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Predictors of First Semester Baccalaureate Nursing Student Academic Success

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Abstract

Accreditation standards, such as those of the American Association of Colleges of Nursing Commission on Collegiate Nursing Education's program indicators, require pre-licensure programs of nursing to report outcome metrics which includes program completion rates. In response to regulatory requirements and accreditation standards, pre-licensure programs of nursing have an interest in selecting applicants most likely to meet outcomes standards. Attrition is a serious issue with implications for students, pre-licensure programs of nursing, the nursing workforce, and populations requiring nursing care. Academic failure due to insufficient cognitive aptitude often contributes to the attrition rate. Pre-licensure programs of nursing may consider interviews, essays, and volunteer work during the admission process, although traditionally, pre-licensure program admission criteria have primarily focused on measures of academic preparedness and current knowledge. The most commonly used criteria in considering an applicant's admission to pre-licensure programs of nursing have been prerequisite courses, science grades, cumulative GPA, and standardized nursing admission exams. The overall aim of this dissertation work was to determine the utility of using standardized nursing admission exams with a critical thinking component as a predictive admission criterion of first semester academic success. An integrative review was conducted to identify the standardized admission exams most predictive of nursing student success. Next, an original Nursing Cognitive Aptitude Model was presented to guide expanding standardized nursing admission exams by including a critical thinking component to predict first semester academic success. Finally, a complex associational design study was conducted to determine if a relationship existed between current

scholastic knowledge (HESI A^2 composite scores), critical thinking ability (HESI A^2 Critical Thinking scores), prior academic performance (pre-nursing overall GPA), and first semester baccalaureate nursing student academic success. The model containing prior academic performance, current scholastic knowledge, and critical thinking ability was predictive of overall first semester nursing grade average. Further, critical thinking ability was the best predictor of success in each individual first semester nursing course. By identifying admission criteria most predictive of academic success, pre-licensure programs of nursing can improve retention rates, improve program outcomes, and increase the number of nurses entering the workforce.

Keywords: standardized exams, admission criteria, conceptual model, attrition, academic success

Chapter One

Julie Twidwell

Introduction

Nursing Workforce

The profession of nursing will soon experience a critical shortage of nurses able to care for aging populations with increasingly complex medical problems. The number of Americans aged 65 years or older is projected to almost double from 39.6 million in 2009 to 72.1 million by 2030 (Administration of Community Living, 2015). With an aging population comes an increase in the strain on the nursing workforce due to the increase in the number of individuals gaining access to the healthcare system (Knickman & Snell, 2002). Simultaneously, over half (55%) of the nursing workforce is approaching retirement age with over 27% of practicing nurses in 2017 stating that they plan to retire within a year (American Association of Colleges of Nursing [AACN], 2017; American Mobile Nurses [AMN], 2017).

There is an anticipated 15% growth in the demand for registered nurses (RNs) between 2016-2026, with a need for about 204,000 new RNs each year (Bureau of Labor Statistics, 2018; AMN, 2017). However, a recent survey of the nursing workforce indicated that only about 155,000 new nurses are entering the work each year (NCSBN, 2016). If these current rates continue, this will equate to an approximate 25% deficit between the supply and demand for nurses over the next decade.

Pre-licensure programs of nursing can be thought of as the entry point to the pipeline that supplies the nursing workforce. Therefore, ensuring that pre-licensure programs of nursing fill the number of available seats with applicants who will most likely be successful is one key aspect in ensuring that the needs of the nursing workforce are met. Recent changes in healthcare and healthcare education have also included an

attempt to address underprivileged populations who are at a disadvantage within the healthcare system (Glazer, Clark, Bankston, Danek, Fair, & Michaels, 2017; Scott & Zerwic, 2015). Pre-licensure programs of nursing have an interest in selecting from the applicant pool those who not only are most likely to meet outcome standards such as satisfactory completion of the program but who also exhibit unique and diverse qualities (Glazer, Clark, Bankston, Danek, Fair, & Michaels, 2017).

Nursing Program Admission Criteria

With the call to increase diversity in the nursing workforce, some pre-licensure programs of nursing have sought to adapt their admission process to capture the unique experiences applicants from diverse backgrounds can bring to the profession (AACN, 2016; Association of Medical Colleges [AAMC], 2013). The strategy that has been coined to address this endeavor is known as *holistic admissions*. One principle of holistic admissions describes a process in which broad-based selection criteria consist of E-A-M which stands for experiences, attributes, and academic metrics. While experiences may consist of selecting applicants on criteria such as prior healthcare experience and volunteerism, attributes would consist of characteristics such as race/ethnicity, maturity, and language skills (Scott & Zerwic, 2015). The last criterion in the holistic process are academic metrics which consist of criteria including cumulative grade point average (GPA), science course grades, number of repeated courses, overall grade trends, and standardized admission exam scores (Scott & Zerwic, 2015). Although pre-licensure programs of nursing may occasionally consider interviews, written essays, and volunteer work during the admission process, traditionally, pre-licensure program admission

criteria have primarily focused on measures of academic preparedness and current knowledge as the best predictors of academic success (Schmidt & MacWilliams, 2011).

Common academic metrics utilized for determining admission into pre-licensure programs of nursing have been prerequisite course grades, prerequisite science course grades, cumulative GPA, and standardized nursing admission exam scores (Robert, 2018; Schmidt & MacWilliams, 2011). Some pre-licensure programs of nursing continue to use a minimum cut-off GPA as a requirement to even apply. In more recent years, pre-licensure programs of nursing have begun using more standardized methods of measuring cognitive ability with standardized nursing admission exams such as the Health Education Systems, Incorporated admission exam (HESI A^2) and the Test of Essential Academic Skills (TEAS) (Bennett, Bormann, Lovan, & Cobb, 2018).

Attrition

One major barrier pre-licensure programs of nursing face in attempting to meet the demands of the nursing workforce is the high attrition rates. Not only is attrition from pre-licensure programs of nursing a problem when it comes to meeting the demands of the nursing workforce, pre-licensure programs of nursing also must answer for high attrition rates when it comes to both regulatory and accrediting bodies. Accreditation standards such as those of the American Association of Colleges of Nursing (AACN) Commission on Collegiate Nursing Education (CCNE) program indicators, require that pre-licensure programs of nursing report outcome metrics, including program completion rates (AACN, 2018). The CCNE standards require that demonstration of program effectiveness is achieved by a program completion rate of 70% or higher. Programs not meeting any target outcome must provide a written explanation and analysis with

supporting documentation of the cause of the failure to meet the standard, and additionally must provide a written plan for addressing the issue (AACN, 2018). Programs with completion rates consistently falling below the required 70% minimum are at risk for losing accreditation, and their approval status by the state board of nursing may be jeopardized (AACN, 2018; NCSBN, 2018a).

Attrition in pre-licensure programs of nursing is a widespread issue with rates reported up to 50% and the attrition typically occurring early on in the program (Merkley, 2016; Newton & Moore, 2009). Attrition may occur for a number of reasons such as difficulty juggling many personal responsibilities, financial constraints, or lack of career fit (Jeffries, 2007). However, the most common reason for attrition that occurs early on in the program is academic failure which may be related to a lack of the cognitive aptitude necessary for the unique demands of nursing program curricula (Jeffreys, 2007; Peterson, 2009; Andrew, Salamonson, Weaver, Smith, O'Reilly, & Taylor, 2008). Students demonstrating poor academic performance early on in pre-licensure programs of nursing often struggle throughout the program and may later be unsuccessful on the National Council Licensure Exam for Registered Nurses (NCLEX-RN) (Domiano, 2018), the national licensure exam that must be successfully passed before gaining entry into practice.

Currently, the university in the Midwest serving as the setting for this study, only considers overall pre-nursing grade point average (GPA) and pre-nursing science GPA in selecting students for admission. Based on continuing evaluation of the program curriculum and the recognition of an issue with first semester attrition, this study was conducted. The primary investigator (PI), who serves as a faculty member within the

department of nursing, investigated whether the current admission criteria still serve program outcome objectives when it comes to student retention. The overall goal of the program is to move toward a more holistic assessment model which includes the adoption of academic metric criteria that are more valid measures of prior academic achievement and current academic knowledge, and therefore, better predictors of student academic success.

A recent review of program attrition rates at the university serving as the setting for this study suggests that the current admission criteria assessing current scholastic knowledge and prior academic preparation is in need of revision given that most attrition occurs in the first semester and is due to academic failure. The purpose of this dissertation work, as reflected in the following three manuscripts, is to determine whether the addition of an expanded standardized nursing admission exam that includes a measurement of critical thinking may reduce program attrition, particularly during the first semester of the program when it tends to be the highest. Reducing attrition rates will assist pre-licensure programs of nursing in meeting accreditation and regulatory body requirements and will ultimate help to meet the nursing workforce demands.

Aims and Research Questions

Table 1.

Aims and Research Questions

Overall Aim: The overall aim of this dissertation work is to determine the utility of adding standardized nursing admission exams with a critical thinking component as a predictive admission criterion of academic success during the first semester in a baccalaureate pre-licensure nursing program.

Overarching Research Question: Is there a relationship between the utilization of a standardized nursing admission exam with a critical thinking component as an admission criterion and first semester student academic success in a baccalaureate pre-licensure nursing program?

Specific Aim	Research Question	Manuscript
An integrative review will be conducted to identify the standardized admission exams most predictive of pre-licensure nursing student success.	Which standardized admission exam is most predictive of nursing GPA and NCLEX-RN first-time pass rates in U.S. programs of professional nursing?	One (Chapter Two)
An original conceptual model will be presented describing the utility of expanding standardized nursing admission exams to predict first semester pre-licensure nursing student success.	What are the salient concepts of interest in a model depicting the use of the HESI A^2 with Critical Thinking as a predictor of first semester baccalaureate nursing student academic success?	Two (Chapter Three)
A complex association design study will be conducted to determine if there is a relationship between current scholastic knowledge (HESI A^2 composite scores), critical thinking ability (HESI A^2 Critical Thinking scores), and prior academic performance (pre-nursing overall GPA) and first semester baccalaureate pre-licensure nursing student success.	1) What is the relationship between: a) current scholastic knowledge, critical thinking ability, and prior academic preparation and first semester student academic success in the BSN program? b) current scholastic knowledge, critical thinking ability, and prior academic preparation and end of first semester	Three (Chapter Four)

baccalaureate overall grade average?
c) specific current scholastic knowledge content areas and critical thinking ability and final course grades in each individual first semester BSN course?

Review of Literature

According to the National League for Nursing ([NLN], 2012), approximately one in three pre-licensure programs of nursing in the United States require satisfactory performance on a standardized exam to be admitted into the program or to progress within the program. State boards of nursing regulations in the United States are written with the expectation that admissions committees in schools of nursing will admit students who will be successful in the programs and on the NCLEX-RN (Missouri State Board of Nursing, 2013). Programmatic success can be measured by metrics that include graduation and attrition rates, and first-time pass rates on the NCLEX-RN. Actual graduation rates vary by program type from 75–85%, leaving attrition rates of up to 25% (NLN, 2016). According to the National Council of State Boards of Nursing ([NCSBN], 2018b), the overall average 2017 first-time NCLEX-RN pass rate of individuals educated in the United States was 87.11%. This percentage is just above the minimum 80% pass rate required by the board of nursing in several states. A review of the literature was conducted to examine the evidence for these standardized admission exams to determine which standardized admission test is most predictive of nursing program academic success.

Methods

Database searches were conducted in MEDLINE, Cumulative Index of Nursing and Allied Health Literature, PsycINFO, and Academic Search Complete. Keywords included standardized exams, nursing program, admission criteria, NCLEX, and licensure exam. Boolean operators 'OR' and 'AND' were applied in various combinations with the keywords to increase the results returned. Searches were limited to English-language manuscripts published between 2005 and October 2016 to capture outcomes for current versions of exams rather than outdated versions. Searches resulted in 65 articles with an additional five found through manual searching of bibliographies. Abstract screening led to the exclusion of 19 articles. Fifty-one articles were reviewed against the inclusion criteria of admission standards for RN programs, specific exams (e.g., HESI A2, TEAS, SAT, CAAP, NLN PAX-RN, or ACT), NCLEX-RN performance, or program success. International studies were retained in the sample. Studies focusing on mid-curricular or exit exams, NET only, or those failing to address either NCLEX-RN performance or program success were excluded. Dissertations, duplicate studies by same author, and articles that were not original research were also excluded. Thirty-six articles failed to meet the inclusion/exclusion criteria leaving 15 for inclusion in this review.

Results

Comprehensive results from the integrative review can be found in the manuscript that will be inserted for Chapter Two. In summary, multiple studies have shown that the HESI A^2 is superior to other standardized exams as a valid predictor of student success. However, there is not one consistent definition of student success used in the literature. Some studies have shown that the HESI A^2 is a predictor of National Council Licensure

Examination for Registered Nurses (NCLEX-RN) success (Hinderer, DiBartolo, & Walsh, 2014). Some studies have shown that it is a predictor of success in specific courses, such as adult health (Knauss & Willson, 2013; Manieri, DeLima, & Ghosal, 2013; Underwood, Williams, Lee, & Burnnert, 2013), while some studies have shown that it can predict those who will complete the nursing program (Chen & Voyles, 2013; Yoho, Young, Adamson, & Britt, 2007). However, no studies were identified in the literature that investigated the utility of adding a critical thinking component to existing standardized nursing exams. In light of these studies, the HESI A^2 with Critical Thinking exam may be able to predict students who are more likely to be successful in the first semester of a baccalaureate pre-licensure nursing program, and therefore, reduce first semester attrition. If the HESI A^2 with Critical Thinking exam is found to be a predictor of first semester student success in terms of grades and completion, it could be adopted as one component of the new admission criteria.

Conceptual Framework

No previously published framework was identified in the literature regarding the use of standardized nursing admission exams. Existing theories contributing to this area of study include Ausubel's Cognitive Learning Theory, Bloom's Revised Taxonomy, and Critical Thinking theories (Ausubel, 1963; Aliakbari, Parvin, Heidari & Haghani, 2015; Jensen, McDaniel, Woodard, & Kummer, 2014; Yildirum & Ozkahraman, 2011). The major assumption of Ausubel's theory is that a learner's future learning is predicated on current knowledge. According to Ausubel's theory, learning is inductive and begins with an understanding of general concepts (Ausubel, 1963; Aliakbari, Parvin, Heidari & Haghani, 2015).

