

Running head: PREDICTING EARLY ACADEMIC SUCCESS

Academic and Non-Academic Factors as Predictors of  
Early Academic Success in Baccalaureate Nursing Programs

by

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## DEDICATION

“To God through whom all things are possible”

I wish to dedicate this manuscript to my family, whose constant support and love sustained me throughout the doctoral education journey and made this achievement possible. Their combined sacrifices and encouragement not only sustained me but inspired me through their love throughout this journey. I would like to more specifically dedicate this work to my husband, Patrick, and daughter Katie. Patrick not only provided support, but patience, love, and valuable proof-reading and sounding board services for working through ideas to clarity. Katie’s joyful presence and unflappable belief in me inspired me to persist to complete this endeavor.

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### Abstract

Nurses are in very high demand and this situation has placed an unprecedented call for faculty in higher education institutions to produce more graduates. With more students applying to nursing programs and a limited number of nursing slots available, admission to nursing programs has become increasingly competitive. Given these conditions, a trend toward increasing admissions standards has been noticed as program leaders and faculty struggle to institute some type of sorting method to select the applicants who are most likely to succeed in their nursing education programs. Entrance examinations have been increasingly used as a major part of admissions criteria for nursing programs with an assumption that high test scores on entrance examinations will correlate with program success. The purpose of this study was to examine selected academic and non-academic variables of first-term nursing major students to identify variables that correlate with early in-program success, and second, to compare the predictive efficiency between widely used nursing entrance tests (i.e., NET, TEAS, CCTST, ATI-CTT). This study was a retrospective, descriptive, and correlational investigation of 651 baccalaureate nursing students at a single study site. The researcher compiled data from academic student records to examine 18 independent variables for predictive correlation with the criterion variable of term-one success. The results of data analysis demonstrated that of the variables investigated, 43% to 48% of the variance in term-one outcome was predicted by these two main variables: pre-nursing grade-point average (GPA) and critical thinking test score. Nursing entrance test scores did not add to prediction of term-one success. Multiple regression analyses demonstrated stronger predictive efficiency with the model utilizing pre-nursing GPA and ATI Critical Thinking Test scores. The researcher also found significantly lower term-one

pass rates in minority, African American, and English-as-a-second language students. This area of investigation should be studied further. Additionally, by using results of this study, a model, the Early Academic Success (EAS) Prediction model, was developed for nursing leaders and faculties interested in investigating predictors of early academic success in their baccalaureate programs.

*Keywords:* baccalaureate nursing education, early academic success, nurse entrance examinations

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# PREDICTING EARLY ACADEMIC SUCCESS

## CHAPTER 1: INTRODUCTION AND BACKGROUND

Nurses are in very high demand, and this situation has placed an unprecedented call for faculty in higher education institutions to produce more graduates. The current and predicted nursing shortage has gripped the attention of the nation, as a critical public health concern as well as an economic concern (Michigan Center for Nursing, 2006; Nelson, 2002). In 2006 registered nurses (RNs) accounted for 2.3 million jobs nationally and were the largest group within the healthcare occupations. The employment growth rate for nurses has been projected to be 23%, generating 587,000 new jobs between 2006 and 2016, a faster growth rate than for all other occupations (U.S. Department of Labor, 2008). Additionally, the need for replacement nurses, resulting from retirements and nurses leaving the profession, is expected to create thousands of additional job openings. The total number of openings expected due to growth plus replacement needs is projected at 1.1 million jobs for registered nurses by 2012 (Michigan Center for Nursing, 2006).

In Michigan, healthcare is now the largest single employer, and nurses compose the largest single group of employed and licensed healthcare professionals. The ratio of active registered nurses to the population in Michigan is 921 nurses for every 100,000 people, with a rate of 85% active in nursing and 72% of those active being employed full-time (Michigan Center for Nursing, 2007). As noted in a number of reports, the growing concern about the impact of the nursing shortage on the health of the public has been addressed. Reports have shown that lower hospital ratios of RNs to patients result in poorer health outcomes achieved (Aiken, Clarke, Sloane, Sochalski, & Silber, 2002; Center for Health Workforce Studies,

2007; Joint Commission on Accreditation of Healthcare Organizations [JCAHO], 2002).

Not only has the essential contribution of nurses to public health been shown in national and statewide reports, but the contribution of nurses to the economy has also been highlighted. In the Coalition of Michigan Organizations of Nursing (COMON) report, *The Nursing Agenda for Michigan: 2005-2010, Actions to Avert a Crisis* (2006) the economic importance of nurses to the Michigan economy was summarized in the following manner:

Nurses are the largest licensed group of healthcare professionals, and have above average compensation. Therefore, each nursing position is worth a minimum of \$55,000 per year, and the 90,470 nurses working in direct patient care jobs in 2004 brought a minimum of \$5 billion into local and state economies. Each unfilled nursing position constitutes a substantial economic loss to local and state economies. The number of . . . vacancies statewide in 2004 was [estimated at] 12,000 to 14,000. This means that local and state economies have suffered a minimum estimated loss of \$660 million in [2004 alone]. (p.13)

