ordinal variable, thus binomial logistic regression was utilized to analyze these relationships. The fourth and fifth

components of the second null hypothesis sought to determine the confounding or cumulative relationship between one dichotomous variable and two continuous level variables and one ordinal level variable. Logistic regression was again employed to explore this cumulative effect, as well as the variance explained at each step.

Null Hypothesis H_{02.0}. This null hypothesis asserted that there would be no statistically significant predictive relationship between passage of the NCLEX-RN[®] and critical thinking skills as measured by the ATI CTE. Significance for this null hypothesis was set at the $p < .05$ level and power at .80. Warner (2013) suggested a sample size of at least 153 for the above noted alpha and power levels. Additionally, the researcher utilized the equation $N \geq 104 + m$, where m = the number of predictor variables, to make sure that the sample size was adequate to elicit sufficient power (Tabachnick & Fidell, 2013). There were a total of 494 cases included in the analysis of this hypothesis, thus power was deemed adequate. Chi square for the Omnibus Tests of Model Coefficients was 9.365, $p = 0.002$, making the model statistically significant. The researcher also explored the Hosmer and Lemeshow Test values and found the test not significant, $p = 0.870$, again displaying good model fit. Cox and Snell R Square and Nagelkerke R Square values were 0.019 and .052, respectively, representing 1.9 – 5.2% of the variance.

The model correctly predicted 94.1% of the cases. However, when exploring students who passed the NCLEX-RN[®] versus those who failed, the model did not correctly identify any students who failed solely based upon the critical thinking score. This represents extremely poor negative predictive value. The model did predict 100% of the students who were successful on the NCLEX-RN[®], representing excellent positive predictive value. Critical thinking scores were predictive of NCLEX-RN[®] success, $p = .002$, thus rejecting the null hypothesis. According to

this model, an increase in the critical thinking score by one unit would represent an increase in the likelihood of student success on the NCLEX-RN® by one unit, as well.

Table 11
Critical Thinking Model Predicting NCLEX-RN® success

	<i>B</i>	SE	Wald	<i>df</i>	<i>p</i>	Odds Ratio	95% CI for Odds Ratio	
Constant	-1.831	1.469	1.554	1	.213	.1600		
CT Comp	.065	0.21	9.391	1	.002	1.068	1.024	1.113

Null Hypothesis H_{02.1}. This null hypothesis asserted that there would be no statistically significant predictive relationship between passage of the NCLEX-RN® and nursing course GPA. Significance for this null hypothesis was set at the $p < .05$ level and power at .80. Warner (2013) suggests a sample size of at least 153 for the above noted alpha and power levels. Additionally, the researcher utilized the equation $N \geq 104 + m$, where m = the number of predictor variables, to make sure that the sample size was adequate to elicit sufficient power (Tabachnick & Fidell, 2013). There were a total of 494 cases included in the analysis of this hypothesis, thus power was deemed adequate. Chi square for the Omnibus Tests of Model Coefficients was 10.694, $p = 0.001$, making the model statistically significant. The researcher also explored the Hosmer and Lemeshow Test values and found the test not significant, $p = 0.368$, again displaying good model fit. Cox and Snell R Square and Nagelkerke R Square values were 0.021 and .059, respectively, representing 2.1 – 5.9% of the variance.

The model correctly predicted 94.1% of the cases. However, when exploring students who passed the NCLEX-RN® versus those who failed, the model did not correctly identify any students who failed solely based upon the student's GPA. This represents extremely poor negative predictive value. The model did predict 100% of the students who were successful on

the NCLEX-RN[®], representing excellent positive predictive value. GPA was predictive of NCLEX-RN[®] success, $p = .001$, thus rejecting the null hypothesis. According to this model, an increase in the GPA by one unit would represent an increase in the likelihood of student success on the NCLEX-RN[®] by 3.3 units.