Furthermore, a student's success in a program of nursing and later in nursing practice is contingent on the ability to implement Bloom's Taxonomy higher order thinking processes and demonstrate the critical thinking skills required to make sound clinical decisions (Jensen, McDaniel, Woodard & Kummer, 2014). Nurses are expected to be able to analyze client information, problem-solve, and evaluate outcomes among other higher level cognitive operations. Clinical decision-making expectations illustrate the relevance of critical thinking and Bloom's higher levels of thinking to the current study. Each of these theoretical perspectives will be used to develop an original conceptual model.

Glossary of Terms

Aptitude for Clinical Reasoning- the application of critical thinking skills demonstrating the expectation of nurses to be able to analyze client information, problem-solve, make clinical decisions, and evaluate client outcomes in the clinical setting

Attrition-baccalaureate nursing students leaving the program of nursing prior to completion

Completion Rates- a measurement of baccalaureate nursing students who satisfactorily finish the program of nursing

Critical Thinking Ability- demonstration of higher level thinking processes and discernment of thought, decision-making, and problem-solving skills

Current scholastic knowledge -is the measure of general scholastic concepts obtained through core prerequisite coursework such as math, reading, science (Anatomy & Physiology, Chemistry, and Biology), and English at the time of applying for admission

into a baccalaureate program of nursing; measured by performance on standardized nursing admission exam

Graduate Nurse-an individual who has successfully completed and graduated from a baccalaureate program of nursing but who has still not taken the NCLEX-RN licensure exam

HESI A^2 Anatomy and Physiology subscore- a subcomponent included in the overall HESI A^2 composite score; measures a student's understanding of anatomical structures, systems and general terminology; scores range from 0-100%; composed of 25 questions with the expectation that testers will take 25 minutes or less to complete

HESI A^2 Chemistry subscore- a subcomponent included in the overall HESI A^2 composite score; tests topics including atomic structure, the periodic table, matter, chemical equations, chemical reactions, chemical bonding and nuclear chemistry; scores range from 0-100%; composed of 25 questions with the expectation that testers will take 25 minutes or less to complete

HESI A^2 Composite score- standardized nursing admission exam by Elsevier; an average score compiled from the following HESI A^2 subscores: anatomy and physiology; chemistry; math; vocabulary and general knowledge; and, reading comprehension; scores range from 0-100%; composed of the number of question and time limits from all subsections

HESI A^2 Critical Thinking Exam Score-standardized nursing admission exam by Elsevier; exam is intended to provide a brief "snapshot" of critical thinking ability in situations encountered in healthcare settings; total score is reflective of abilities in four categories: (1) Problem Solving which refers to the process of inquiry in which the nurse seeks

multiple facts to remove obstacles or resolve patient care problems; (2) Biases and Ethical Dilemmas which addresses ethical, legal, and moral issues, as well as biases nurses may have about patients and others; (3) Argument Analysis which refers to situations in which the nurse seeks to resolve conflicts or disagreements by considering multiple points of view;, and (4) Analysis of Data which addresses the need to interpret patient data correctly, and decide if further nursing action is required; scores range from 0-1000 (not percentage); composed of 30 questions with the expectation that testers will take 30 minutes or less to complete

HESI A^2 Math subscore- a subcomponent included in the overall HESI A^2 composite score; tests math skills including multiplication, division, addition, subtraction, fractions, ratios, proportions, decimals, conversions, household measures, roman numerals and dosage calculations; scores range from 1-100%; composed of 50 questions with the expectation that testers will take 50 minutes or less to complete

HESI A^2 Vocabulary and General Knowledge subscore- a subcomponent included in the overall HESI A^2 composite score; tests knowledge of various health care related basic vocabulary words; scores range from 0-100%; composed of 50 questions with the expectation that testers will take 50 minutes or less to complete

HESI A^2 Reading Comprehension subscore- a subcomponent included in the overall HESI A^2 composite score; measures a testers ability to understand reading passages, especially as they relate to health related situations; examines the ability to identify a main idea/theme, determine the meaning of words and phrases in context, understand passages and make logical inferences; scores range from 0-100%; composed of 47 questions with the expectation that testers will take one hour or less to complete

National Council Licensure Exam for Registered Nurses (NCLEX-RN)- a national licensure exam that is taken by graduates of registered pre-licensure programs of nursing which must be passed before being granted an RN license, and gaining entry into practice

NC 371- Fundamental of Nursing Clinical course taken during the first semester in the baccalaureate nursing program at SEMO university; the clinical or lab component of NS 371

Non-traditional student-A student who was ≥ the age of 25 at the commencement of the study

NS 371-Fundamentals of Nursing Theory course taken during the first semester in the baccalaureate nursing program at the university serving as the setting for the study; fundamental nursing skills, concepts, and theories necessary for application and critical thinking in the nursing skills laboratory and clinical setting

NS 372-Nursing Assessment course taken during the first semester in the baccalaureate nursing program at this university setting; identification of factors influencing functioning in everyday living, application of basic physical, cultural, and spiritual assessment principles and techniques

NS 373-Pharmacology course taken during the first semester in the baccalaureate nursing program at this university setting; overview of drug categories and actions as applied to clients of all ages, with an emphasis on nursing care as it applies to medication administration and treatments

NS 374-Pathophysiology course taken curing the first semester in the baccalaureate nursing program at this university setting; the study of disordered physiological processes

of the body; includes genetic and environmental risk factors, manifestations, and treatment modalities

Nursing Cognitive Aptitude- the degree to which the student demonstrates the capacity to learn and be successful in a baccalaureate nursing program

Nursing Grade Point Average (GPA)- calculated on a 4.0 scale from all completed courses taken within the baccalaureate nursing curriculum course sequence

Pre-licensure Program of Nursing-entry level program of nursing for students who do not yet hold a state nursing license and have no prior nursing experience or education; while this can include associate degree or diploma programs, only baccalaureate degree programs are addressed in this study

Pre-Nursing Overall Grade Point Average (GPA)- calculated on a 4.0 scale from all completed courses taken prior to matriculation into the baccalaureate nursing program

Prior Academic Preparation- measurement of knowledge attained through previous core scholastic coursework, general liberal education coursework, and prerequisite coursework prior to the matriculation into a nursing program; specific scholastic courses may vary among nursing program applicants; measured by pre-nursing overall GPA

Progression- refers to the advancement of a baccalaureate nursing student in the curriculum sequence of course

Retention- refers to status of remaining enrolled in a baccalaureate program of nursing

Satisfactory Academic Progression-refers to the advancement of a baccalaureate nursing student in the curriculum sequence of courses who has met all minimum academic standards and who has received no academic failing grades, and will progress to the next semester of nursing coursework as scheduled

Science GPA-measure of general science courses taken as prerequisites prior to admission into the baccalaureate nursing program.

Student Academic Success- meeting all minimum academic standards as follows: baccalaureate nursing program minimum GPA of 2.0 which is an equivalent of an earned "C", indicating that the student has achieved a 75% or better in each individual nursing course; and, satisfactory academic progression to the next semester of nursing coursework

The Manuscripts

The three manuscripts completed for this dissertation will address the overarching research question: : Is there a relationship between the utilization of a standardized nursing admission exam with a critical thinking component as an admission criterion and first semester student academic success in a baccalaureate pre-licensure nursing program? The three manuscripts will be included as dissertation Chapters Two, Three, and Four, respectively. The first of the three manuscripts will be an integrative review. The integrative review will identify the standardized nursing admission exams in the literature that are most predictive of nursing student success. The second manuscript will present the development of an original conceptual model. The conceptual model will illustrate the salient concepts of interest in a model depicting the use of the HESI A^2 with Critical Thinking as a predictor of first semester baccalaureate pre-licensure nursing student academic success. The last of the three manuscripts will be the results of the dissertation original research project as a whole. This manuscript will describe the problem of interest, the design, recruitment, data collection, and analysis procedures. Findings will be presented by using statistical analysis to answer the question of whether the

implementation of the HESI A^2 standardized exam with a critical thinking component is predictive of first semester nursing student academic success.

Discussion

Pre-licensure programs of nursing must ensure that students who are accepted for admission have the best chance of success for program completion and entry into the profession. The use of the HESI A^2 was one admission criterion identified in the literature that may be able to predict student success. This study adds a Critical Thinking component to the standard HESI A^2 exam which may increase the predictive value of success in pre-licensure programs of nursing. Pre-licensure programs of nursing must go beyond the assessment of an applicant's prior academic preparation to consider critical thinking ability in order to maximize the likelihood of predicting student success. Nursing practice requires higher level thinking that not only is necessary for academic success but is foundational to the quality and safety of care delivered (Lee, Lee, Bae, & Seo, 2016).

Additionally, attrition is costly to the students, pre-licensure programs of nursing, and society (Knauss & Willson, 2013). Therefore, it makes sense that baccalaureate pre-licensure programs of nursing should select the most cognitively capable individuals. The use of standardized nursing admission exams as a measure of cognitive ability can assist pre-licensure programs of nursing in selecting the most capable students for the limited seats available.

Summary

Chapter One has provided an introduction to this dissertation work. The problem of student attrition in pre-licensure programs of nursing was identified. It is proposed

that the utilization of standardized nursing admission exams that can measure both current scholastic knowledge and critical thinking ability may be a means for pre-licensure programs of nursing to select applicants who are more likely to be successful in baccalaureate pre-licensure programs of nursing. A review of the literature was also presented along with the theoretical underpinnings. The three manuscripts that will be presented as Chapters Two, Chapter Three, and Chapter Four were identified as the integrative review, the presentation of an original conceptual model, and the original quantitative study, respectively.

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Chapter Two

Julie Twidwell

Chapter Two is the first of three manuscripts. This integrative review will identify the standardized nursing admission exams in the literature that are most predictive of nursing student success. The identification of the standardized nursing admission exam that is the best predictor of student success in the literature is important because it will determine which standardized nursing admission exam will be utilized as the measure of current scholastic knowledge in this dissertation research study. The manuscript was submitted in July of 2016 and was accepted January of 2017 after revision by the *International Journal of Nursing Education Scholarship.*

An Integrative Review on Standardized Exams as a Predictive Admission Criterion for RN Programs

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Abstract

Pre-licensure programs of nursing reject qualified applicants due to limited clinical placements and faculty. By admitting the strongest candidates, schools of nursing will reduce attrition rates, increase NCLEX-RN pass rates, and speed the entry into practice of well-prepared nurses to help stem the nursing shortage. This integrative review identified the standardized admission exams most predictive of student success. Included were articles published between 2005 and 2016 that focused on admission criteria, RN programs, specific exams (e.g., HESI-A2, TEAS, SAT, CAAP, or ACT), NCLEX-RN performance, or program success. Standardized exams are effective predictors of success in pre-licensure programs of nursing and first-attempt NCLEX-RN. While predictive accuracy differs between exams, findings suggest that the HESI-A2 is currently the best predictor of success. By optimizing the use of standardized exams as admission criteria, pre-licensure programs of nursing can reduce attrition rates and improve NCLEX-RN pass rates. This will maximize program capacity and contribute to a greater number of practicing nurses.

Keywords: standardized exams, NCLEX-RN, admission criteria, pre-licensure programs of nursing

An Integrative Review on Standardized Exams as a Predictive Admission Criterion for RN Programs

Standardized exams, overall grade point average (GPA), and science GPA are some of the most common criteria utilized by admission committees in schools of nursing in the United States. Standardized exams are viewed as being somewhat objective in nature and are thought to temper the effect of grade inflation in pre-admission GPAs. While pre-admission GPAs can be valuable, care must be taken to ensure a consistent appraisal among applicants. Not all pre-admission GPAs are equivalent. For example, many overall GPAs do not encompass all grades when courses have been repeated. There is also debate among educators regarding the quality of GPAs based on the educational level and institution from which they were obtained. Standardized admission exams taken within a designated timeframe prior to consideration for admission, that test on basic concepts derived from prerequisite courses, can negate the relevance of where a prerequisite course was taken or the grade that was received in that course. The standardized exam that tests applicants' current knowledge may hold greater significance than a grade received in a prerequisite course taken years prior for predicting (a) successful completion of a program of nursing or (b) passing the NCLEX-RN.

According to the National League for Nursing ([NLN], 2012), approximately one in three pre-licensure programs of nursing in the United States require satisfactory performance on a standardized exam to be admitted into the program or to progress within the program. It is not uncommon for pre-licensure programs of nursing throughout the world to use standardized admission exams designed to assess academic readiness. Japan, Taiwan, and Thailand are just three of several countries that require standardized

exams to be taken prior to admission into pre-licensure programs of nursing (Chiang-Hanisko, Boonyanurak, Ozawa, & Chiang, 2008).

State boards of nursing regulations in the United States are written with the expectation that admissions committees in schools of nursing will admit students who will be successful in the programs and on the NCLEX-RN (National Council Licensure Examination for Registered Nurses)(Missouri State Board of Nursing, 2013). Programmatic success can be measured by metrics that include graduation and attrition rates, and first-time pass rates on the NCLEX-RN. Actual graduation rates vary by program type from 75 - 85%, leaving attrition rates of up to 25% (National League for Nursing [NLN], 2016). According to the NCSBN (2015), the overall average 2014 first-time NCLEX-RN pass rate of individuals educated in the United States was 81.78%. This percentage is just barely above the minimum 80% pass rate required by the board of nursing in several states.

NCLEX-RN was originally used in the United States and in four U.S. territories (i.e., American Samoa, Guam, Northern Mariana Islands, and the Virgin Islands) as well as in 10 countries around the world for the purpose of domestic licensure in the United States" (National Council of State Boards of Nursing [NCSBN], 2014, para 2). In November of 2014, Canada began offering the NCLEX-RN for the purpose of licensure in Canada (NCSBN, 2014).

As the demand for nurses in the United States grows due to an aging population and an increase in the demand for healthcare, the demand for skilled nurses will increase globally (Pittman, 2013). In order to satisfy the increasing demand for nurses, pre-licensure programs of nursing around the world must select students who have the

potential to complete their programs, be successful on licensure exams, and gain entry to and be successful in the workforce. Unfortunately, the shortages of faculty and available clinical sites hinder schools from admitting all applicants who meet the admission standards. According to the NLN (2013), 48% of pre-licensure programs of nursing in the United States actually admitted less than 50% of applicants. In 2009, almost 40,000 qualified nursing school applicants were turned away (American Association of Colleges of Nursing, 2015). Therefore, it is imperative that the students who are accepted have the best chance of success for program completion and to gain entry in to the profession.