The nursing shortage is complex and has many contributing factors. One such factor was a steady decline in nursing program enrollment from 1995 to 2000 (American Association of Colleges of Nursing [AACN], 2007; Buerhaus, Auerbach, & Staiger, 2007; Buerhaus, Staiger & Auerbach, 2000; Staiger, Auerbach, & Buerhaus, 2000). This trend was also observed in Michigan nursing program enrollments with the peak enrollment decline occurring in academic year 2000-2001 (Public Sector Consultants, 2001). This decline, in the face of increasing projected need for more nurses, attracted the attention of many citizens as well as policymakers. Seeking answers to this trend, in 1999 a group of researchers conducted a

study to analyze freshman trends in career choices. They found that half as many women were entering nursing programs as in the past and that less than 5% of freshman indicated nursing as one of their top career choices (Staiger, Auerbach, & Buerhaus, 2000). These researchers attributed the trend to expanded career opportunities for women in other fields and noted that as the potential pool of applicants to nursing programs declines, so does the pool of applicants with particularly high academic ability (Staiger et al., 2000).

In the fall of 2002, an 8% increase in nursing program enrollment was reported nationally (AACN, 2002). Some authors attributed this increase to “a call to service” following the terrorist attacks on September 11, 2001 (JCAHO, 2002; National League for Nursing [NLN], 2002). Data from subsequent years have shown a continued increase in applications to nursing programs with the number of qualified applicants exceeding college capacity to accommodate them (AACN, 2004; Joynt & Kimball, 2008; Klestzick, 2005; Tanner, 2004). Members of the NLN’s Board of Governors (NLN, 2005) noted that over 33,279 qualified baccalaureate applicants were denied admissions in 2005. In the American Association of Colleges of Nursing (AACN), *Annual State of the Schools 2007* report, the authors said that baccalaureate school enrollments had increased nationally with nursing programs receiving 168,468 applications. Of the 107,930 applications that met admissions criteria, 69,515 applications were accepted, yielding an overall 41.3% acceptance rate (AACN, 2007).

Similar admissions trends have been observed in Michigan baccalaureate programs. According to the 2006 Michigan Center for Nursing’s Report *Survey of Nursing Education Programs: 2005-2006*, collegiate nursing programs received 4,691 applications to fill a total of 1,874 approved admissions slots in the 2005-2006 academic year; 2,410 applicants met admissions criteria. Of these, 1,547 enrolled, leaving 863 qualified applicants (36%) not

enrolled. A number of reasons were cited for the inability to enroll these qualified students, with one such factor being a cap on enrollment. The Michigan Board of Nursing allocates the maximum number of students a program is allowed to admit, and program faculty must seek Board approval to increase their enrollment capacity (Michigan Board of Nursing, 2003). Other factors cited by nursing program faculty included lack of faculty, lack of clinical teaching sites, inadequate classroom/laboratory/technology facilities, and inadequate funding (Michigan Center for Nursing, 2006).

With more students applying to nursing programs and capacity limits placed on the number of nursing slots available in academic programs, admissions to nursing programs are becoming increasingly competitive. Given these conditions, a trend toward increasing admissions standards has been noticed as program leaders and faculty struggle to institute some type of ranking method to select the applicants who are the most likely to succeed in their nursing education programs.

### **Admissions Practices in Baccalaureate Nursing**

Although a gap exists in the literature about best admissions practices in nursing, some information can be derived from the nursing literature focused on educational outcome achievement. As with undergraduate admissions and admissions to graduate as well as professional programs, the specification of admissions criteria in nursing is aimed at identifying those students most likely to succeed in the program. Data commonly collected during the nursing admissions process include cumulative grade-point average (GPA); pre-requisite GPA; pre-requisite science course GPA; admissions test scores, which may include ACT® or SAT® test scores; admission essay or letter of intent; and additional test scores such as the Nurse Entrance Examination (NET), Test of Essential Academic Skills (TEAS),

Mosby Assess Test, and NLN Pre-Nursing Test. Grade-point average was noted as being weighted heavily by most researchers (Byrd, Garza, & Nieswiadomy 1999; Endres, 1997; Gallagher, Bomba, & Crane, 2001; Lewis & Lewis, 2000; Newton, Smith, & Moore 2007; Newton, Smith, Moore, & Magnan, 2007; Potolsky, Cohen, & Saylor, 2003; Spurlock, 2006; Uyehara, Magnussen, Itano, & Zhang, 2007; Yoho, Young, Adamson, & Britt, 2007).

Programs admitting students from high school often consider cumulative high school GPA and grades in college preparatory courses such as biology, mathematics, chemistry, literature, and language (Bolan & Grainger, 2003).

A paucity of published research exists on admissions factors correlating to early academic success in nursing programs. Most research has been centered on factors that predict final educational outcomes such as graduation and first-time pass rate on the nursing licensure examination. A review of this research will provide the context for further consideration of nurse entrance examination test validity and its contribution to predicting student early academic achievement.