Table 12

Nursing Course GPA Model Predicting NCLEX-RN[®] success

	<i>B</i>	SE	Wald	<i>df</i>	<i>p</i>	Odds Ratio	95% CI for Odds Ratio
Constant	-.591	.995	.354	1	.552	.554	
NSG GPA	1.209	.369	10.755	1	.001	3.349	1.626 6.898

Null Hypothesis H_{02.2}. This null hypothesis asserted that there would be no statistically significant predictive relationships between passage of the NCLEX-RN[®] and preadmission TEAS scores. Significance for this null hypothesis was set at the $p < .05$ level and power at .80. Warner (2013) suggests a sample size of at least 153 for the above noted alpha and power levels. Additionally, the researcher utilized the equation $N \geq 104 + m$, where m = the number of predictor variables, to make sure that the sample size was adequate to elicit sufficient power (Tabachnick & Fidell, 2013). There were a total of 494 cases included in the analysis of this hypothesis, thus power was deemed adequate. Chi square for the Omnibus Tests of Model Coefficients was 13.014, $p = 0.001$, making the model statistically significant. The researcher also explored the Hosmer and Lemeshow Test values and found the test not significant, $p = 0.267$, again displaying good model fit. Cox and Snell R Square and Nagelkerke R Square values were 0.026 and .072, respectively, representing 2.6 – 7.2% of the variance.

The model correctly predicted 94.1% of the cases. However, when exploring students who passed the NCLEX-RN[®] versus those who failed, the model did not correctly identify any

students who failed solely based upon the student's TEAS score. This represents extremely poor negative predictive value. The model did predict 100% of the students who were successful on the NCLEX-RN®, representing excellent positive predictive value. TEAS scores were predictive of NCLEX-RN® success, $p = .001$, thus rejecting the null hypothesis. According to this model, an increase in the TEAS score by one unit would represent an increase in the likelihood of student success on the NCLEX-RN® by one unit, as well.

Table 13

TEAS Model Predicting NCLEX-RN® success

	<i>B</i>	SE	Wald	<i>df</i>	<i>p</i>	Odds Ratio	95% CI for Odds Ratio	
Constant	-3.040	1.592	3.645	1	.056	.048		
TEAS Comp	.081	.023	12.615	1	.001	1.084	1.037	1.133

Null Hypothesis H_{02.3}. This null hypothesis asserted there would be no statistically significant predictive relationships between passage of the NCLEX-RN® and critical thinking skills as measured by the ATI CTE while controlling for nursing course GPA and preadmission TEAS scores. Significance for this null hypothesis was set at the $p < .05$ level and power at .80. Warner (2013) suggests a sample size of at least 153 for the above noted alpha and power levels. Additionally, the researcher utilized the equation $N \geq 104 + m$, where m = the number of predictor variables, to make sure that the sample size was adequate to elicit sufficient power (Tabachnick & Fidell, 2013). There were a total of 494 cases included in the analysis of this hypothesis, thus power was deemed adequate. Chi square for the Omnibus Tests of Model Coefficients was 24.990, $p = 0.000$, making the model statistically significant. The researcher also explored the Hosmer and Lemeshow Test values and found the test not significant, $p =$

0.668, again displaying good model fit. Cox and Snell R Square and Nagelkerke R Square values were 0.049 and .137, respectively, representing 4.9 – 13.7% of the variance.

However, when exploring students who passed the NCLEX-RN® versus those who failed, the model did not correctly identify any students who failed based upon the model. This represents extremely poor negative predictive value. The model did predict 100% of the students who were successful on the NCLEX-RN®, representing excellent positive predictive value. For this model, critical thinking scores were not predictive of NCLEX-RN® success, $p = .189$, while TEAS scores, $p = .004$, and GPA, $p = .004$, were both predictive. Though the overall model was predictive as noted by the Omnibus Tests of Model Coefficients above, the null hypothesis was not rejected. Critical thinking was not a significant predictor utilizing this model, thus did not add to the model's overall effectiveness.

Null Hypothesis H_{02.4}. This null hypothesis asserted there would be no statistically significant predictive cumulative relationship between critical thinking skills as measured by the ATI CTE, nursing course GPA, and preadmission TEAS scores and first time NCLEX-RN® passage. Significance for this null hypothesis was set at the $p < .05$ level and power at .80. Warner (2013) suggests a sample size of at least 153 for the above noted alpha and power levels. Additionally, the researcher utilized the equation $N \geq 104 + m$, where m = the number of predictor variables, to make sure that the sample size was adequate to elicit sufficient power (Tabachnick & Fidell, 2013). There were a total of 494 cases included in the analysis of this hypothesis, thus power was deemed adequate. Chi square for the Omnibus Tests of Model Coefficients was 24.990, $p = 0.000$, making the model statistically significant. The researcher also explored the Hosmer and Lemeshow Test values and found the test not significant, $p =$

0.668, again displaying good model fit. Cox and Snell R Square and Nagelkerke R Square values were 0.049 and .137, respectively, representing 4.9 – 13.7% of the variance.