In the United States, the most common standardized entrance exams used for admission criteria include the HESI-A^2, Scholastic Achievement Test (SAT), Test of Essential Academic Skills (TEAS), American College Test (ACT), the NLN Pre-Admission Examination (PAX-RN), and the Collegiate Assessment of Academic Proficiency (CAAP). See Table 2. In this paper, we examine the evidence for these standardized admission exams to answer the following research question: Which standardized admission test is most predictive of nursing GPA and NCLEX-RN first-time pass rates in U.S. programs of professional nursing?

Table 2. *Standardized Admission Exams*

Exam	Structure and Content	Purpose
HESI A^2	Seven academic and one personality exam. Academic components: basic math skills, reading comprehension, grammar, vocabulary & general knowledge, biology, chemistry, and anatomy & physiology.	Predicts performance in pre-licensure programs of nursing and NCLEX-RN (Elsevier, 2015).
SAT	Tests current knowledge with one section each for critical reading, writing, and math .	Used along with other academic measures for admission decisions (The College Board, 2015).
TEAS	Multiple choice assessments in the content areas of math, science, reading and English, and language usage.	Predicts performance in pre-licensure programs of nursing (Assessment Technologies Institute, 2014).
ACT	Tests knowledge in English, math, reading, and science; optional writing section.	Assesses readiness for college (ACT, 2015a).
PAX-RN	Tests knowledge in verbal, math, and science.	To provide admissions officers with a predictor of student success (NLN, 2016).
CAAP	Tests up to six areas: reading, writing skills, essay writing, mathematics, science, and critical thinking.	Measures critical thinking skills (ACT, 2015b).

Methods

Database searches were conducted in MEDLINE, Cumulative Index of Nursing and Allied Health Literature, PsycINFO, and Academic Search Complete. Keywords included standardized exams, nursing program, admission criteria, NCLEX, and licensure exam. Boolean operators ‘OR’ and ‘AND’ were applied in various combinations with the keywords in order to increase the results returned. Searches were limited to English-language manuscripts published between 2005 and October 2016 to capture outcomes for current versions of exams rather than outdated versions. Searches resulted in 65 articles with an additional five found through manual searching of bibliographies. Abstract screening led to the exclusion of 19 articles.

Fifty-one articles were reviewed against the inclusion criteria of admission standards for RN programs, specific exams (e.g., HESI A^2, TEAS, SAT, CAAP, NLN PAX-RN, or ACT), NCLEX-RN performance, or program success. International studies were retained in the sample. Studies focusing on mid-curricular or exit exams, NET only, or those failing to address either NCLEX-RN performance or program success were excluded. Dissertations, duplicate studies by same author, and articles that were not original research were also excluded. Thirty-six articles failed to meet the inclusion/exclusion criteria leaving 15 for this review, as summarized in Table 3.

Table 3: Summary of Review Articles

1st Author and Year	Purpose	Design/ Level of Evidence	Setting & Sample	Survey/ Instrument	Findings
Chen (2013)	To determine the value of HESI A^2 scores in predicting student success in an ADN*** program	**Design:** Retrospective Study period was from January 2008 to December 2011 **Level of Evidence:** Level = II-A	**Setting:** ADN program in Southern California. **Sample Demographics:** (*N* = 506) *Race/Ethnicity:* 40.91% Asian, 32.02% Hispanic 19.98% White, non-Hispanic *Gender:* 79.8% Female 20.1% Male	KR-20 estimated HESI A^2 exam reliability = .97 - .99 Final grades from three first semester nursing courses; Demographic questionnaire is included in HESI pre-test	A^2 scores were higher for completers of all 3 1st-semester courses (*n* = 379, *M* = 81.3, *SD* = 6.66) as compared with non-completers of ≥ 1 course (*n* = 127, *M* = 75.2, *SD* = 10.19**) Math subscores were related to final pharmacology course grades (*r* = *.46***) Use of A^2 scores as a criterion for admission are valid predictors of student success in program
Gilmore (2008)	To determine if ACT composite or subscores as admission criteria predict academic success	**Design:** Comparative descriptive for successful completers with non-completers using retrospective data **Level of Evidence:** Level = II-B	**Setting:** ADN programs at two community colleges in SE United States **Sample Demographics:** (*N* = 218) Successful completers (*n* = 176); unsuccessful (*n* = 42)	Two sources: 1. GPA & ACT scores and subscores from the academic transcript; 2. NCLEX-RN score reports	Higher composite ACT score for program completers (*n* = 176, *M* = 19.70) as compared with non-completers (*M* = 18.85*); no *SD*s reported Predictors accounted for 20% of the variance in program completion

					ACT reading subscore predicted program completion* and NCLEX-RN success*
Grossbach (2011)	To examine the power of the ACT & SAT exams to predict performance on the NCLEX-RN	**Design:** Meta-analysis **Level of Evidence:** Level = I-A	**Setting:** BSN programs from various regions of the United States **Sample Demographics:** Total sample (*N* = 7,159) Independent samples (*n* = 31)	Data were aggregated using the Hunter and Schmidt psychometric meta-analytic method	All SAT and ACT total and subscores and nursing GPA predicted NCLEX-RN performance success SAT and ACT had comparable overall predictive power (*r* = .46, *n* = 991; *r* = .42, *n* = 1572, respectively), with the SAT being the strongest diagnostic predictor across a variety of programs (e.g., 80% credibility interval = .41-.52) Other predictors with diagnostic credibility levels include ACT - social science (.39-.51) and 2nd year nursing GPA (.36-.63)
Hinderer (2014)	To explore relationship of HESI A^2 to various GPAs, timely program progression, and NCLEX-RN success	**Design:** Retrospective Study period of cohorts from 2008, 2009, and 2010 **Level of Evidence:** Level = III-B	**Setting:** Traditional upper division midsized public, accredited BSN program in the rural area of the mid-Atlantic with a low failure rate **Sample Demographics:** Total sample (*N* = 89)	Demographics and GPA collected from institutional database; NCLEX-RN rates collected from official NCLEX-RN reports; HESI A^2 scores from electronic database	HESI A^2 exam scores were moderately related to nursing GPA (*r* = .31**) and NCLEX-RN success (*r* = .30*) but not to pre-admission GPA or science GPA HESI A^2 exam did not predict timely program progression

			Gender 93% Female 7% Male *NCLEX-RN* 97.2% pass rate		High pass rate limited ability to identify predictors of NCLEX=RN success
Knauss (2013)	To examine the relationship between HESI A^2 scores and academic performance in two 1st-semester nursing courses	**Design:** Retrospective Study period of four cohorts entering in the fall and spring semesters of 2008 and 2009 **Level of Evidence:** Level = III-B	**Setting:** ADN program in the southeastern U.S. **Sample Demographics:** Total sample (*N*=157) *Race/Ethnicity:* 86.62% White *Gender:* 89% Female 11% Male *Age Range:* 19-61 years; 77.71% between 19 - 34 years	HESI A^2 composite scores, subscores in math, reading comprehension, vocabulary/general knowledge, and grammar Scores expressed as percentages (range = 0-100%) HESI A^2 scores were weighted at 60% of the total admission score	Moderate relationship between composite HESI A^2 score and final course grades in Nursing-1 (n = 157, r = .53**) and Nursing-2 (n = 135, r = .46**) Moderate relationship between math, vocabulary/general knowledge, and grammar subscores with Nursing-1 (r = .37**, r = .37**, r = .36**, respectively) Moderate relationship between vocabulary/general knowledge, and reading comprehension subscores with Nursing-2 (r = .36**, r = .34**, respectively) As HESI A^2 composite scores ↑, final course grades ↑ HESI A^2 scores predicted student success throughout the curriculum

Manieri (2015)	To determine whether PAX-RN, HESI A^2, or TEAS best predict successful completion of an ADN program	**Design:** Retrospective cohort design Two cohorts over a 5 year period • Cohort 1 (*n* = 171) took PAX-RN and HESI A^2 entrance exams • Cohort 2 (*n* = 168) took the TEAS exam • *ns* difference between cohorts for pre-admission GPA **Level of Evidence:** Level = II-A	**Setting:** ADN program in urban area of southeastern U.S. **Sample Demographics:** Total sample (*N* = 339) No demographic data provided for students	PAX-RN, HESI A^2, TEAS	HESI A^2 and TEAS predicted program success* HESI A^2 explained more variance than the TEAS (HESI A^2 = 15.9%, TEAS = 5.9%) PAX-RN was *ns* predictor
Murray (2008)	To assess the value of the HESI A^2 in predicting (a) ADN and BSN student success and (b) program completers from non-completers	**Design:** Longitudinal Four cohorts took the HESI A^2 after admission for placement (with remediation provided for weak areas)	**Setting:** ADN and BSN programs; Geographic locations not provided **Sample Demographics:** Total sample (*N* = 286) ADN students (*n* = 217) BSN students (*n* = 69)	9 sections: - Academic sections (*n* = 6): math, reading comprehension, grammar, vocabulary, science, and anatomy & physiology - Personality sections (*n* = 3): learning	ADN students' HESI A^2 scores were weakly to moderately related to 8 of the 9 nursing course grades in the total curriculum (*r* = .25 - .44*) BSN students' HESI A^2 scores were weakly to moderately related to 10 of the 20 nursing course grades in the total curriculum (*r* = .24 - .37*)

		Level of Evidence: Level = II-A	Complete data available for: ADN students (*n* = 68) BSN students (*n* = 69)	styles, personal inventory, and behavioral inventory KR-20 for HESI exam reliability	Mean HESI A[2] score of ADN program completers was > non-completers (*M* = 75.98, *M* = 70.44**, respectively) All BSN students completed the program – therefore no comparison possible with non-completers
Newton (2007)	To describe and compare pre-nursing GPA, TEAS, and 1st-semester GPA for two cohorts of first semester sophomore nursing students admitted during one academic year	**Design:** Exploratory descriptive Curriculum evaluation Two cohorts (1st-semester of fall & winter) *ns* difference between cohorts for demographics **Level of Evidence:** Level = II-B	**Setting:** Large, state-supported BSN program located in Midwestern U.S. **Sample Demographics:** First semester students (*N* = 184) Cohort 1 (*n* = 108) Cohort 2 (*n* = 76) *Race/Ethnicity:* 92% Caucasian *Gender:* 86% Female 14% Male	Measures: 1. Overall pre-nursing GPA 2. 1st-semester GPA 3. TEAS composite scores TEAS composite score is number of questions answered correctly divided by the number of questions on the assessment	Fall cohort (*n* = 108): - Pre-nursing GPA *M* = 3.39, *SD* = .26** - TEAS *M* = 78.25, *SD* = 7.17** - 1st semester GPA *M* = 3.23, *SD* = .22**; - Pre-nursing GPA was the best predictor of 1st-semester GPA, and explained 20% of variance (*F* = 25.17, *df* = 98**) Winter cohort (*n* = 76): - pre-nursing GPA *M* = 3.15, *SD* = .17** - TEAS *M* = 74.85, *SD* = 7.89** - 1st semester GPA *M* = 3.08, *SD* = .20** - TEAS as the best predictor of 1st-semester GPA and explained 15% of variance (*F* = 11.834, *df* = 65)

					Fall cohort had higher mean pre-nursing GPAs, TEAS, and 1st-semester nursing GPAs and lower attrition rate than the winter cohort (n = 2; n = 7, respectively) TEAS more reliably predicted risk of failure than pre-nursing GPA for at-risk BSN students
Romeo (2013)	To test if critical thinking skills, nursing GPAs, and combined SAT scores predict 1st-time NCLEX-RN pass rates	**Design:** Comparative retrospective Study conducted over a 3-year period, 2005-2007 **Level of Evidence:** Level = II-A	**Setting:** ADN program at a small private college **Sample Demographics:** Total sample (N = 182) Group 1 = Students who passed NCLEX-RN (n = 91) Group 2 = Students who failed NCLEX-RN (n = 91)	ERI RN Assessment test (critical thinking composite score calculated from six subscale scores within this test); Cronbach's alpha = .90 - .94 Nursing GPA Combined SAT math & verbal scores	RN assessment composite score positively related to nursing GPA (r = .60**) and combined SAT score (r = .21*) NCLEX-RN score was strongly related to nursing GPA (r = .61**) Admission SAT score did not predict NCLEX-RN outcomes Nursing GPA was the strongest predictor of NCLEX-RN outcomes
Shirrell (2008)	To determine if critical thinking (CAAP)[1] predicts success on	**Design:** Retrospective Academic records retrieved from database over 6-years, 2001-2006	**Setting:** ADN program in a private Midwestern college **Sample Demographics:** Students who took the NCLEX-RN (N = 173)	CAAP critical thinking test NCLEX-RN results Nursing GPA	Model containing independent variables of critical thinking, nursing GPA, and science GPA was predictive of success on the NCLEX-RN (F = 7.987**), accounting for 12% of variance (R = 352, R^2 = 124)

	the NCLEX-RN	**Level of Evidence:** Level = II-A			Only nursing GPA as an independent variable significantly contributed to the model (t = 3.939)** Science GPA and CAAP scores were *ns* in predicting NCLEX-RN success
Stuenkel (2006)	To explore the predictive value of SAT, NLN PAX-RN, and achievement measures for NCLEX-RN performance with a focus on those students who were likely to fail	**Design:** Retrospective Six graduating classes who took NCLEX-RN between December 1997 and March 2001 **Level of Evidence:** Level = II-B	**Setting:** BSN program at a university; unstated geographic location **Sample Demographics:** Total sample (N = 312) SAT scores were only required for students coming directly from high school (n = 45) *Race/Ethnicity:* 28% Filipino 24% European 14% Asian 7% Hispanic 5% African American 31% English as a 2nd language	NLN PAX-RN, SAT, & pre-nursing GPA comprised Predictor Set – A; standardized exam raw scores were converted to t scores Nursing theory grades; NCLEX-RN performance; KR-20 estimate for PAX-RN = .69 - .90	Predictor Set A accounted for 51% of the variance; correctly identified 67% of the fail group 80% of students were classified correctly according to pass or fail status when SAT total scores were added to pre-nursing GPA and NLN PAX-RN scores