### **Predictors of Student Success in Nursing Programs**

The success of a nursing program historically has been gauged largely by the respective program's student (first-time) pass rate on the National Council Licensure Examination for Registered Nurses (NCLEX-RN). Graduates of nursing programs must pass the NCLEX-RN to attain state licensure to practice as registered nurses; students who do not pass the NCLEX-RN cannot be licensed or work as a nurse. Since the NCLEX-RN focuses on entry-level practice knowledge, a nursing program's student pass rate on the test is considered a major indicator and a major student-outcome achievement of a program's effectiveness in preparing new nurses for entry into practice. In 2009 the National Council of State Boards of

Nursing reported an NCLEX-RN pass rate of 86.4% for first-time test-takers and a 55.9% pass rate for test repeaters (National Council of State Boards of Nursing, 2009).

Additionally, nursing programs are monitored by state boards of nursing and required to submit a self study every 10 years; moreover, their students' first-time pass rates on the licensing examination are also carefully reviewed on a yearly basis (Michigan Board of Nursing, *Administrative Rules*, 2003). If a program exceeds a failure rate of 25% for any one year, or 15% for any two to three years of compiled statistics, Board members will conduct a review of the program. Sanctions that can be placed on programs include the following: reduction or interruption of admissions, program termination, and/or withdrawal of state approval (Michigan Board of Nursing, 2003).

Given the importance of student success on the NCLEX-RN, numerous researchers (Beeman & Waterhouse, 2001; Collins, 2003; Crow, Handley, Morrison, & Shelton, 2004; Davenport, 2007; Haas, Nugent, & Rule, 2003; Mosser, Williams, & Wood, 2006; Hanks, 1999; Higgins, 2005; Nibert, Adamson, Young, Lauchner, Britt, & Hinds, 2006; Norton, Relf, Cox, Farley, Lachat, Tucker, & Murray et al., 2006; Seldomridge & DiBartolo, 2004; Wissmann, 2006) have examined factors that affect initial success on the NCLEX-RN Examination. In the following narrative, a review of research findings related to indicators predicting initial success on the NCLEX-RN will be presented and summarized. These data, along with research findings regarding predictive validity in undergraduate, graduate, and professional admissions testing, will establish the empirical basis for selecting the variables and methods of examination for the nursing admissions test validity component of this study.

In 2004 Seldomridge and DiBartolo examined the correlation of admissions grade-point average, specific nursing course test averages, and the number of "Cs" in nursing courses as

predictors of NCLEX-RN initial success. In this comprehensive study, Seldomridge and DiBartolo (2004) analyzed the NCLEX-RN success rate of 186 baccalaureate students; several factors were found to correlate with initial NCLEX-RN success. A statistically significant ( $p < .01$ ) pre-admissions factor that correlated with success was the student's pathophysiology course grade. "Within program" factors that correlated with success included test averages from medical-surgical nursing courses; moreover, students who earned no "C" grades in nursing courses had an initial pass rate on NCLEX-RN of 99.3%.

Last an exit examination, the National League for Nursing's Comprehensive Achievement Test for Baccalaureate Students (NLNCATBS), taken 2 weeks prior to graduation, was the strongest predictor ( $p = .000$ ) of NCLEX-RN outcome, accurately predicting success (94.7%) and failure (25%). When results of the NLNCATBS and pathophysiology scores were combined, the predictive power was 93.3% of successes and 50% of the failures (Seldomridge & DiBartolo, 2004).

In the nursing literature several factors have been identified as predictors of success on the NCLEX-RN. Entry grade-point average has been cited as correlating with NCLEX-RN success by several authors (Collins, 2003; Haas, Nugent, & Rule, 2003; Mosser, Williams, & Wood, 2006; Wissman, 2006). Grades earned in nursing courses and specific pre-requisite courses (i.e., pathophysiology and pharmacology) have also been identified as correlating with NCLEX-RN success (Collins, 2003; Mosser, Williams, & Wood, 2006; Nibert, Adamson, Young, Lauchner, Britt, & Hinds, 2006; Santa Ana College, 2003; Seldomridge & DiBartolo, 2004). Standardized nursing entrance examination test scores have also been analyzed as potential predictors of NCLEX-RN success, but only weak correlations resulted (Santa Ana College, 2003; Wissman, 2006).

Further areas that have received much attention are standardized nursing content mastery and comprehensive test scores, which have been shown to be significantly correlated to NCLEX-RN success (Bondmass, Moonie, & Kowalski, 2008; Jacobs & Koehn, 2006; Mosser, Williams, & Wood, 2006; Nibert et al., 2006; Norton, Relf, Cox, Farley, Lachat, Tucker, Murray, et al., 2006; Seldomridge & DiBartolo, 2004). Additionally, only one study was identified in which predictive validity between two NCLEX-RN predictor examinations was compared. In this study researchers examined the accuracy of the HESI Exit Examination and the Mosby Assess Test for predicting NCLEX-RN success in generic baccalaureate nursing students. Both tests proved to be predictive of NCLEX-RN success; however, the HESI Exit Examination was found to have “greater sensitivity, specificity, positive and negative predictive value, and test efficiency than the Mosby Assess Test” (Daley, Kirkpatrick, Frazier, Chung, & Moser, 2003, p. 390).