However, when exploring students who passed the NCLEX-RN[®] versus those who failed, the model did not correctly identify any students who failed based upon the model. This represents extremely poor negative predictive value. The model did predict 100% of the students who were successful on the NCLEX-RN[®], representing excellent positive predictive value. For this model, critical thinking scores were not predictive of NCLEX-RN[®] success, $p = .189$, while TEAS scores, $p = .004$, and GPA, $p = .004$, were both predictive. Critical thinking was not a significant predictor utilizing this model, thus did not add to the model's overall effectiveness. Additionally, both TEAS scores and GPA appeared to have better predictive power when explored independently versus within the overall model, thus a cumulative effect was not noted in this study. Though the overall model was predictive as noted by the Omnibus Tests of Model Coefficients above, the null hypothesis was not rejected.

Table 14
Cumulative Model Predicting NCLEX-RN[®] success

	<i>B</i>	SE	Wald	<i>df</i>	<i>p</i>	Odds Ratio	95% CI for Odds Ratio	
Constant	-7.884	2.274	12.025	1	.001	.000		
CT Comp	.031	.024	1.723	1	.189	1.032	.985	1.081
NSG GPA	1.146	.394	8.481	1	.004	3.146	1.455	6.803
TEAS Comp	.073	.026	8.109	1	.004	1.076	1.023	1.132

CHAPTER FIVE: CONCLUSIONS

Overview

This study examined the relationship between students' critical thinking skills and student success. Further relationships were explored to determine if students' pre-entry Test of Essential Academic Skills (TEAS) scores or nursing course GPA were confounding variables or if these variables could add depth to the final predictive model. This chapter comprises a discussion of the research findings of the aforementioned study in relation to previous studies that have been conducted. The chapter also elucidates the implications of the study findings, as well as any limitations within the study. Finally, the researcher illuminates how this study and its findings may guide future research in nursing education.

Discussion

The purpose of this retrospective, predictive, correlational study was to examine the model of critical thinking as posed by the Model for the National Assessment of Higher Order Thinking (Paul, 1993) to assess for relationships between the predictor variable, critical thinking [as measured by the Assessment Technologies Institute (ATI) Critical Thinking Exam (CTE)], and the criterion variables, student outcomes (as measured by NCLEX-RN® passage rates and successful completion of an ASN program within three years), controlling for potentially confounding variables such as overall nursing GPA and preadmission Test of Essential Academic Skills (TEAS) scores where applicable, for 550 students at a semi-urban nursing school in southwestern, West Virginia.

Prior to this study there were multiple studies investigating critical thinking in nursing but there was not consensus on the appropriate tool to measure critical thinking specific to the nursing discipline. At the time of this researcher's study, two studies had been conducted

utilizing the ATI CTE but produced different results in relation to ability to predict nursing student success, both citing the need for further research in this area. Ukpabi (2008) found a strong correlation between ATI CTE and student success as measured by successful passage of the NCLEX-RN®. As noted earlier, the study employed a very small convenience sample of only 39 nursing school graduates exploring 18 different variables as potential predictors of success. The study's small sample size and the fact that the population was obtained from one school did decrease its general applicability to other schools. Also, though it did not specify in the study, the school was most likely a baccalaureate nursing program, unlike the program addressed in the current research study. Conversely, when Lyons (2008) conducted a study utilizing the ATI CTE to measure the probability of NCLEX-RN® success in a study on problem-based learning, no statistically significant correlation was discovered between critical thinking and student success as measured by NCLEX-RN® results. Lyons study did employ associate degree level nurses, which is more closely related to the student population utilized in the study at hand.