Trofino (2013)	To analyze whether there is a relationship between admission criteria using ACT, SAT, & TEAS exams and successful 1st-time passing of NCLEX-RN	**Design:** Retrospective Pilot study with cohorts graduating in spring or fall 2009 or spring 2010 **Level of Evidence:** Level = III-B	**Setting:** Private rural, liberal arts, ADN program in Pennsylvania **Sample Demographics:** Total sample (*N* = 85) *Gender:* 85% female 15% Male *Age:* *M* = 24.8 years; 54% were ≥ 22 years of age	Normalized scores from exams High school or transfer GPA	*ns* relationship between pre-nursing GPA and pass rate on NCLEX-RN *ns* relationship between composite and reading sub-scores of the tests Normalized math sub-score ↑* probability of passing NCLEX-RN Odds of passing NCLEX-RN were low if a student repeated a nursing course (*OR* = .29) Students had increased odds of passing the NCLEX-RN if they never repeated a course (*OR* = 3.5)
Underwood (2013)	To explore the value of including HESI A^2 exam scores in the admission protocol of a BSN program	**Design:** Descriptive correlational and predictive Cohorts enrolled between fall 2008 and spring of 2010 **Level of Evidence:** Level = III-A	**Setting:** BSN program in southeastern U.S. **Sample Demographics:** Total Sample (*N* = 184) Participants: (a) took all four categories of the HESI A^2 exam and (b) enrolled in ≥ 2 of the 3 1st-semester nursing courses	Final grades for three 1st-semester nursing courses calculated based on criteria in syllabi 20 point protocol admission tool - 9 points allotted to HESI A^2 scores - 11 points to ACT, pre-admission GPA, and number of	Moderate relationship between all HESI A^2 scores and final course grades in three 1st-semester nursing courses (*r* = .52 - .80**) As students' HESI A^2 exam scores ↑, their final course grades in the three 1st-semester nursing courses ↑

				prerequisite courses taken at that university	
Wolkowitz (2010)	To determine the relative strength of four TEAS subscores in predicting nursing school success	**Design:** Retrospective TEAS scores collected between May 2005 and May 2008 ATI's Fundamental assessment scores collected between February 2006 and December 2008 **Level of Evidence:** Level = III-A	**Setting:** ADN and BSN programs (N = 49) from various regions; sample from diploma programs too small to include in analyses **Sample Demographics:** Total sample (N = 4105)	ATI's TEAS and ATI's RN Fundamentals assessments Surveys were sent to directors of all programs that had purchased both the TEAS and Fundamentals assessment (n=314) in order to identify student samples ATI Fundamentals assessment used as a proxy variable for 1st-semester student success	Strongest predictor of early nursing program success is the science subscore, followed by reading, written/verbal, and math, respectively Linear combination of the four TEAS subscores to the RN Fundamentals score explained 20% of the variance (F[4, 4100] = 256.467**)
Yoho (2007)	To determine the predictive accuracy of HESI A^2 exams (admit, mid-curricular [MC], & exit	**Design:** Longitudinal Conducted from August 2002 until October 2004 **Level of Evidence:**	**Setting:** ADN program in Southwest Texas **Sample Demographics:** (N = 139)	HESI A^2 subscales (N = 9: 6 academic, 3 personality) KR-20 for math and reading subsections = 0.93 and 0.90, respectively	Of 139 students who took the A^2 , 135 (97.12%) achieved recommended $\geq$ 70% 101 of 139 students remained at mid-curriculum; only 22 of those achieved the recommended $\geq$ 850 on MC

[E^2]) for student success in the ADN program and on NCLEX-RN	Level III-A	HESI MC administered in first half of program; KR-20 = 0.92 HESI E^2 administered at end of program; KR-20 = 0.90 NCLEX-RN evaluated with a decision consistency statistic; reliability = .87 - .92	In final semester, 77 of the original 139 students remained in the program; 58 of those achieved the recommended of $\geq$ 850 on the 1st-attempt of the E^2 HESI A^2 , especially the reading sub-score, was: - Predictive of MC scores (r = .41**) - MC scores were related to E^2 scores (r = .62**) - E^2 scores were 94.83% predictive of 1st-time NCLEX-RN scores

Note. *$p \leq .05$; **$p \leq .01$; 1 = Collegiate Assessment of Academic Proficiency (CAAP) critical thinking test; ***ADN = associate degree in nursing program, offered primarily through community colleges with coursework that is completed in approximately two years. Graduates of ADN programs take the same NCLEX-RN as graduates of BSN programs.

Results

Design, Level of Evidence, and Quality

The majority of studies (n = 8) used a retrospective cohort design. Three studies used a correlational design and two used longitudinal designs. One of the studies was a meta-analysis and one was conducted as part of program evaluation.

The Johns Hopkins Nursing Evidence-based Practice Rating Scale was used to rate the evidence (Newhouse, Dearholt, Poe, Pugh, & White, 2005). This scale requires evaluation of levels of evidence and quality of evidence. The level of evidence of each study is rated on a scale from a 1 to 5. Examples of levels of evidence include 1 = experimental study, 2 = quasi-experimental study, 3 = non-experimental study, 4 = expert committee or consensus panels, and 5 = experiential or non-research evidence. Quality ratings are rated as A (high quality), B (good quality) or C (low quality). The rating scale provides thorough descriptors to aid in rating evaluations, and each article rated receives level and quality ratings. In our sample of literature, the meta-analysis was rated as level I evidence while the remaining articles were level II or level III evidence (n = 8, n = 4, respectively). The rating level was unclear for two studies. All of the articles were rated as high (A; n = 9) or good quality (B; n = 6).

Setting and Sample

All of the studies were conducted using data from RN programs in the United States. The major settings for the studies included Associate Degree of Nursing [ADN] programs (n=8) and Bachelor of Science in Nursing [BSN] programs (n=5). One study involved a mix of RN program types and one was not specified. The geographic regions identified included southern California, Maryland, southwestern Texas, and

Pennsylvania. Four studies were conducted in the southeast and two were conducted in the Midwest. Two of the studies were conducted using information collected by from pre-licensure programs of nursing in different areas of the United States. The geographic location could not be determined in three of the studies.

There were a total of 13,852 students represented in the 15 studies included in this review (9 ADN studies, *n* = 2086; BSN studies, *n* = 7661; RN programs [unspecified mix], *n* = 4105). Demographics, when reported, varied depending on the geographic location. The majority of the sample population was female, which is consistent with the overall student nurse population.

Standardized Entrance Exams

The HESI A^2 was the most frequently used standardized entrance exam in this review (*n* = 7). The SAT and the TEAS were each used either solely or as one component of the admission criteria in four studies. Only three studies included the ACT and one tested the CAAP. Two studies that met the inclusion criteria also included the NLN PAX-RN exam and were, therefore, included in this review.

Predictors of Program Success

Of the 15 included studies, seven focused primarily on whether the standardized exams predicted nursing program success while two others focused on prediction of 1st time NCLEX-RN success. The authors of the remaining studies focused on program success as well as NCLEX-RN success. The majority of studies (*n* = 13) found that a standardized entrance exam did predict student success in either the nursing program or on the NCLEX-RN. The exams that were not effective predictors of nursing student

success were the PAX-RN and the CAAP critical thinking exam, although findings are contradictory for the PAX-RN.

Findings overwhelmingly supported the value of the HESI A^2 as a predictive pre-admission criterion of student success. Seven of the 15 studies either included the HESI A^2 or used the HESI A^2 exclusively. Most focused on the HESI A^2 comprehensive score. Chen and Voyles (2013) found that the mean composite HESI A^2 scores were higher for those who successfully completed (n = 379) nursing program courses (M = 81.33, SD = 6.66) as compared to those who did not complete (n = 127) at least one course (M = 75.15, SD = 10.19). Their study also found a significant correlation (p<.01) between the math subscore and pharmacology success. Four studies found that HESI A^2 composite score was significantly correlated (p<.01) to nursing grades as described in Table 2 (Hinderer et al., 2014; Knauss & Willson, 2013; Murray et al., 2008; Underwood et al., 2013). Yoho et al., (2007) found that the reading subscore was positively correlated (r = .412, p<.01) to mid-curricular success. Manieri et al. (2015) studied the HESI A^2 along with the TEAS exam and found that the HESI A^2 was superior to the TEAS exam in predicting program success. While Manieri et al. (2015) found PAX-RN was not statistically significant, HESI A^2 was found to explain 15.9% of the variance of success while the TEAS explained only 5.9% of the variance of success.

Four studies investigated the use of the TEAS standardized exam, of which three focused on the predictive value of the TEAS on successful nursing program completion. Specifically, the comprehensive TEAS score is a predictor of program success. In one study, the TEAS was a more reliable predictor of student failure than was nursing GPA. Newton et al. (2007) compared two cohorts, one fall cohort and one winter cohort. As

noted in Table 2,the study found that while in the fall pre-nursing GPA was the best predictor (F = 25.17, p<.001, df = 98) explaining 20% of the variance, in the winter cohort the TEAS composite score was most predictive of nursing GPA, explaining 15% of the variance (F = 11.834, p<.001, df = 65). Manieri et al. (2015) found that the TEAS, while not as useful a predictor as HESI A^2, did explain 5.9% of the variance of success. Wolkowitz and Kelley (2010) found that the use of the TEAS subscores was correlated to the RN Fundamentals scores (R^2 = .20, F(4,4100) = 246.467). The linear combination of subscores, science, reading, verbal and math, was better than any individual score explaining 20% of the variance of fundamentals scores.

Although three studies were conducted on the predictive value of ACT scores, only one specifically focused on nursing program success (Gilmore, 2008). Gilmore (2008) found that completers of the program (n = 176) had a higher composite ACT score (M = 19.70) while non-completers of the program (n = 42) had a lower composite ACT score (M = 18.85). No standard deviation was reported. With regards to subscores, Gilmore (2008) also found the reading subscore to be significant (p<.05).

The SAT standardized exam was included in one study that considered program success. Stuenkel (2006) found that the SAT was a predictor of nursing program success and identified 67% of the fail group correctly. However, Stuenkel (2006) utilized the SAT as a component of a predictor set that also included PAX-RN and pre-nursing GPA. Therefore, it is difficult to conclude that the SAT alone is a valuable predictor of program success based on this particular study.

Predictors of NCLEX-RN Success

Eight of the studies included in the review (Table 2) investigated the use of standardized admission exams as predictors of NCLEX-RN success (Gilmore, 2008; Grossbach & Kuncel, 2011; Hinderer et al., 2014; Romeo, 2013; Shirrell, 2008; Stuenkel, 2006; Trofino, 2013; Yoho et al., 2007). The only study investigating the use of the CAAP critical thinking exam, found that it was not a useful contributor in predicting NCLEX-RN success (Shirrell, 2008).

Romeo (2013) found that the admission SAT scores were not predictive of NCLEX-RN success. However, as noted in Table 2, those results were contradicted by Grossbach and Kuncel (2011) as well as by Trofino (2013). Grossbach and Kuncel (2011) found a moderately positive relationship between the composite SAT score and NCLEX-RN success (r = .46, n = 991) and that the verbal subscores were predictors of NCLEX-RN success as well (r = .36, n = 1,965).

The ACT comprehensive score was found to be predictive of NCLEX-RN success (Grossbach & Kuncel, 2011; Trofino, 2013). Grossbach and Kuncel (2011) determined that there was a moderate and positive relationship between ACT composite scores and NCLEX-RN success (r = .42, n = 1,572). Further, Grossbach and Kuncel's findings showed that while all subscores predicted NCLEX-RN performance, the social science subscore of the ACT appeared to be the strongest predictor.

Trofino (2013) used a different analysis approach with the data and normalized all of the subscores of the ACT, SAT, and TEAS. Findings indicated that only the normalized math subscore was predictive of NCLEX-RN success (p<.03). It is undetermined whether the math subscore of the ACT, TEAS, or SAT alone was a significant predictor of NCLEX-RN success. Trofino (2013) was the only investigator to

study NCLEX-RN success and the TEAS. More data is needed to determine the predictive value of the TEAS exam on NCLEX-RN success.

Both Hinderer et al. (2014) and Yoho et al. (2007) found that the HESI A^2 was a predictor of NCLEX-RN success (Table 2). However, it was noted that the HESI A^2 was weakly related to NCLEX-RN success (r = .30, p<.01) and the program's low failure rate (n = 2) made it imprudent to draw conclusions about that relationship (Hinderer et al., 2014). Since HESI A^2 was used as the entrance exam in this study, that further supports the use of the exam as a predictor of program success based on the program's low failure rate. Yoho et al. (2007) found that HESI A^2 was an indirect predictor of NCLEX-RN success. The reading subscore was moderately related to mid-curricular success (r = .41, p<.01) which in turn was strongly related to exit scores (r = .62, p<.01). The exit scores were 94.83% predictive of first-time NCLEX-RN scores (Yoho et al., 2007).

Discussion

HESI A^2, TEAS, and ACT standardized exams have all shown to be valuable predictors of student success in pre-licensure programs of nursing as well as predictors of NCLEX-RN success while the PAX-RN had conflicting findings. Based on the findings in this review, HESI A^2 appears to be statistically superior to other standardized exams as a predictor for student success. Further, findings suggest that the HESI A^2 may be a better predictor than pre-nursing GPA (Newton et al., 2007). Caution is warranted because the HESI A^2 was the most commonly studied standardized nursing admission exam - which may be considered a weakness of this review as results could be skewed. In light of this, further research should be done on other standardized admission exams such as the TEAS, the PAX-RN, and the ACT.

A strength in the research is that current evidence is from heterogeneous samples, with representation from ADN and BSN programs in different regions of the United States. This is important because ADN and BSN programs often use the same admission criteria and program graduates take the same NCLEX-RN exams. Because there were 13,852 students represented in the studies included in this review from various program types and geographical regions, the findings are robust and could likely be generalized to a variety of pre-licensure programs of nursing.

Standardized exams are often used in conjunction with other admission criteria such as overall GPA and science GPA. A gap in the literature is how and when weighting of the standardized exam might be needed. It would also be useful to replicate the study by Manieri et al. (2015) to delineate the factors affecting the predictive ability of the HESI A^2, the TEAS, and the ACT; all three of which, according to this review, were predictive of success.

Predictive admission criteria should not be viewed as static and universal. Each nursing program needs to determine which combination of admission criteria work best given its unique needs and characteristics of its student body. Entrance criteria must be routinely assessed for validity. Changes in demographics of entering students (e.g., balance of traditional or nontraditional; percentage of community college transfers) may necessitate adjustments in the admission criteria just as a change in the level of difficulty of the NCLEX-RN exam can affect 1^{st} time student pass rates. Also, it is likely that variances in the rigor with which programs are implemented and students are evaluated will affect the outcome variables of program success and NCLEX-RN pass rates and must be taken into consideration.