### **Predictors of Early Academic Success for Nursing Students**

Only two studies focused on predicting early academic success through the correlation of admissions criteria to early grades in the nursing program have been conducted. One of these studies examined baccalaureate nursing program students, and one study analyzed associate degree nursing program students.

Gallagher, Bomba, and Crane (2001) examined early academic success as part of a study on predictors of program success in an associate degree nursing program. Their sample was composed of 121 associate degree nursing students. The criterion for early academic success was the final grade in an early nursing course, NUR 101, with success defined as a grade of “C” (73.5) or better. Predictor variables included the Registered Nurse Entrance Examination (RNEE) composite score and sub-scores for reading comprehension and

mathematics. A single predictor model was used. The findings showed that the RNEE reading comprehension score was the only significant predictor that was positively correlated,  $r = .23$  ( $P < 0.05$ ), with early program success. By completing further analysis, Gallagher, Bomba, and Crane (2001) determined that a 50% probability of passing NUR 101 existed if the passing score on the reading comprehension test was 32 or better. These authors suggested further study of program admissions criteria for determining factors that correlate with student success.

One other study focused on factors that may be predictive of baccalaureate nursing students' early in-program achievement. In this study, Newton, Smith, Moore, and Magnan (2007) examined 164 students on two independent variables for correlation with early in-program achievement. Early in-program achievement (the criterion variable) was defined as grade-point average in four first-semester nursing courses. The predictor variables were scholastic aptitude and nursing aptitude. The investigators defined scholastic aptitude as pre-program final grade-point average (PGPA) in seven courses (anatomy, biology, biochemistry, chemistry, composition I, composition II, and physiology). Nursing aptitude was defined as the composite score on the Assessment Technologies Institute (ATI) Test of Essential Academic Skills (TEAS). Regression and correlation analyses were utilized. The main findings were that pre-admission GPA accounted for 15.4% of the variance in first-semester grades and that TEAS scores, when added into the model, accounted for 4.8% of the variance. The authors concluded that both pre-admissions GPA and TEAS test scores were valid predictors of early academic achievement and should be retained as useful program-admissions criteria (Newton, Smith, Moore, & Magnan, 2007).

Given the need for an increased number of nurses and the constraints on academic programs to increase enrollments rapidly, efforts should be taken to identify and retain current qualified students in nursing programs. Valid admissions criteria that aid in the selection of students most likely to succeed in the nursing program will be invaluable to program faculty in utilizing scarce resources effectively. Early academic success, in itself, has been found to be a predictor for future academic success. Selecting students who can succeed in academically demanding nursing programs and be prepared to pass the NCLEX-RN on the first attempt are immediate strategies that nursing educators can enact to address the nursing shortage.

### **Statement of the Problem**

The current and predicted nursing shortage has placed unprecedented pressure on nursing programs to increase enrollment. In response to this demand, nursing program faculty have developed policies to enhance the selection of qualified applicants. To date, most of the research on outcome achievement in nursing has focused on factors likely to predict first-time success on the NCLEX-RN. Few researchers have examined predictors of early in-program success. However, growth has occurred in the use of entrance examinations as a major part of admissions criteria for nursing programs with an assumption that high test scores on entrance examinations will correlate with program success. Examining the factors that may correlate with early in-program success and the effectiveness of predictor examinations in identifying students likely to succeed in the baccalaureate nursing program is a research imperative for nursing education.

### **Purpose of the Study**

The purpose of this study was twofold: a) to examine selected academic (GPA, Nursing Entrance Examination test scores, educational background, admissions type, enrollment status) and non-academic (gender, race, age) variables of first-term nursing major students at a selected four-year institution of higher education to determine if these variables correlate with early in-program success; and b) to compare the predictive efficiency between the Nursing Entrance Test (NET) and the Test of Essential Academic Skills (TEAS).

### **Hypotheses**

Based on the review of literature, the following hypotheses were formed and tested:

1. There will be no significant difference in grade-point average by educational background, enrollment status, or admissions status.
2. There will be no significant difference in achievement scores on nursing examinations by educational background, enrollment status, or admissions status.
3. There will be no significant relationship in term-one outcome by educational background, enrollment status, or admissions status.
4. There will be no significant relationship between term-one outcome and critical-thinking test score.
5. There will be no significant relationship between term-one outcome and pre-nursing cumulative grade-point average or nursing entrance test scores.
6. There will be no significant difference between the predictive efficiency of the NET, TEAS, or critical-thinking tests.

### **Research Design**

The research design incorporated descriptive, correlational, and retrospective elements. As Gall, Gall, & Borg (2005) pointed out, “Descriptive research involves the collection and analysis of quantitative data in order to develop a precise description of a sample’s behavior or personal characteristics” (Gall et al., 2005, p.180). In the descriptive portion of this study, the demographics and academic characteristics of upper division baccalaureate nursing students were described. Furthermore, a correlational approach was applied. Correlational research allows “researchers to determine not only whether a relationship between variables exists, but also the extent of the relationship between them” (Gall, Gall, & Borg, 2005, p. 219). The independent variables for this study were demographic variables, educational background variables, and academic variables. The dependent variable was term-one academic achievement. The independent variables were naturally occurring in the study population and have not been manipulated by the researcher; hence, the study design was non-experimental. A retrospective design was used, since only data from students who completed all term-one nursing courses were examined to ascertain the relationship of predictor variables on the outcome variable.