The fact that these two studies' results invalidated one another supports the assumption that more studies are warranted exploring the input of critical thinking as measured by ATI CTE as a potential predictor of student success. The present study supports the findings from the Ukpabi (2008) study stating that ATI CTE is a good predictor of student success as measured by NCLEX-RN® success. The results derived from this study also support that the ATI CTE is a good predictor of student success as measured by program completion, an output not explored in the Ukpabi or Lyons studies. It is important to note that each null hypothesis that was rejected, successfully predicted student success, but none of the findings supported successful prediction of failure. This is a limitation that will be discussed at length later in this chapter.

The results of the current study also validated the assumptions of Paul's (1993) Model for the National Assessment of Higher Order Thinking that states an assessment tool should be able to assess critical thinking in a manner that allows for improvement of instruction and that it should have the ability to measure "the achievement of students against national standards" (p. 118). As stated earlier, though the model's emphasis is on the infusion of critical thinking into curriculum and adequate assessment, it does infer that critical thinking has a high probability of determining success and that higher order thinking improves student outcomes, in general.

Research Question One and Corresponding Null Hypotheses

The first research question and its corresponding null hypotheses sought to explore relationships between critical thinking as measured by ATI CTE, student TEAS scores, and student success as measured by ASN program completion. As discussed in Chapter Four, the findings of the current study supported the assertion that both critical thinking and TEAS scores, independently, are predictive of student success as measured by ASN program completion. However, placing the two predictors into one model did not strengthen the model's predictability. Similarly, Manieri, De Lima, and Ghosal (2015) found TEAS to be predictive of program success, but did not address critical thinking in the study. Diaz, Sanchez, and Tanguma (2012) explored ATI CTE as a predictor for first nursing course completion in a BSN program and found TEAS to be predictive, but ATI CTE was not a statistically significant predictor in that study. These incongruencies are further evidence that more studies are warranted to validate the most predictive variables and models of ASN program success.

Research Question Two and Corresponding Null Hypotheses

The second research question and its corresponding null hypotheses sought to explore relationships between critical thinking as measured by ATI CTE, student TEAS scores, nursing

course GPA and student success as measured by NCLEX-RN® passage. As discussed in Chapter Four, the findings of the current study supported the assertion that critical thinking, TEAS scores, and nursing course GPA were all independently predictive of student success as measured by NCLEX-RN® passage. However, placing the three predictors into one model did not strengthen the model's predictability. Prior studies related to ATI CTE as a predictor of success in relation to NCLEX-RN® have had varying results, as well (Lyons, 2008; Ukpabi, 2008). McCarthy, Harris, and Tracz (2014) conducted a study and found the TEAS examination to be a significant predictor of student success as measured by the NCLEX-RN®; however, critical thinking was not addressed as a predictor in this study. Similarly, Trofino (2013) explored the relationship between multiple student variables and NCLEX-RN® success finding both nursing courses and normalized TEAS math scores to be a positive predictors of success as measured by passage of the NCLEX-RN® but did not explore critical thinking as a predictor. Multiple studies (Alameida et al., 2011; Beeson, 2001; Davenport, 2007) exist that support the assertion that nursing course GPA are predictive of student success as measured by the NCLEX-RN® and the current study added to the extant body of knowledge asserting this positive predictor.

Implications

As previously stated, the United States is in danger of not having enough nurses to care for its population (American Association of Colleges of Nursing [AACN], 2017b). The aging population, the increase in chronic disease of patients, the aging workforce, nursing faculty shortages, and nurse burnout are all cited as reasons for this potential disaster (AACN, 2017b; Jones & Morris, 2007; Ukpabi, 2008). Thanks in part to a growing job market and governmental incentives aimed at drawing people into the nursing profession, there are a plethora of

individuals willing to enter into healthcare fields. Unfortunately, many of those eager to apply to nursing programs are ill equipped for the rigor and demands such educational endeavors require. Nevertheless, applicants' lack of necessary skills does not acquit nursing schools of their responsibility for maintaining high retention rates while still producing safe, competent graduates.

These salient facts all elucidate the necessity of identifying at-risk students early in nursing programs (Ahuna et al., 2011; Davenport, 2007; Harris et al., 2014). An appropriate strategy to implement, therefore, is baseline critical thinking screenings for all students upon entry into nursing programs so that deficits can be identified early. Screening for critical thinking on admission to nursing programs may help identify at-risk students and allow for early intervention. Early identification of potential hindrances to success is needed so that nursing educators can implement evidence based teaching strategies to improve identified deficits (Ahuna et al., 2011; Davenport, 2007), thus improving retention and ultimately NCLEX-RN® passage rates (Ahuna et al., 2011; Heroff, 2009; Hopkins, 2008; McDowell, 2008). It would also be helpful for faculty advisors to analyze the ATI CTE scores to offer counseling and guidance to those identified at risk upon admission.