Faculty may be reluctant to admit nursing students based on the results of a standardized entrance exam. However, the increasing pressure on schools of nursing to select qualified applicants who will successfully complete the program and pass the NCLEX-RN is shifting this paradigm. The findings in this integrative review clearly demonstrate that the inclusion of standardized admission exams in the nursing program admission criteria can predict program success and NCLEX-RN success. Admitting the strongest candidates will help to reduce attrition rates, increase NCLEX-RN pass rates, and speed the entry into practice of well-prepared nurses.

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Chapter Three

Julie Twidwell

The topic for the second manuscript is the presentation of an original conceptual model describing the utility of expanding nursing admission criteria to include critical thinking assessment. The conceptual model will illustrate the salient concepts of interest in a model depicting the use of the HESI A^2 with Critical Thinking component, along with pre-nursing overall GPA as a predictor of first semester baccalaureate nursing student academic success. The manuscript has been submitted to *Nurse Educator* and is currently under review.

A Conceptual Model for Predicting Academic Success in Pre-licensure Programs of Nursing through Expanded Cognitive Aptitude Assessment

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Abstract

Attrition is a serious issue with implications for students, pre-licensure programs of nursing, and the nursing workforce. Academic failure due to insufficient cognitive aptitude often contributes to this problematic attrition rate. Thus, cognitive aptitude could be included in admission criteria, as a predictor of academic success and a strategy to minimize attrition. Currently, admissions practices are often incomplete and lack standardization for measuring cognitive aptitude. The Nursing Cognitive Aptitude Model (NCAM) presented in this paper is an innovative conceptual model to guide educators in expanding current admissions processes. The NCAM model depicts the cognitive domains involved in student academic success including current scholastic knowledge, previous academic performance, and critical thinking ability. Together, these three domains predict student academic success and are a useful reference for the admissions process.

Keywords: nursing education, standardized exams, cognitive aptitude, conceptual model

Background

The world is reaching a critical shortage of nurses who are able to care for aging populations with increasingly complex medical problems (World Health Organization, 2013; American Association of Colleges of Nursing [AACN], 2017). Pre-licensure programs of nursing are essential in preparing a sustainable supply of nurses to meet the growing demand. Attrition occurs when students leave an academic program for any reason, threatening the supply of nurses and ultimately nursing care delivery. During the 2014-2015 academic year, 119,428 students were matriculated into baccalaureate pre-licensure programs of nursing in the United States (AACN, 2015). Nearly half of those who matriculated did not complete their programs, with the highest attrition rates occurring during the first semester (Merkley, 2016; Newton & Moore, 2009).

Attrition is also very costly to students both financially and emotionally. The average cost for a Bachelor of Science in Nursing (BSN) degree in the United States ranges between $40,000 and $200,000 among both public and private programs (Costhelper, Inc., 2017). With the high cost of education, student loans are at an all-time high (Reilly, 2017). Attrition can leave students with tremendous debt and no reliable income by which to pay it back. Furthermore, attrition creates an emotional toll by causing high stress and low self-esteem (Karande & Kulkarni, 2005).

Multiple personal challenges contribute to this troublesome first semester attrition rate including lack of career fit, difficulty balancing family responsibilities with academic workload, financial constraints (Jeffreys, 2007), and lack of social support to manage the inherent challenges of nursing school (Jeffreys, 2007; Newton, Smith, Moore & Magnan, 2007). The personal challenges associated with nursing school are not the only culprits

for the alarmingly high attrition rates. Attrition due to academic failure is often linked to a lack of cognitive aptitude for learning (Andrew, Salamonson, Weaver, Smith, O'Reilly, & Taylor, 2008; Jeffreys, 2007; Peterson, 2009;). Students lacking the cognitive ability necessary for the rigor of pre-licensure programs of nursing often struggle throughout the program and are later unsuccessful on the National Council Licensure Examination for Registered Nurses (NCLEX-RN; Domiano, 2018).

Most programs currently use various metrics to evaluate and rank applicants for admission that may include grade point average (GPA), standardized tests, essays of intent, and interviews (Bennett, Bormann, Lovan, & Cobb, 2018). Holistic admissions processes are also gaining popularity in an effort to capture multiple characteristics and criteria that are broad-based, linked to the program's mission and goals, and designed to promote diversity (Association of American Medical Colleges [AAMC], 2013, p. ix). Regardless of the approach, most admissions metrics include academic background, cumulative GPA, science course grades, number of repeated courses, overall grade trends, and standardized admission exam scores (Scott & Zerwic, 2015). Standardized testing is a common method of evaluating applicants' current level of scholastic ability. Unfortunately, standardized testing can be incomplete in scope, providing an inadequate picture of students' academic preparedness.

Despite the growing need to reduce attrition rates, no previously published frameworks or models were identified in the literature to guide nurse educators in the use of standardized nursing admission exams as predictors of student success. This paper presents a conceptual model depicting how expanded standardized testing that includes all salient domains of cognitive aptitude can be used during the applications process. The

assessment of all domains of cognitive aptitude upon admission into pre-licensure programs can be used to predict students' academic success and, therefore, reduce attrition rates related to academic failure.

Review of Literature

Theoretical Underpinnings

A combination of existing theories and frameworks underpin the proposed conceptual model including Ausubel's Cognitive Learning Theory, Bloom's Revised Taxonomy, and Critical Thinking theories (Aliakbari, Parvin, Heidari & Haghani, 2015; Jensen, McDaniel, Woodard, & Kummer, 2014; Yildirum & Ozkahraman, 2011). These theories are synergistic in describing the concepts of interest when it comes to predicting nursing student academic success. The major assumption of Ausubel's Cognitive Learning theory is that a learner's future learning is predicated on current knowledge. Learning is believed to be inductive and begins with an understanding of general concepts (Aliakbari et al., 2015; Ausubel, 1963). The revised Bloom's Taxonomy of cognitive learning built on this assumption, creating a standardized framework denoting graduated levels of cognitive functioning.

The revised Bloom's Taxonomy is a familiar framework for nurse educators when planning education strategies and evaluating student learning outcomes. Foundational knowledge acquired in prerequisite arts and sciences coursework aligns with Bloom's Level 1 of the taxonomy, *Remember*, and Level 2, *Understand* (Anderson et al., 2001). Cognitive processes involved in *Remember* are aimed at memorization and fact recall while Level 2, *Understand*, requires the learner to assign meaning to those facts.

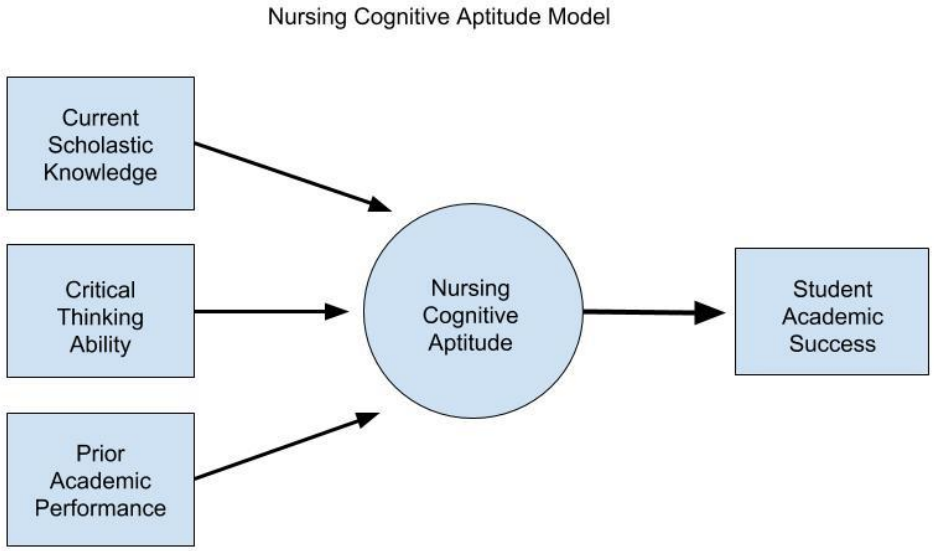
Higher order cognitive processes at levels 3-5 build upon mastery of content at levels 1 and 2 ("Addressing multiple cognitive levels", 2017) and require students to utilize critical thinking. At a minimum, student nurses must be able to apply the information they have learned in class to the patient care environment. Applying taxonomic Level 3 requires students to relate knowledge gained through complex clinical situations to guide best practice. Even new nurses are expected to demonstrate safe nursing judgment (Fero, O'Donnell, Zullo, Dabbs, Kitutu, Somosky, & Hoffman, 2010) which requires the analysis and evaluation of situation-specific information. Level 4, *Analyze*, is a level of thinking characterized by the ability to dissect concepts into individual components, draw connections between the components, and relate the connections back to the major ideas. This is a critical skill needed in caring for patients with multiple complex health care needs and is becoming an increasingly common learning goal in pre-licensure nursing education. Level 5, *Evaluate*, is the ability to make valid judgements for planning patient care, based on relevant information based on information (Anderson et al., 2001; Fero et al, 2010).

The NCLEX-RN licensure exam measures graduates' preparedness to care for patients safely upon entry to the workforce (NCSBN, 2017). The NCLEX-RN for pre-licensure graduates tests their abilities to process information at Levels 3 and 4, setting the leveling benchmarks for examinations in pre-licensure programs. Thus, pre-licensure graduates must attain cognitive operations at a minimum of Levels 3 and 4 to be successful on the NCLEX-RN. Because critical thinking is required for levels 3 and 4, it is also a predictor of graduates' abilities to provide safe patient care and is, as a result, an essential component of complete admissions criteria.

The Nursing Cognitive Aptitude Model (NCAM)

Cognitive aptitude, or the capacity for future learning, is a primary determinant of achieved learning outcomes which requires critical thinking ability (Brown, Le, & Schmidt, 2006; Konold, & Canivez, 2009). The NCAM (Figure 1) presents cognitive aptitude within the context of nursing. Thus, the theoretical definition for *nursing cognitive aptitude* as used in the NCAM is as follows: the degree to which the student demonstrates the capacity to learn and be successful in a baccalaureate nursing program. The NCAM presents cognitive aptitude as a central latent construct with three contributing and measurable concepts (Figure 1). Demonstrating *current scholastic knowledge*, *critical thinking ability*, and *prior academic preparation* are theorized to contribute to nursing cognitive aptitude and ultimately, to effect student academic success. Each of these concepts is described below, with suggestions for measurement strategies that can be used during the admissions process for pre-licensure programs of nursing.

Figure 1.
Nursing Cognitive Aptitude Model



Note: Circle represents latent construct of *Nursing Cognitive Aptitude*. Rectangles represent concepts. Arrows represent direct pathways. *Current Scholastic Knowledge* is measured by the observed variable HESI A^2 composite score. *Critical Thinking Ability* is measured by the observed variable HESI A^2 Critical Thinking component score (not a part of composite score). *Prior Academic Performance* is measured by the observed variable pre-nursing overall GPA. *Student Academic Success* is measured by the observed variables of minimum acceptable overall nursing GPA, minimum acceptable individual nursing course grades, and satisfactory academic progression. Copyright Julie Twidwell 2018.

Student Academic Success

Student academic success is often measured in terms of positive enrollment status at the end of the academic semester, with satisfactory course grades and GPA, as defined by individual programs (Kowitlawakul, Brenkus, & Dugan, 2013; Timer & Clauson, 2011; Yeom, 2013). For the NCAM, student academic success is defined as having met all minimum academic standards to include minimum acceptable overall nursing GPA, minimum acceptable individual nursing course grades, as well as satisfactory academic progression to the next semester of coursework.

Individual baccalaureate pre-licensure programs of nursing establish achievement standards and progression policies for both theory and clinical coursework. Though

classroom and clinical benchmarks are typically measured separately, it is essential that students understand the connections between knowledge and skills from theory and clinical courses. Difficulty applying information from the classroom to the clinical setting creates a gap between theory and practice (Ajani & Moez, 2011) that often creates an impediment toward achieving academic success. Moreover, successful performance in one does not guarantee success in the other (Chen et al., 2017). Failure to meet benchmarks in either aspect of nursing curricula can negatively impact student academic progression. Measures of cognitive aptitude address the academic preparation needed for didactic work and the critical thinking ability needed to bridge the theory and practice gap.

Current Scholastic Knowledge

Pre-licensure programs of nursing in the United States commonly require courses from liberal arts, science, and math disciplines prior to program matriculation, providing the academic foundation for pre-licensure nursing curricula (Kowitlawakul, Brenkus, & Dugan, 2013; Timer & Clauson, 2011). Cognitive aptitude measurements in math and reading are historically and consistently strong predictors of subsequent academic performance in pre-licensure programs of nursing (Knauss & Willson, 2013; Michael, 1966; Newton, Smith & Moore, 2007; Sayles, Shelton, & Powell, 2003). Reading comprehension is an essential academic skill that crosses knowledge acquisition in all disciplines and is especially important to success in pre-licensure programs of nursing due to the amount of reading that is required. This range of prerequisite coursework is universally required to provide the essential building blocks for the higher order thinking required in nursing curricula.

Approximately one in three pre-licensure programs of nursing in the United States requires satisfactory performance on a standardized exam for admission to programs or progression within programs (National League for Nursing [NLN], 2012). This number is on the rise as pre-licensure programs of nursing seek objective predictors of student success to decrease attrition rates (NLN, 2012). The literature has consistently supported the use of standardized exams, such as the Health Education Sciences, Inc. Admissions Assessment (HESI A^2), Test of Essential Academic Skills (TEAS), American College Testing (ACT), and Scholastic Achievement Test (SAT), as valid and reliable predictors of student academic success (Chen & Voyles, 2013; Grossbach & Kuncel, 2011; Manieri, DeLima, & Ghosal, 2015). The HESI A^2 exam was found to be not only the most frequently studied standardized nursing admission exams but also was found to be the best predictor of student academic success (Manieri, DeLima, & Ghosal, 2015; Twidwell & Records, 2017). Standardized admission exams typically contain sections that evaluate current scholastic knowledge and comprehension on varied combinations of scholastic concepts. Current scholastic knowledge can be operationalized through standardized nursing admission exams administered at the time of application into a baccalaureate program of nursing. Because the HESI A^2 was shown to be the best predictor of student academic success in a review of the literature (Twidwell & Records, 2017), it is the exam exemplar depicted in the NCAM used to measure current scholastic knowledge (Figure 1).