### **Significance of the Study**

The results of this research study contributed to understanding important factors that relate to nursing student early in-program success, an area that has been under-studied. Additionally, in this investigation, the researcher explored the predictive efficiency of two widely used standardized nursing program entrance examinations. In a systematic and comprehensive review of the literature, this researcher was unable to find published research related to a comparison of the predictive efficiency of these two widely used examinations.

The findings of this study add to the knowledge base of nursing education research as well as research in the field of higher education test evaluation and admissions practices.

Implications for higher education nursing program administrators are explored in the recommendations for practice section of this dissertation's final chapter.

### **Limitations of the Study**

In this study the researcher examined a selected number of academic and non-academic factors for possible correlation to first-term nursing course success or failure and subsequent progression in the nursing program. However, academic success can be influenced by many factors that were not the focus of this study such as life events, number of classes missed during the term, number of hours spent on assignments outside of class per week, number of hours worked per week, total number of credits enrolled in during the semester, role strain, and social support.

Another acknowledged limitation of this study is that the group of non-passers was a relatively small number of subjects, a factor that posed methodological problems in statistical analysis. Additionally, all subjects in this study were enrolled in an upper-division major nursing program at only one university. Therefore, these findings are not generalizable to other nursing programs.

### **Delimitations of the Study**

This study includes the following delimitations: a) student data from only one university were examined, and b) data were collected from student records over 11 specific semesters (i.e., Fall 2003, Winter 2004, Fall 2004, Winter 2005, Fall 2005, Winter 2006, Fall 2006, Winter 2007, Fall 2007, Winter 2008, and Fall 2008).

### **Definition of Terms**

The following section contains definitions for important terms utilized in this study:

Admissions Status: Either pre-nursing (PNUR) or nursing (NUR). Pre-nursing status includes students admitted to nursing prior to completion of pre-requisite coursework. Nursing status refers to students admitted to the nursing major who have completed all pre-requisite coursework.

Critical Seven Grade-Point Average: An average of the final grades achieved in the following pre-requisite courses: Anatomy and Physiology I and II, Microbiology, Pathophysiology, Chemistry 161, English I and II.

Critical-Thinking Test: One of two examinations that evaluate problem-solving cognitive skills (i.e., California Critical Thinking Test or ATI Critical Thinking Test).

Early In-Program Success: The successful completion of term-one nursing courses in which the student is enrolled with a cumulative grade-point average of 2.0 or higher (on a scale where 4.0 is the highest score).

Educational Background: Classification as either a transfer or first-time-in-any-college (FTIAC) student.

Enrollment Status: Part-time or full-time student.

First-Time-in-Any-College (FTIAC) Student: A student who has not completed college-level coursework at a college or university prior to admissions at the study institution.

Full-Time Student: A person enrolled in all four first-term nursing courses.

Grade-Point Average: Cumulative grade-point average prior to admissions to the nursing program.

Nursing Entrance Examination (NEE): NET or ATI examination.

Nursing Entrance Test (NET): A standardized examination provided by the Educational Resource Institute from which reports are prepared on attainment scores for reading, verbal comprehension, and mathematics along with a composite score.

Nursing Status: A designation for students who have declared a nursing major, completed pre-requisite coursework and been admitted to the nursing program.

Part-Time Student: A person enrolled in fewer than four first-term nursing courses.

Pre-Nursing Status: A designation for a student who has requested to major in nursing but is not yet formally admitted to the nursing program at the institution selected as the research site due to incomplete pre-requisite coursework.

Term-One Courses: The following four required courses for newly admitted nursing students: NUR 3030: Health Assessment; NUR 3060: Foundations of Psychosocial Care; NUR 3220: Introduction to Nursing Therapeutic Interventions; and NUR 3270: Introduction to Professional Nursing Seminar.

Term-One Outcomes: Successful completion of all term-one courses (passed), failure to successfully complete one or more term-one courses (failed), failing and withdrawal from one or more term-one courses (withdrew failing), passing and withdrawal from one or more term-one courses (withdrew passing). A cumulative grade-point average in the four term-one courses of  $\geq 2.0$  on a scale of 1.0 to 4.0, with 4.0 being the highest.

Test of Essential Academic Skills (TEAS): A standardized examination provided by the Assessment Technologies Institute from which attainment scores are provided for

reading, verbal comprehension, mathematics, and science, along with a composite score.

Transfer Student: A student transferring from another higher education institution and admitted to the nursing major at the site institution.

### **Organization of the Dissertation**

The dissertation is organized into the four following chapters: (a) literature review; (b) research methodology; (c) presentation and analysis of data; and (d) summary, conclusions, and recommendations for future research and practice. Following the final chapter of the dissertation, the author will provide a comprehensive list of references cited in the dissertation as well as copies of relevant documents germane to the research effort in the appendices.