In addition to helping foster needed skills for the at risk students admitted to these rigorous programs, early identification of variables known to affect success should guide admission policies and procedures. Doing so could ensure appropriate students are being placed in the available nursing school slots from the start. This is of utmost importance when, according to American Association of Colleges of Nursing, nursing schools in the United States denied admission to over 64,000 applicants related to factors such as faculty and clinical site shortages (AACN, 2017c). As a result of this study's findings it may be beneficial to include

preadmission ATI CTE score results to the points system utilized by the target school to bolster the chance of admission for those with a higher propensity to succeed.

Limitations

Threats to both internal and external validity were addressed in this study. Potential threats to internal validity of regression studies that were explored are: omitted variable bias, overfitting, errors-in-variable bias, biased sampling, and simultaneous causality bias (Stock & Watson, 2010). There were potentially confounding variables, such as nursing course GPA and preadmission TEAS scores that could have accounted for the ATI critical thinking scores, the nursing school completion rates, or the NCLEX-RN® passage rates. Logistic regression was utilized to control for these potentially interfering variables. Though the study design attempted to account for these, it is not possible to completely eliminate the effects of certain confounding variables. Since logistic regression was employed for this study, a minimum of 20 to 1 case-to-variable ratio was utilized to ensure an adequate sample size and increase the plausibility that the data were valid (Hosmer & Lemeshow, 2000).

The major threat to external validity was lack of generalizability. The study took place in one nursing school; therefore, the results may not be applicable to all students, in every demographic or geographical area. The target school had a very homogenous student population, primarily Caucasian and Appalachian, thus the possibility of cultural bias exists, as well. The use of convenience sampling, employed in this study, has the propensity to weaken the generalizability of results (Warner, 2013). Finally, the ex post facto nature of the data collection prohibited a true experimental design (Gall, Gall, & Borg, 2007). However, utilizing the CTE ATI as an assessment tool in future studies conducted by other nursing schools, with

different populations, and at various educational levels will help strengthen the breadth of this study's findings.

Another limitation was that though all variables were found to be positive predictors of success, none were found to be good predictors of failure. This is definitely a limitation of the study because students at risk for failure were not identified appropriately. Though it can be inferred that students with low critical thinking skills should be identified and interventions employed, the data did not support the assumption that low scores predicted failure.

Another limitation of the study was that TEAS scores were not always part of the admission process at the target school. Currently, students are required to take the TEAS exam prior to admission into the program. Students are granted points based upon their achieved score and higher scores increase the student's chance of admission. Students falling in the cohort prior to points being awarded for TEAS scores may not have taken the test as seriously, thus may not have performed as well since the stakes were low.

A further limitation involves the timing of the administration of the ATI CTE at the target school. Unlike the TEAS exam, the CTE is given after students are granted admission into the nursing program. The students are not awarded points for scores achieved on the exam and there is no repercussion for scoring poorly. Though most students undoubtedly try their best, there is no incentive for doing well, nor penalty for poor performance.

Curricular changes and updates to the NCLEX-RN® may also be limitations to the study. The grading scale changed during the mid-2000's at the target school, thus compilation of nursing course GPAs may not have been equivalent for all students in the study. Similarly, the NCLEX-RN® is updated every three years, often increasing in complexity, thus the exams taken by different cohorts were not necessarily equivalent measures of success.

Finally, a concern with the study is that, though the ATI CTE touts itself as being a test specific to healthcare professionals, the test is closely related to the other tests utilized to measure critical thinking (Newton & Moore, 2008). This limitation cannot be ignored. Further tests exploring critical thinking in nursing students utilizing the ATI CTE, whether related to success or other academic endeavors, are imperative to further investigating this limitation.