Critical Thinking Ability

Prior academic performance and current scholastic knowledge are often used measures of aptitude as measured through GPA and standardized entrance testing.

Though critical thinking is also closely linked to students' academic success, it is not typically included in the battery of screening evaluations for admissions to pre-licensure programs. The NCAM includes critical thinking as an essential component of comprehensive admissions testing practice.

Critical thinking involves demonstrating higher-level thinking and discernment of thought, problem-solving skills (Dewey, 1910; Fero et al., 2010; Lee, Lee, Bae, & Seo, 2016), purposeful self-regulatory judgment (Gholami et al., 2016), and metacognition (Dewey, 1910; Ennis, 1985; Foundation for Critical Thinking, 2015; Watson & Glaser, 1991). Critical thinking is an essential building block of clinical reasoning and decision-making, a complex cognitive process using both formal and informal processes to analyze and evaluate information required for implementing appropriate nursing actions (Lee et al., 2016).

Critical thinking can be nurtured and developed through educational strategies (Yildirim & Ozkahraman, 2011). Educational strategies that promote base-level cognition, such as rote memorization, are unlikely to cultivate and enhance critical thinking ability. Instead, strategies that employ the use of problem-solving, such as problem-based and experiential learning, can promote engagement in higher-level cognition and critical thinking advancement (Lisko & O'Dell, 2010). Though critical thinking can be improved, baseline ability or disposition must be present making this a crucial variable to include on admissions testing (Yildirim & Ozkahraman, 2011).

Expanded admissions tests that include critical thinking have been designed specifically for the health science professions. First, the Health Sciences Reasoning Test (HSRT) requires test-takers to answer questions about health-related scenarios without

requiring prior healthcare knowledge or education (Kelsch & Friesner, 2014). Second, the HESI A^2 includes a component that can be added to the base exam to assess critical thinking ability (Elsevier, n.d.). Third, the Assessment Technologies Institute (ATI) also produces a critical thinking exam to measure critical thinking that can be added to the traditional Test of Essential Academic Skills (TEAS) exam (ATI, 2016).

Prior Academic Performance

While GPA alone may not be a measure of an applicant's motivation to be a good student, it does reflect general academic habits (Patron & Lopez, 2011). GPA has been found to be reflective of study time, study habits, and academic orientation (Patron & Lopez, 2011). Most programs also have a minimum overall GPA required for admission due to the high importance typically placed on prior academic performance (Timer & Clauson, 2011) while others use a minimum cut-off GPA as a requirement to apply to a program. One of the most common criteria utilized for determining admission into pre-licensure programs of nursing is the pre-nursing overall GPA (Robert, 2018; Schmidt & MacWilliams, 2011). Programs may use the pre-nursing overall GPA in combination with other criteria.

While pre-nursing overall GPA has often been thought of as a measure of prior academic performance, it does not necessarily correlate with mastery of content (Lemke, Marx, & Dundes, 2017). Grade inflation in education has been an ongoing problem for years (White & Heitzler, 2018) as a high course grade is awarded without the associated high level demonstration of knowledge in that course (Elie, 2015). A 4.0 GPA may lead to the erroneous assumption that the individual possesses exemplary current scholastic knowledge. The utility of GPA is also limited by the lack of course equivalency in

content and rigor between institutions (Townsend & Wilson, 2006) and between instructors in the same institution who are teaching different sections. Finally, GPA can be inflated with less rigorous courses that are not relevant to nursing course work (Shepard, 2008; White & Heitzler, 2018).

Despite the limitations identified in using different types of GPA as predictors of academic success, grades in prerequisite coursework have been linked to academic success (Higgins, 2005; Patzer, Lazzara, Keebler, Madi, Dwyer, Huckstadt, & Smith-Campbell, 2017). As a result, GPA is a commonly used benchmark that is included in admissions criteria for pre-licensure programs of nursing. In the NCAM, pre-nursing overall GPA is used as the measurement of prior academic performance.

Explanation of the Model

The NCAM (Figure 1) progresses in a time-ordered sequence from left to right. As current scholastic knowledge, critical thinking ability, and prior academic performance increase, there is an increase in nursing cognitive aptitude. As nursing cognitive aptitude increases, student academic success increases. In a review of the literature, the HESI A^2 exam was shown to be the best predictor of student performance (Manieri, DeLima, & Ghosal, 2015; Twidwell & Records, 2017). Therefore, the HESI A^2 composite score is the exemplar measure of current scholastic knowledge in the NCAM. Knowledge in seven domains are scored and, together, these have been shown to be reliable estimates of current student knowledge in the scholastic areas of reading comprehension, vocabulary, grammar, math, chemistry, biology, and anatomy and physiology. The Kuder-Richardson (KR) reliability estimate ranges between .90-.99 for the HESI A^2 composite score (Chen & Voyles, 2013; Yoho, Young, Adamson, & Britt,

2007). Higher HESI A^2 composite scores indicate an overall increase in the likelihood of student academic success throughout the nursing program (Chen & Voyles, 2013; Hinderer, DiBartolo, & Voyles, 2014; Underwood, Williams, Lee, & Brunnert, 2013).

Because the HESI A^2 standardized exam was used as the exemplar standardized admission exam, a critical thinking component add-on to the HESI A^2 exam was used as the exemplar for the critical thinking assessment. Other critical thinking assessments may be utilized depending on the preference of the nursing program faculties.

Despite the various limitations of GPA as a sole predictor of academic success, numerous studies support the use of pre-nursing overall GPA as a predictor of academic success within pre-licensure programs of nursing (Higgins, 2005; Schmidt & MacWilliams, 2011; Yin & Burger, 2003). GPA may reflect development of study habits that can contribute to academic success later (Patron & Lopez, 2011). Thus, pre-nursing overall GPA is recommended for continued inclusion as part of a comprehensive admission criteria as a measure of prior academic performance.

Discussion

The NCAM describes the role of the three elements of cognitive aptitude in predicting student success and how standardized exam scores, critical thinking assessments, and pre-nursing overall GPA can be used to increase the likelihood that the pre-licensure students who are admitted to the limited number of seats available in each program will be successful. Nursing cognitive aptitude can be measured by a combination of these variables as part of admissions criteria. Focusing on nursing cognitive aptitude is important because cognitive attributes have been more successful in predicting student success than non-cognitive attributes (Timer & Clauson, 2011).

Pre-licensure programs of nursing should go beyond the assessment of an applicant's current scholastic knowledge, critical thinking ability, and prior academic performance to embrace a holistic model of admissions. The general consensus is that nurses should demonstrate compassion, have strong advocacy skills and be clinically competent. However, upon graduation from schools of nursing and prior to entry into practice, there are no assessments for compassion, advocacy skills, or clinical competence. There is only the standardized licensure exam that assess cognitive metrics.

The scope of nursing practice requires higher level thinking that is foundational to quality and safe care. Appropriate clinical decision-making is a skill requiring all dimensions of cognitive aptitude. To capture this aspect of cognitive aptitude, schools of nursing could measure applicants' critical thinking ability. The NCAM serves to address this identified gap in the literature. The model represents a comprehensive guide for use of academic metrics which can be an important part of the holistic admissions process. The model explains how the critical concepts predicting student success and their associated measurements can guide admission decisions and increase the number of students demonstrating student academic success. Therefore, in addition to reducing attrition it may indirectly increase the number of nurses entering practice and/or graduate programs. The major limitation of this model is that it has yet to be empirically tested.

Conclusion

Nursing cognitive aptitude is a requisite characteristic for nurses to provide safe and competent care to clients. It is evident that higher level thinking skills such as critical thinking and clinical decision-making are essential for contemporary nurses. Cognitive proficiency of nurses is essential upon passage of the NCLEX-RN and entry

into practice to safe and quality care. At the same time, pre-licensure programs of nursing need to find ways to address attrition that is costly to the students, schools of nursing, and society. To that end, the most cognitively capable individuals must be selected to fill the limited number of seats available in pre-licensure programs of nursing. The use of standardized nursing admission exams that measure all salient elements of cognitive ability are excellent tools to assist in selecting the most capable students for the seats available. This model may serve as a useful guide in meeting that objective.

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Chapter Four

Julie Twidwell

The topic of the third manuscript consists of the findings of the dissertation work. This is an original quantitative research study on the use of the HESI A^2 with Critical Thinking exam when used along with overall pre-nursing GPA as a predictor of first semester baccalaureate nursing student academic success and retention in the nursing program. This is the last of the three manuscripts and presents the results of the dissertation original research project as a whole. This manuscript describes the problem of interest, the design, recruitment, data collection, and analysis procedures. The implication of this study for nursing education will be discussed as will the recommendations for further research. The manuscript has been submitted to the *Journal of Professional Nursing* and is currently under review.

Expanded Standardized Admissions Criteria and First semester Academic Success in Baccalaureate Pre-licensure Programs of Nursing

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Abstract

Pre-licensure programs of nursing must meet workforce demands by preparing a sustainable supply of Registered Nurses (RNs). One way to meet this demand is to reduce attrition rates due to academic failure. A nonexperimental, retrospective, complex association design study was conducted at a Midwest baccalaureate nursing program to determine if a relationship exists between current scholastic knowledge (HESI A^2 scores), critical thinking ability (HESI A^2 Critical Thinking score), and prior academic performance (pre-nursing overall GPA), and first semester student success. The Nursing Cognitive Aptitude Model (NCAM) served as the theoretical framework. Linear and logistical regression results indicated that critical thinking ability was the best predictor of satisfactory academic progression. Current scholastic knowledge, critical thinking ability, and prior academic performance were all predictive of first semester overall GPA. Critical thinking ability was predictive of course performance in all first semester nursing courses. This study supported use of the NCAM as a valid conceptual framework and the measure of current scholastic knowledge, critical thinking ability, and prior academic performance as predictive admission criteria. These results can help educators select applicants most likely to achieve academic success and reduce attrition, increasing the number of nurses entering the workforce.

Keywords: standardized admission exams, cognitive aptitude, student academic success, attrition

Introduction

The number of Americans aged 65 years or older are projected to almost double from 39.6 million in 2009 to 72.1 million by 2030 (Administration of Community Living, 2015), and concurrently, over half (55%) of the nursing workforce is approaching retirement age (American Associations of Colleges of Nursing [AACN], 2017). In 2017, approximately 27% of the nursing workforce indicated that they planned to retire in less than a year (American Mobile Nurses [AMN], 2017). These factors combined, place a great pressure on an already strained nursing workforce. As a result, the demand for registered nurses (RNs) is expected to grow by 15% between 2016-2026, with a demand for approximately 204,000 new RNs each year (Bureau of Labor Statistics, 2018; AMN, 2017) This growth exceeds the average growth in the healthcare industry (Bureau of Labor Statistics, 2018) and outpaces the recent numbers of new nurses actually entering the workforce.

Only 155,000 new nursing graduates entered the workforce in 2015 (Grant, 2016; National Council of State Boards of Nursing [NCSBN], 2016), which suggests insufficient numbers to meet the projected workforce demand. Pre-licensure programs of nursing serve as a primary source and a foundational component in ensuring that these workforce demands are met and graduates are ready for practice. Therefore, it is crucial that baccalaureate pre-licensure programs of nursing are able to identify the applicants who are most likely to be successful to meet anticipated healthcare needs.

State Boards of Nursing ensure the quality of pre-licensure programs and measure programmatic success through criteria such as academic circumstances surrounding attrition, graduation rates, and first-time pass rates on the National Council Licensure

Examination-Registered Nurses (NCLEX-RN). Programs are also regulated on the percentage of graduates who pass the NCLEX-RN on the first attempt by state boards (Missouri State Board of Nursing, 2013). However, before graduate nurses can attempt the NCLEX-RN, they must demonstrate academic success and be retained throughout the nursing program. The lack of program retention is a widespread problem with most attrition occurring during the first semester of the nursing program (Merkley, 2016; Newton & Moore, 2009). Research suggests that many nursing students who are unsuccessful during the first semester, may not have demonstrated the academic aptitude upon admission (Andrew, Salamonson, Weaver, Smith, O'Reilly, & Taylor, 2008; Jeffreys, 2007; Peterson, 2009).

With calls to increase diversity in baccalaureate pre-licensure programs of nursing, admission criteria assessing more holistic attributes of applicants such as volunteer work and the ability to speak a second language may be used (AACN, 2016; AAMC, 2013). Subjective information such as interviews and written essays may also be useful in determining the unique characteristics that an applicant may contribute to a nursing program (Bennett, Bormann, Lovan, & Cobb, 2018). While baccalaureate pre-licensure programs of nursing can utilize holistic admissions criteria processes that also include the evaluation of unique applicant attributes and experiences, academic metrics remain crucial components (Association of American Medical Colleges [AAMC], 2013).

By far the most common type of admission criteria focuses on measures of academic preparedness and current knowledge (Schmidt & McWilliams, 2011). Standard academic metrics for admissions often include cumulative grade point average (GPA), science course grades, number of repeated courses, overall grade trends, and standardized

admission exam scores (Scott & Zerwic, 2015). The single most common metric utilized for determining admission is overall GPA, which is typically used in combination with other criteria (Robert, 2018; Schmidt & McWilliams, 2011). Some studies have also found the science GPA to be a useful indicator of future student success (Patzer, Lazzara, Keebler, Madi, Dwyer, Huckstadt, & Smith-Campbell, 2017; Higgins, 2005). One issue with using both overall pre-nursing GPA and pre-nursing science GPA is that the overall pre-nursing GPA already encompasses the science GPA. This results in and even greater emphasis being placed on the performance of a few classes and potential issues with collinearity. Further, grade inflation which has been prevalent in nursing education can diminish the academic appraisal value of the GPA (White & Heitzler, 2018).