Chapter 2, the review of literature, contains theoretical and empirical support for the study and all research variables. Previous research on college admissions testing practices and the predictive validity of undergraduate, graduate, and professional college admissions tests are also reviewed. Additionally, test validity theory, predictive validity theory, differential validity, and differential prediction theory are examined.

In Chapter 3, an in-depth presentation of the research methods, study population, data-collection procedure, instrumentation, and data-analysis procedures employed in this study is provided. Chapter 4 includes the findings of the study as well as data analysis and interpretations. Last, in Chapter 5 the researcher summarizes the study and presents relevant conclusions; in addition, recommendations for improving admissions practices in baccalaureate nursing programs as well as several viable suggestions for further research are provided.

## CHAPTER 2: LITERATURE REVIEW

The accountability movement in higher education, debate surrounding high-stakes testing, and fairness in college admissions are inextricably interwoven topics that are hotly contested issues in higher education today (Koretz, 2008; Linn, 2000; Zwick, 2002).

Although widespread adoption of admissions examinations for entry into nursing programs has occurred, little has been written about the “value-added-ness” of such high-stakes testing in nursing or its validity for determining admissions to nursing programs (Newton, Smith, Moore, & Magnan, 2007; Spurlock, 2006). Most of the nursing research literature to date has focused on the effect of in-program achievement variables on these two main outcome measures: a) graduation success and b) first-time pass rate on the registered nurse licensure examination (NCLEX-RN). Clearly, nursing faculty members and administrators must understand high-stakes testing and college admissions issues from the broader perspective of post-secondary education. They also need to utilize this knowledge to align nursing testing as well as admissions practices appropriately within the broader context of best practices in admissions testing, measurement, admissions decision-making, and accountability.

A review of literature focused on the accountability movement in higher education, the history of college entrance examination practices, and current debates in higher education admissions testing will be undertaken in the following sections of this chapter. This information will provide the context and rationale for the validity study of one institution’s nursing entrance examination practices.

### **The Accountability Movement**

The U.S. Department of Education's (2006) landmark and controversial report of the Secretary of Education's Commission on the Future of Higher Education, *A Test of Leadership: Charting the Future of U.S. Higher Education* included the importance of having greater accountability and transparency in higher education, stating:

To meet the challenges of the 21<sup>st</sup> century, higher education must change from a system primarily based on reputation to one based on performance.

We urge the creation of a robust culture of accountability and transparency throughout higher education. Every one of our goals . . . will be more easily achieved if higher education institutions embrace and implement serious accountability measures. (p. 21)

Currently, higher education's constituencies are demanding reliable evidence that supports policies as well as practices that validate the achievement of learning outcomes in higher education. Both at the national and state level, policy-makers are pressuring higher education's leaders to make a college education more accessible and to produce more graduates able to contribute to future economic growth that only members of a highly educated and skilled workforce can achieve in today's competitive global economy (Gladieux, Kings, & Corrigan, 1999; Miller & Oldham, 2006).

This utilitarian view of a college education has further fueled the accountability movement in terms of performance-based measures that are increasingly being mandated and linked to higher education funding (Dickeson, 2006; Miller & Oldham, 2006; Wellman, 2006). Alexander (2000) reported that "the growing movement to assess student learning and performance as another dimension of performance-based accountability, may continue to

push state governments . . . to couple formulaic funding levels with institutional and student performance standards” (p. 422).

According to Breland, Maxey, Gernand, Cumming, and Trapani (2000), staff members with the U.S. Department of Education reported that more high school students than ever before are seeking admissions to college, with a 31% increase since 1979. Further, 18 million students were enrolled in undergraduate programs in 2004 (Knapp, Kelly-Reid, Ginder, & Miller, 2008), with projections of over 20 million enrollees by 2017 (Hussar & Bailey, 2008). The increasing trend of high school students enrolling in college was recently confirmed in the 2008, *State of College Admission* report prepared by personnel with the National Association for College Admission Counseling (NACAC). This report documented a mean national college enrollment rate of 79.3% for graduating high school students in 2007.

Given these facts, college admissions can be expected to become increasingly competitive; and admissions policies as well as testing requirements will likely be increasingly scrutinized. Results of a survey conducted by Breland, Maxey, Gernand, Cumming, and Trapani (2000), sponsored by ACT, Inc., the Association for Institutional Research, The College Board, Educational Testing Service, and the National Association for College Admission Counseling, revealed that admissions standards in four-year institutions have increased, with over 90% of four-year institutions requiring college admissions test scores. In this survey, test scores were ranked second in importance in admissions decisions by college officials, while high school grade-point average or class rank was rated as the “most important factor in admissions decisions” (p. ix).

The ACT and the SAT examinations are both widely utilized as part of criteria examined by admissions professionals to predict an applicant's likelihood of academic success in college (Rigol, 1997). In fact, in 2008 more than 1.4 million students took the ACT examination, an increase of 9% in test-takers over 2007 (ACT, 2008b); the College Board reported that over 1.5 million students took the SAT examination, an increase of 8% in test-takers over 2007 (The College Board, 2008a).