Recommendations for Future Research

Several recommendations for future research can be obtained from a review of the limitations mentioned above:

- More studies related to critical thinking as a measurement for success need to be explored in other ASN programs to see if findings can be replicated. The literature related to this variable is sparse for ASN programs. Increasing the body of knowledge specific to this program level is imperative due to the difference in the student populations of ASN versus BSN schools.
- Studies exploring predictors of success in RN-BSN programs could be beneficial, as well. Many ASN students progress to RN-BSN programs; discovering predictors of success in this population may help increase the output of competent, safe nurses in the workforce. It is likely that this population has different predictors than traditional ASN or BSN students.
- Multisite studies are needed involving other nursing programs across the country, and perhaps global studies, as well. Though the current study had an adequate sample size, studies involving larger samples would provide more diversity than found in the target school.

- Further studies are needed specifically utilizing Assessment Technologies Institute's Critical Thinking Exam. Though multiple studies exist exploring critical thinking in nursing students, few utilized this exact tool.

In the midst of the rising nursing shortage, and the lack of available nursing school spots, it is of utmost importance that nursing schools recruit and retain qualified applicants. One way to accomplish this is to create a body of knowledge that attempts to predict which nursing school applicants have the highest chance of success. Though this study did reveal a positive correlation between critical thinking and student success, there is a great need for further studies to validate this conclusion. Replication of the study in varied populations could strengthen the applicability of the findings and address any variances that may occur in other student cohorts. Ultimately, discovering and validating variables of success for nursing school applicants, and intervening as appropriate, will increase the output of safe, competent nurses in the workforce.

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APPENDICES

Appendix A: Request for Permission to Collect Data

Rebecca Porter
[REDACTED]

April 21, 2016
[REDACTED]

Subject: Request for authorization to conduct research at [REDACTED]

Dear [REDACTED],

My name is Rebecca Porter and I am a doctoral candidate at Liberty University in Lynchburg, VA, pursuing an EdD in Teaching and Learning. My dissertation proposal involves exploration of variables that may predict nursing student success. Specifically, I plan to investigate if the variables of entrance Assessment Technologies Institute (ATI) Critical Thinking Exam (CTE) scores, preadmission ATI Test of Essential Academic Skills (TEAS) scores, and nursing course GPA are predictive of nursing school success as measured by three year program completion and NCLEX-RN success on the first attempt.

Given that you have administered these specific exams for an extended period of time, I am requesting permission to collect data from your institution for all students entering the program from August 2006 until August 2013. As part of the IRB approval process I am required to obtain written permission from your institution, stated on official letterhead, granting me access to this information for research purposes. I respectfully request this permission and that you reply in a manner congruent with the IRB mandate. If permission is granted, I will also need a copy of the student consent for data collection to put in my file.

I truly appreciate your consideration of this request. If you have any concerns or require additional information please feel free to contact me directly.

Sincerely,

Rebecca Porter, RN, MSN, FNP-BC, CNE

Appendix B: Letter Granting Permission for Data Collection

June 3, 2016

To Whom It May Concern:

Rebecca Porter is granted permission to obtain data regarding students who entered our nursing program between August 2006 and August 2013. You have permission to obtain demographic data as well as academic data, including ATI Critical Thinking exam scores, TEAS exam scores, nursing GPA, program completions and first time passage rate on the NCLEX. Ms. Porter will maintain the anonymity of all students and the institution when publishing her results.

I am very glad to grant this permission and will be interested in the results of her study. Please contact me if you need additional information.

Sincerely,

[REDACTED]

[REDACTED]

[REDACTED]

Appendix C: Student Permission Form for Data Collection

[REDACTED]

[REDACTED]

PERMISSION TO USE DATA FORM

In an effort to improve courses and programs, faculty at [REDACTED] – [REDACTED] 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 [REDACTED] [REDACTED] to use my test and/or course data to evaluate and revise courses and/or programs.

Signature: _____

Appendix E: IRB Approval Letter

Dear Rebecca Porter,

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 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 46:101(b):

(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 retain this letter for your records. Also, if you are conducting research as part of the requirements for a master's thesis or doctoral dissertation, this approval letter should be included as an appendix to your completed thesis or dissertation.

Please note that this exemption only applies to your current research application, and 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,

A large black rectangular redaction box covering the signature area.

Appendix F: Power Analysis Chart

χ^2 tests - Goodness-of-fit tests: Contingency tables

Df = 1. α err prob = 0.05. Effect size $w = 0.3$