Using standardized nursing admission exams has gained popularity as schools of nursing seek an objective and consistent means of measuring cognitive ability. Multiple studies have shown standardized nursing admission exams to be valid in predicting student success (Chen & Voyles, 2013; Hinderer, DiBartolo, & Walsh, 2014; Knauss & Willson, 2013; Manieri, DeLima, & Ghosal, 2015; Newton, Smith, & Moore, 2007; Underwood, Williams, Lee, & Brunnart, 2013; Wokowitz & Kelley, 2010; Yoho, Young, Adamson, & Britt, 2007). Among the most commonly used standardized exams during the nursing program admission process are the Test of Essential Academic Skills (TEAS), the Health Education Systems, Inc. Admission Exam (HESI A^2), the Scholastic Achievement Test (SAT), the American College Test (ACT), and the National League for Nursing Pre-Admission Exam (NLN PAX-RN; Twidwell & Records, 2017). The HESI A^2 was the most frequently studied followed by the TEAS exam, with the HESI A^2

showing superiority in the prediction of student academic success (Twidwell &Records, 2017).

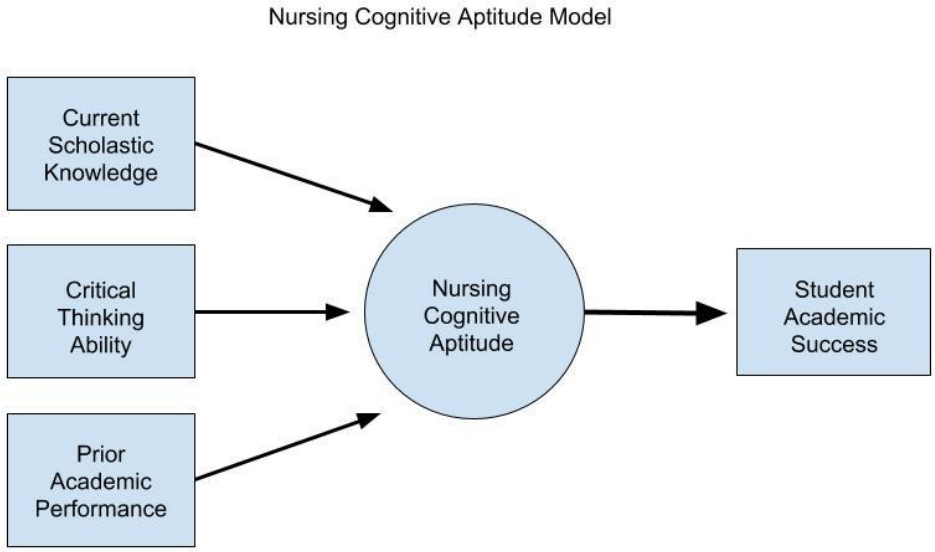
The utilization of standardized admission exams as admission criteria is not without critics. Some critics have expressed concern that standardized exam scores may be influenced by race and ethnicity (Marklein, 2009). Other critics have noted that women and older, non-traditional students may also be disadvantaged when it comes to standardized exams (Calvin, 2000). The standardized exam most frequently asserted in the literature as being biased against minority groups was the SAT (Calvin, 2000; Fleming, 2000; Nankervis, 2011). A search of the literature did not yield evidence of inequity or bias specific to nursing standardized admission exams such as the HESI A^2 or the TEAS exams.

Theoretical Framework

The Nursing Cognitive Aptitude Model (NCAM) served as the framework for this study (Figure 1). Central to the NCAM, is the latent construct of nursing cognitive aptitude. Nursing cognitive aptitude is defined as the degree to which the student demonstrates the capacity to learn and be successful in a baccalaureate nursing program and encompasses the measured concepts of current scholastic knowledge, critical thinking ability, and prior academic performance (Twidwell, Sanner-Stiehr, Allen, Records, & Hsueh, 2018). Current scholastic knowledge is a measure of general scholastic concepts such as math, reading, science (Anatomy & Physiology, Chemistry, and Biology), and English at the time of applying for admission into a baccalaureate program of nursing (Twidwell et al., 2018). This can be measured by the applicant's performance on a standardized nursing admission exam such as the HESI A^2 or the TEAS

exam. Critical thinking is the second concept that is measured within the NCAM. Critical thinking ability is the demonstration of higher-level thinking and discernment of thought, and problem-solving skills (Dewey, 1910; Fero et al., 2010; Lee, Lee, Bae, & Seo, 2016). Critical thinking ability can be measured by the performance on a standardized critical thinking assessment (Twidwell et al., 2018). A critical thinking component can be added to the HESI A^2 exam and could be offered as a separate assessment along with the TEAS exam. Last, prior academic performance is demonstrated through prior academic grades and can be assessed by measuring pre-nursing overall GPA (Twidwell et al., 2018). While pre-nursing GPA does not necessarily correlate with mastery of content and current scholastic knowledge (Lemke, Marx, & Dundes, 2017) because of grade inflation (White & Heitzler, 2018), it has been found to be reflective of study time, study habits, and academic orientation (Patron & Lopez, 2011).

Figure 1.
Nursing Cognitive Aptitude Model



Note: Circle represents latent construct of *Nursing Cognitive Aptitude*. Rectangles represent concepts. Arrows represent direct pathways. *Current Scholastic Knowledge* is measured by the observed variable HESI A^2 composite score. *Critical Thinking Ability* is measured by the observed variable HESI A^2 Critical Thinking component score (not a part of composite score). *Prior Academic Performance* is measured by the observed variable pre-nursing overall GPA. *Student Academic Success* is measured by the observed variables of minimum acceptable overall nursing GPA, minimum acceptable individual nursing course grades, and satisfactory academic progression. Copyright Julie Twidwell 2018.

The purpose of this study was to determine whether the utilization of an expanded set of admission criteria, in addition to GPA, may be a better predictor of student academic success. Instead of utilizing GPA as a single admission criterion, it was hypothesized that a more comprehensive measure of cognitive aptitude, as depicted in the NCAM, may yield more critical information regarding academic success. Three research questions guided the study. What is the relationship between:

1. current scholastic knowledge, critical thinking ability, and prior academic preparation and first semester student academic success in the BSN program?

2. current scholastic knowledge, critical thinking ability, and prior academic preparation and end of first semester baccalaureate overall grade average?

3. specific current scholastic knowledge content areas and critical thinking ability and final course grades in each individual first semester BSN course?

Methods

Design

The design for this study was nonexperimental retrospective with a complex associational approach. A complex associational approach is appropriate when the researcher seeks to discover whether a combination of several independent variables is more predictive of the dependent variable than any one of the predictors alone (Gliner, Morgan, & Leech, 2009). Sometimes referred to as the correlational approach, the associational research approach involves a specific investigation of two or more continuous variables for the same group of participants to determine if the variables are related or associated (Morgan & Harmon, 2000).

Setting

This study was conducted at one state university in Midwest region of the United States. The program requires 59 hours of general and prerequisite coursework prior to entering the baccalaureate pre-licensure program of nursing. Currently, the university only considers overall pre-nursing GPA and pre-nursing science GPA in selecting students for admission. This admission protocol has been in place for approximately 20 years. Based on issues with attrition rates occurring in the first semester (See Table 4), this study was conducted to determine if expanded assessment of cognitive aptitude upon admission would be useful in reducing first semester attrition rates by admitting more academically prepared students.

Table 4.
First semester Attrition Rates

Semester of Admission	First semester Attrition Rate (*N*=175)
Spring 2016	25%
Fall 2016	30%
Spring 2017	25%
Fall 2017	30%
Spring 2018	32%

Sampling and Subjects

This study used convenience sampling from all first semester baccalaureate nursing students admitted between the Fall of 2016 and the Spring of 2018. The inclusion criteria were: a) students newly admitted into the traditional undergraduate BSN program, b) at least 18 years of age, c) a pre-nursing minimum required GPA of 2.8, d) completion of the prerequisite nursing courses of Anatomy and Physiology I, Anatomy and Physiology II, Nutrition, Microbiology, Chemistry, and either College Algebra or an Introductory Statistics course, and e) completion of 59 college credit hours, which include the required prerequisite courses, before beginning the nursing program. The exclusion criteria were: a) students who have previously taken the HESI A^2 exam, or b) previous enrollment in the nursing program. Thirty-five students comprise each fall and spring semester cohort consisting of a fairly homogenous group of students with low representation of minority and ethnic groups, males, and non-traditional students. Ultimately, 124 subjects met inclusion criteria and agreed to participate. (See Table 5).

Table 5.
Demographic Characteristics

Characteristic Sample	Frequency (n=124)	Percentage(%) of Total
Gender		
Male	17	13.70
Female	107	86.29
Race/Ethnicity		
White	115	92.74
Black	4	3.22
Hispanic/Latino	4	3.22
Asian	1	0.80
Student Type		
Traditional	116	93.94
Non-traditional*	8	6.45

Note: Non-traditional student defined as being ≥ 25 years of age at time of admission

A priori power analysis was conducted prior to initiating the study using the G*Power application to determine minimum sample size. The sample size of 124 was sufficient to meet the minimum requirement of 85 subjects to achieve a moderate effect of 0.5, a power of 0.80, and an alpha of 0.05 (Faul, Erdfelder, Buchner, & Lang, 2009). Also, the sample was deemed adequate for this study using a multiple regression analysis to test prediction models with up to five independent variables using the criterion of 15-20 subjects per predictor (Siddiqui, 2013).

Subject Enrollment

Since this study involved the collection of data from human subjects, Institutional Review Board approval was obtained from Southeast Missouri State University, the setting for the study, as well as University of Missouri-St. Louis. The primary investigator (PI) met with all newly admitted students prior to the commencement of nursing courses. Students were informed regarding the type of data that would be

collected as well as the purpose for the study. They were informed that they would be assigned an identification (ID) number and that all data collected would be kept confidential. Participation was completely voluntary and their admission/progression throughout the nursing program was in no way impacted whether or not they participated and no matter their HESI A^2 scores. Interested students were asked to provide written informed consent which was obtained by the PI.

Measurement

Independent Variables. Three independent variables used in this study were concepts represented in the NCAM; *current scholastic knowledge, critical thinking ability, and prior academic performance*.

- *Current scholastic knowledge* was measured using either the HESI A^2 composite score or the individual subscores. The composite score was used for research questions #1 and #2 and is the average score of the following HESI A^2 subscores: anatomy and physiology; chemistry; math; vocabulary and general knowledge; and, reading comprehension. Each individual subscore demonstrating current knowledge in specific content areas was utilized in research question #3. The HESI A2 exam has a high Kuder-Richardson (KR) reliability score range of .90-.99 (Chen & Voyles, 2013; Yoho, Young, Adamson, & Britt, 2007). While other subcategories can be administered during the HESI A^2 exam, only the above categories were utilized in this study.
- *Critical thinking ability* was measured by the HESI A^2 Critical Thinking score providing a brief "snapshot" of critical thinking ability in situations encountered in healthcare settings. The total score is thought to be reflective of abilities in

four categories: problem solving, argument analysis, analysis of data, and biases and ethical dilemmas. The HESI A^2 Critical Thinking assessment can be an add-on component to the general HESI A^2 exam.

- *Prior academic performance* was measured by pre-nursing overall GPA in this study, which was defined as the grade point average calculated on a 4.0 scale from all completed courses taken prior to matriculation into the baccalaureate nursing program.

Dependent Variables. The dependent variables for the three research questions were various metrics of student academic success. The first research question investigated the relationship of the independent variables on *first semester student academic success*. Because attrition was an internal validity issue for this study, it was necessary to create a dichotomous dependent variable that measured whether the subject satisfactorily completed all first semester courses and was progressing into the second semester of coursework on schedule. This allowed measurement of performance and progression even if their end of first semester grade percentage could not be calculated due to attrition from the program prior to semester end.

- *First semester student academic success* was defined as being still enrolled in the program at the end of the semester, making satisfactory progress with a 75% or higher in all theory courses, a "pass" rating in the clinical course, and set to progress to the next semester of coursework as scheduled.

The second research question investigated the relationship between the independent variables and the end of first semester overall grade average.

- *End of first semester overall grade average* is the mathematical mean of all first semester nursing courses that grant a final percentage grade.

The third research question investigated the relationship between the independent variables and the final course grades in each individual first semester course.

- Fundamentals of Nursing Theory (NS371);
- Nursing Assessment Theory(NS372)
- Pharmacology Theory (NS373)
- Pathophysiology (NS374)
- Fundamentals of Nursing Clinical (NC371)

Data Collection

Subjects were tested in their natural academic setting in order to achieve high ecological external validity. The setting, procedures, and proctor for the HESI A^2 exams were held constant across all cohorts of students. Further, the exam was administered prior to the beginning of any nursing coursework that might have influenced performance. Data was collected after admission utilizing the existing criteria of overall and science GPA rankings. Data was also retrieved from the subjects' first semester grade reports which were accessed through the university's academic database. Pre-nursing overall GPA was also obtained from the university's academic database.

The method of data collection was primarily through the Elsevier's online secure database which contains the HESI A^2 exam composite scores, sub-scores for each content area, and critical thinking scores. Once the data was retrieved, subjects were only referred to by the case ID number. This allowed cross-reference between HESI score

information, program grades and, demographic information while protecting student confidentiality.

Data Analysis

After all data were entered into SPSS, descriptive statistics were analyzed. Frequency tables were reviewed and data was screened to ensure that all entries were logical and within appropriate ranges. One extreme case was removed due to invalid HESI A^2 scores.

Histograms, Q-Q plots, and scatterplots were analyzed to determine normality and linearity. All dependent variables exhibited some degree of negative skew. Therefore, reflective square root and log transformation were conducted which resulted in normal distribution of the variables. Z-scores were used to screen for outliers. Three cases were identified as having at least one outlier in the dependent variable. However, close review of those cases revealed that the outliers were indeed true scores and they were retained in the dataset. Multiple regression analysis was utilized when there were multiple independent variables and the outcome variables were continuous. Research questions that included a dichotomous dependent variable were analyzed using logistic regression analysis.

Results

Research Question #1: What is the relationship between current scholastic knowledge, critical thinking ability, and prior academic performance and first semester student academic success in the BSN program?

Binary logistic regression analysis was conducted to determine if the independent variables of current scholastic knowledge, critical thinking ability, and prior academic

performance predict whether or not the student was making satisfactory academic success at the completion of the first semester of coursework. Forward likelihood ratio method was used. The measures for current scholastic knowledge (HESI A^2 composite score), critical thinking ability (HESI A^2 Critical Thinking score), and prior academic performance (pre-nursing overall GPA) were entered into the model. Regression results indicated that only critical thinking ability was statistically reliable in distinguishing whether or not a student would achieve satisfactory academic success at the completion of the first semester coursework [$X^2(1) = 4.979$, p=.026, Nagelkerke's $R^2 = .06$, Exp(B) = 1.02] (See Table 6). The odds of successfully completing the first semester coursework increased by a factor of 1.02 on critical thinking ability. The model correctly classified 71.1% of the cases.