The unfortunate news in college testing in 2008 was that on the ACT examination, only 17% of test-takers performed at the college-readiness level in all four subject areas. Test scores in the subject areas individually showed college readiness at 55% in English, 31% in algebra, 41% in social studies, and 23% in biology (ACT, 2008a).

Concerns about achievement and college readiness are not new and have fueled several studies as well as reports. In 2007 Achieve, Inc., published the report, *Aligned Expectations? A Closer Look at College Admissions and Placement Tests*; in this document the authors examined college admissions and placement tests for alignment with high school standards. The authors acknowledged that “only a minority of students are prepared for success in college . . . an alarming number [of high school graduates] are unprepared for college-level work . . . [and] 30 percent of first-year college students [must be placed] into remedial college course[s]” (p. 5). According to the U.S. Department of Education report (2008), *A Nation Accountable: Twenty-Five Years after A Nation at Risk* little progress has been made toward the benchmarks set by members of the National Commission on Excellence in Education in the earlier report produced by the U.S. Department of Education (1983), *A Nation at Risk*; however, U.S. high school students still fall behind in scoring at college readiness levels in mathematics and science and score well below their international peers.

Many consider the National Commission on Excellence in Education's (1983) report, *A Nation at Risk*, as the watershed report triggering the accountability and reform movement in the U.S. This report highlighted the importance of testing and shifted the focus of testing away from diagnosing of student strengths and weaknesses or achievement of minimum competencies. Instead, the authors of the report proposed higher benchmarks for achievement and the attachment of consequences to test scores (Koretz, 2008). The most recent 21<sup>st</sup> century reports have continued to demonstrate that testing remains a central element in assessment and accountability and that the results are used by policy-makers, not only as indicators of student achievement but also as indicators of overall educational system effectiveness, practices that remain hotly contested issues.

The American ideal of egalitarianism when applied to higher education access is laudable; but when capacity and resources are limited, a selection process is inevitable, as screening/choosing provides a means for distributing limited resources to highly qualified applicants. Because of this scarce resource model, many proponents of college admissions tests have argued that if test scores are not used, another less reliable measure will simply replace them.

### **Testing and College Admissions**

The tradition of the entrance examination as a criterion for admissions into college in the United States has a long and storied history. Most researchers agree that the modern era of admissions testing in America began in the early 1900s with the formation of The College Board. Organized by administrators at 12 elite northeastern universities, the Board members sought to develop a uniform test that could be applied at a variety of colleges in lieu of requiring applicants at each college to complete a unique college entrance examination with

limited reliability and validity (Linn, 2001, Zwick, 2002). This event led to the creation of the first standardized college-entrance examination, the Scholastic Aptitude Test (SAT), and later, to the development of an educational testing company known as the Educational Testing Service (ETS); for almost 50 years the SAT was the only standardized college admissions examination available (Zwick, 2002). According to ACT Inc., (2009) the SAT was considered by most academics to be a college-entrance test “that focused on identifying the most academically able students for admission to the nation’s selective universities” (p. 8). In 1959 the American College Testing (ACT) program was founded with the intent to serve “the remainder of students seeking entrance into college” (ACT, 2009, p. 10) and became the second standardized college entrance examination offered nationally (ACT, 2009).

Closely following the advent of undergraduate admissions testing, advanced tests for admissions to graduate school as well as professional schools were developed. The widely administered Graduate Record Examination (GRE) for applicants to a variety of graduate programs and the Graduate Management Admission Test (GMAT) for applicants to graduate programs in business are both administered today by the Educational Testing Service (ETS). The Law School Admission Test (LSAT) for applicants to law schools and the Medical College Admission Test (MCAT) for applicants to medical colleges are administered by ACT, Inc. (Zwick, 2002). The Psychological Corporation, a subsidiary of Harcourt Assessment (now Pearson Assessment) offers an alternative test, the Miller Analogies Test (MAT), that is accepted as an admissions examination by many graduate school leaders (Meagher, 2006). Additionally, the Psychological Corporation developed a professional

school admissions test, the Pharmacy College Admission Test in 1974 (PCAT; Meagher, Lin, & Stellato, 2006).

The common thread running through all of these tests is their intended use (i.e., to aid in the selection of students most likely to be academically successful). With the widespread adoption of entrance examinations for college and professional school admissions, testing has attracted the attention of researchers, educational professionals, members of advocacy groups, and public citizens. Central to the use of testing in college admissions is the debate over test validity and the ability of these tests to accurately predict college success. A review of college admissions decision-making models will be explored next, in order to establish the context for use of admissions testing and its “value-added-ness” to the college admissions process.

### **Decision-Making in College Admissions**

Criteria for admissions decision-making in U.S. colleges are almost as varied as the number of institutions nationally. Regardless, in examining testing and its importance in admissions decision-making, one must have an in-depth understanding of the current context in which college admissions decisions are made.