Table 6.
Regression Coefficient

	B	*Wald*	*df*	*p*	Odds Ratio
Critical Thinking Ability	.008	4.470	1	.029	1.02

Research Question #2: What is the relationship between current scholastic knowledge, critical thinking ability and prior academic performance and end of first semester baccalaureate nursing overall grade average?

To address this research question, multiple linear regression analysis was used to determine whether current scholastic knowledge (HESI A^2 composite score), critical thinking ability (HESI A^2 Critical Thinking score), and prior academic performance (pre-nursing overall GPA) were predictors of the end of semester overall nursing course grade average. Results indicated that the overall model significantly explained 40.6% of the

variance on overall first semester grade average by the three predictors of current scholastic knowledge, critical thinking ability, and prior academic preparation [R^2 = .406, R^2_{adj} = .390, $F(3,112)$= 25.508, p=<.001]. (See Table 7).

Table 7.
Multiple Linear Regression for Predictors of Overall First semester Grade Average

Predictors	β
Current scholastic knowledge	.332**
Critical thinking ability	.244**
Prior academic preparation	.346**
F	25.548**
R^2	.406
R^2_{adj}	.390

Note: * p=<.05; **p=<.001

Research Question #3: What is the relationship between specific current scholastic knowledge content areas and critical thinking ability, and final course grades in each individual first semester BSN course?

To address this research question, multiple linear regression was conducted to determine if a relationship exists between current scholastic knowledge content areas (HESI A^2 sub-scores of math, anatomy & physiology, chemistry, reading, and vocabulary) and critical thinking ability (HESI A^2 Critical Thinking score) and final first semester nursing course grades which are graded using continuous data. Beta coefficients and levels of significance are reported in Table 8. The first analysis was conducted with NS371 Fundamentals of Nursing Theory as the dependent variable while specific current scholastic knowledge content areas (HESI A^2 subscores) and critical thinking ability (HESI A^2 Critical Thinking score) were entered as predictor variables. The overall model

was significant explaining 33.5% of the variance [R^2 = .335, R^2_{adj} = .299, F(6,109)= 10.361, p=<.001]. Second, NS372 Nursing Assessment Theory was entered as the dependent variable while specific current scholastic knowledge content areas (HESI A^2 subscores) and critical thinking ability (HESI A^2 Critical Thinking score) were entered as predictor variables. The overall model was significant explaining 24.4% of the variance [R^2=.244, R^2_{adj} = .202, F(6,109)= 5.854, p=<.001]. Pharmacology Theory, NS373, was the third course analyzed and was entered as the dependent variables while specific current scholastic knowledge content areas (HESI A^2 subscores) and critical thinking ability (HESI A^2 Critical Thinking score) were entered as predictor variables. The overall model was significant explaining 19.2% of the variance [R^2=.192, R^2 adj=.148, F(6,109)=4.318, p=<.001]. Fourth, the NS374 Pathophysiology Theory course was entered as the dependent variable while specific current scholastic knowledge content areas (HESI A^2 subscores) and critical thinking ability (HESI A^2 Critical Thinking score) were entered as predictor variables. This model was also statistically significant explaining 19.6% of the variance [R^2=.196, R^2_{adj}= .152, F(6,109)=4.437, p=<.001]. Last, NC371 Fundamentals of Nursing clinical was entered as the dependent variable while specific current scholastic knowledge content areas (HESI A^2 subscores) and critical thinking ability (HESI A^2 Critical Thinking score) were entered as predictor variables. Once again, the model was significant explaining 24.3% of the variance [R^2=.243, R^2_{adj}= .202, F(6,109)=5.843, p<.001].

Table 8
Predictors of Final First semester Course Grades

Predictors	NS371 β	NS372 β	NS373 β	NS374 β	NC371 β
Current Scholastic Knowledge					
Math subscore	.160	.179	.196	.221*	.267*
Anatomy & Physiology subscore	.154	.117	.158	.200	.188
Reading subscore	.046	-.026	-.172	-.024	.001
Chemistry subscore	-.024	.002	.036	.017	.082
Vocabulary subscore	.267*	.200	.099	.030	.033
Critical Thinking Ability					
Critical thinking score	.247*	.254*	.252*	.200*	.323**
F	10.261**	5.854**	4.318**	4.437**	5.843**
R^2	.335	.244	.192	.196	.243
R^2_{adj}	.299	.202	.148	.152	.202

Note: * p= <.05; ** p=<.001

Discussion

The findings in this study support the Nursing Cognitive Aptitude Model and suggests that current scholastic knowledge, critical thinking ability, and a student's prior academic performance taken together are all significant predictors of overall student academic success during the first semester in the nursing program. First, the greatest predictor as to whether or not a student was still enrolled at the end of the first semester and would be progressing on into the second semester was critical thinking ability. Second, findings supported that current scholastic knowledge, critical thinking ability,

and prior academic performance were all predictive of first semester overall grade average. The order of influence of these variables on overall first semester GPA was prior academic performance, current scholastic knowledge, and critical thinking ability, respectively. Therefore, a student's study habits and their knowledge of general academic concepts at the time of admission into the nursing program are the greatest predictors of how high their overall GPA would be during their first semester in the program, followed by critical thinking ability. This was interpreted to indicate that prior academic performance, current scholastic knowledge, and critical thinking ability, in that order, were all predictors in overall first semester GPA for those students were successful completers of the first semester. However, critical thinking ability was the only significant predictor as to whether or not a student was retained at the completion of the first semester and would be progressing on to the second semester of coursework.

Further, all models investigating scholastic subscores and critical thinking scores as predictor variables were significant predictors of the end of first semester courses. Specifically, the vocabulary subscore was predictive of success in the NS371 Fundamentals of Nursing Theory course while the math subscore was predictive of success in NS374 Pathophysiology and NC371 Fundamentals of Nursing Clinical. Also noteworthy is that critical thinking ability was the only significant predictor that was related to success in every individual first semester courses. Critical thinking ability is linked to problem-solving skills and clinical decision making skills (Fero et al., 2010; Lee, Lee, Bae, & Seo, 2016), making it a crucial component to the success of nursing students. In that context, it is not surprising that critical thinking ability was determined to be the greatest predictor of student academic success in this study.

These findings are significant for pre-licensure programs of nursing because they illustrate the importance of assessing for various domains of cognitive aptitude, including critical thinking ability, upon admission. Academic metrics have been shown to be better predictors of student success than non-academic attributes (Timer & Clauson, 2011). This application of the NCAM model may help to explain why screening for the specific measures of current scholastic knowledge, critical thinking ability, and prior academic performance are useful criteria when considering admission into pre-licensure programs of nursing. The study addresses a gap identified in the literature not only by testing the NCAM model but with the addition of a critical thinking component along with standardized nursing admission exams and pre-nursing overall GPA.

This study has several identified strengths with the first being a high ecological validity. The study was conducted within the natural setting and representative of the overall general population of nursing applicants with regards to academic preparation. The inclusion and exclusion criteria helped to ensure internal validity. The HESI A^2 exam had sufficient KR reliability. Additionally, there has been prior research on the HESI A^2 exams providing a sound theoretical basis for the study. Last, the design and statistical analyses that were conducted were appropriate and the power of the study was sufficient to yield robust and valid results.

There are several limitations to the study. It was nonexperimental in design and utilized convenience sampling which may limit generalization of the study. Sampling error may exist as the sample was mostly homogenous in gender and ethnicity and may not hold true to more diverse populations. The subject pool was selected using specific admission criteria with minimum requirements which may not be the same as other pre-

licensure programs of nursing. There was also the potential for other internal validity threats that were not controlled for such as course delivery over the four different semester cohorts. History, in the form of other influencing factors such as study habits, time spent working outside of school, family demands, among many other potential variables may have also influenced results. Perhaps the most significant limitation is that this study only captures information about cognitive predictors of academic success. It does not control for other potentially significant variables such as student motivation, experience, study habits or other personal characteristics.

Therefore, further research is needed that includes minority populations. Additionally, since minimum nursing requirements for pre-licensure programs of nursing vary for pre-nursing GPA, prerequisite courses, and academic standing, further research should be conducted investigating the predictive ability of other student attributes. With a shift toward holistic assessment criteria, unique experiences such as prior healthcare experience, volunteer work, and speaking a second language would all add to the richness of the nursing workforce. Therefore, it would be useful for studies to be conducted to determine if these unique and valuable experiences may also contribute to the success of nursing students.

Conclusion

Baccalaureate pre-licensure programs of nursing must admit applicants most likely to be academically successful in order to meet workforce demands. The Nursing Cognitive Aptitude Model served as a model for measuring applicants' prior academic performance, current scholastic knowledge, and critical thinking ability during the admissions process. The measurement of these qualities have been shown to be valid

predictors of overall first semester nursing grade average, how successful a student will be in completing the first semester coursework, and whether or not a student will be able to progress into the next semester of coursework. In this study, critical thinking ability was a better predictor of student retention and progression while academic study habits and knowledge of general academic concepts predicted overall first semester GPA and how well successful students would perform. Academic metrics are not the only assessments that should be considered when considering an applicant for admission into a pre-licensure nursing program, but when they are used they must be valid predictors. By understanding the likelihood of an applicant's ability to successful in his/her nursing courses, pre-licensure programs of nursing can ensure better program outcomes and meet the workforce demands of the future.

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Chapter Five

Introduction

This chapter provides a brief review of the findings from each manuscript in this study. The findings are synthesized to provide insight for nursing education and the implications for admission processes are discussed. Recommendation are made for further research.

Overview of Findings

This study identified the problem of attrition from baccalaureate pre-licensure programs of nursing, particularly during the first semester. Attrition from pre-licensure programs of nursing is troublesome given the impending increase in demand for nurses in the workforce (AACN, 2017; Andrew et al., 2008; Jeffreys, 2007). One way pre-licensure programs of nursing can reduce attrition and increase the number of nurses entering the workforce is by selecting students during the admissions process who are most likely to be successful.

An integrative review of the literature demonstrated that while a variety of admission criteria are typically reviewed during the admissions process for pre-licensure programs of nursing, objective measures of current academic knowledge utilizing standardized admission exams are gaining popularity. Standardized nursing admission exams diminish the effects of grade inflation and provide a reliable and consistent measure of student academic abilities. Although various standardized admission exams are utilized, the HESI A^2 was not only the most frequently studied but it was also found to be the best predictor of student success (Twidwell & Records, 2017).

The NCAM was developed as an innovative model that can be used to guide the admissions process in pre-licensure programs of nursing. This conceptual model defined nursing cognitive aptitude as a products of the combined observed variables of prior academic performance, current scholastic knowledge, and critical thinking ability (See Figure 1). Prior academic performance was measured by pre-nursing overall GPA which was thought to provide an overview of prior study habits (Patron & Lopez, 2011). Current scholastic knowledge provided a snapshot of the applicant's level of

understanding of general academic concepts at the time of admission and can be captured through the scores of a standardized nursing admission exam such as the HESI A^2 exam. Critical thinking ability was the third construct assessed and can be measured using a standardized critical thinking assessment such as the HESI A^2 Critical Thinking exam.

This research study then tested the ability of the NCAM to predict first semester student academic success. The first research question investigated whether current scholastic knowledge, critical thinking ability, and prior academic performance were predictive of end of first semester academic success. End of first semester academic success was defined as having passing grades in all courses and making satisfactory progression into the next semester of the program. Critical thinking ability was the only significant predictor in the model in predicting end of first semester academic success. The second research question in the study investigated whether current scholastic knowledge, critical thinking ability, and prior academic performance were predictive of first semester overall grade average. The model was significant with prior academic performance, current scholastic knowledge, and critical thinking ability, in that order, predicting first semester overall grade average. The third research question investigated which specific current scholastic knowledge content areas of the HESI A^2 subscores of math, reading, chemistry, vocabulary, anatomy and physiology, along with the critical thinking score were predictive of each individual first semester nursing course. The vocabulary subscore was predictive of success in the Fundamentals of Nursing theory course (NS371). The math subscore was predictive in both the Pathophysiology (NS374) course and the Fundamentals of Nursing Clinical course (NC371). Interestingly, the

critical thinking score was predictive of student success in all first semester nursing courses.

The study's findings supported the notion that academic metrics remain crucial predictors of student academic success (Timer & Clauson, 2011). Pre-nursing overall GPA, the measure of prior academic performance, has long been used as a predictive admission criterion (Schmidt & MacWilliams, 2011). More recently, increasing weight is being placed on the use of standardized nursing admission exams as a measure of an applicant's knowledge of scholastic content (NLN, 2012). The findings from this study solidly demonstrated the importance of including a measure of students' critical thinking ability upon admission into the pre-licensure nursing program. While critical thinking ability is a quality that can be exercised and improved through education, it must be present upon admission to some extent in order for a student to demonstrate success (Yildirum & Ozkahraman, 2011).

This study's findings contributed to the field of nursing education in that it went beyond examining the ability of HESI A^2 scores alone to predict student success. This study introduced the NCAM as a conceptual model of the concepts that are measured using standardized exams and why they are often successful in predicting academic success. The implication from this study is that nursing education programs now have a model to guide the admissions process that can help promote student success while reducing attrition.

Admission criteria can vary significantly from one program to another. Pre-licensure programs of nursing are frequently searching for the best combination of admission criteria to ensure that the limited number of seats available are filled with

candidates who will most likely be successful. Predicting success is of interest to pre-licensure programs of nursing not only because they must address the needs of the nursing workforce but also because their program outcomes are continuously being monitored by regulatory and accrediting bodies.

Although the findings from this study support and validate the NCAM, further testing should be done. More research is needed to ensure that this model is generalizable to programs that may use other types of admission criteria. Further research needs to be conducted in programs serving primarily minority populations and diverse groups of students as the subject pool for this particular study was homogenous in ethnicity and gender.

Academic metrics remain a vital aspect of nursing admissions criteria. However, further studies are needed that evaluate how attributes that go beyond cognitive measures may be predictive of student academic success. The desirable qualities and behaviors of a nurse go beyond what he or she knows or thinks. In order to meet the workforce demands of today and predict the workforce needs of tomorrow, pre-licensure programs of nursing must continue to produce nurses who possess critical thinking and problem-solving skills.

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