In a report of The College Board (2002a), *Best Practices in Admission Decisions*, these four distinct decision-making models used by most college officials were outlined: a) the eligibility-based model involves the evaluation of a student’s achievement of a minimum set of admissions criteria. Admissions to higher education is viewed as “a natural progression from high school and should be made available to everyone who is qualified” (p. 1); b) the performance-based model is attached to meritocracy and is driven by the philosophy that access to college should be a “reward for those most academically successful” (p. 1); c) the

student-capacity-to-benefit model supports the view that the role of higher education is “to seek out and nurture talent . . . and [to] promote social and economic mobility; and d) the student-capacity to contribute model, “should promote the greater good and further development of society” (p. 2) through a selection process “designed to meet the enrollment goals and unique organizational goals of the admitting institution” (p. 2). The authors of the report (2002a) noted that “although these philosophical models can be neatly outlined . . . they are not mutually exclusive” (p. 4). This report’s authors also suggested that admissions decision-making at a given college can vary from highly formulaic to more holistic. In addition, they opined that, traditionally, grade-point average (GPA) is widely assessed on incoming students because most predictive validity studies have focused on cumulative GPA at the end of the freshman year as an important criterion of college success.

In 2003, Rigol studied the formulas and procedures used for making admissions decisions at more than 100 U.S. colleges and universities. She noted that “where the numbers of applicants far exceed the number of available spaces, more complex, often multi-step, processes that employ both numbers and judgments” (Rigol, 2003, p. 11) are likely to be used. She reported that institutional personnel collected both academic and non-academic information in evaluating applications for admissions. The academic information was frequently constituted into an “academic index” that was usually based on a combination of GPA, class rank, test scores, rigor of courses taken, college pre-requisite coursework, and the number of advanced placement courses completed. Often, cut-scores (threshold criteria that the applicant had to meet) were utilized for academic criteria, such as “class rank – top 50% or minimum high school GPA 2.5 . . . minimum ACT 22 . . . minimum SAT 510 verbal and 510 math . . . admissions index of 90 or higher” (Rigol, 2003, pp. 43-44).

If a student met academic criteria, the application was accepted for consideration; at that point, these additional non-academic factors were examined: non-academic accomplishments; quality of the admissions essay; background characteristics; and personal qualities including leadership potential, creativity, or other areas deemed important by institutional personnel. Final decisions to admit were noted to be made in a variety of ways, but such decisions usually began with the sorting of applicants into admit, hold/waitlist, and deny groupings. Applications placed in the hold/waitlist or deny groups were often sent for further review either to a second admissions officer or an admissions committee.

In summary, Rigol (2003) noted that these data “confirm . . . the overall importance of traditional academic indicators and [the] increasing importance of essays, and [of] certain personal qualities, such as leadership and community activities” (p. 49). She encouraged institutional personnel to periodically validate their admissions process through “correlation studies to determine whether the admissions factors used are positively related to students’ academic performance” (p. 53). As seen in this current investigation, admissions application review goes beyond an examination of an applicant’s GPA and test scores. In fact, a number of other criteria are reviewed, and admissions application reviewers rate applicants several factors beyond GPA and test scores.

The quality and consistency of intra-reviewer reliability and inter-reviewer reliability in college admissions decision-making are also key elements in the fairness of the admissions decision-making process (Shaw & Milewski, 2004). Although intra-reviewer reliability was not a focus of this test-validity study, it is an important factor to note in the overall discussion of fairness in college admissions decision-making.

### **Admissions Testing and Validity**

Data used to determine an admissions decision are clearly the product of the types and quality of data collected. What is not collected cannot be evaluated – and what is collected may not be valid for all groups of applicants. This contention has given rise to much of the concern about fairness in college admissions decisions. When test scores are heavily weighted in admissions decision-making, the validity of these scores as predictors of academic success must be considered. A review of the current concept of validity in testing and current guidelines regarding use of tests as well as the concept of high-stakes testing will be explored next, as the implications of test fairness are further discussed.

The concept of validity will be introduced briefly in this section with further detailed discussion following when the conceptual framework for this test-validity study is described and analyzed. The accepted contemporary concept of validity was defined in the *Standards for Educational and Psychological Testing* (American Educational Research Association [AERA], 1999) as “the degree to which evidence and theory support the interpretations of test scores entailed by proposed uses of tests” (p. 9). Validity, in this context, is more than a property of a test; validity is a theoretical concept that derives from both score meaning and social values (Messick, 1995; Sawyer, 2007). When considering the validity of an examination used for college admissions, a test that is asserted to measure knowledge required or a pre-requisite to academic success in college should demonstrate that the test’s content measures foundational knowledge and correlates with the criterion, (i.e., college success; Sawyer, 2007). The ability of a test to predict college success must be carefully considered when a relative weight is assigned to college test scores.

The role and weighting of tests in college admissions has been addressed in several reports and has resulted in the issuance of a number of guidelines for the fair use of tests in college admissions (American Educational Research Association [AERA], 1999; The College Board, 2002b; Joint Committee on Testing Practices, 2004; National Association for College Admission Counseling [NACAC], 1995). In fact, the weighting of test scores and the consequences attached to the weighting designates a particular test as a high-stakes test. Members of AERA (1999) clearly defined college admission tests as high-stakes tests, stating “when significant educational paths or choices of an individual are directly affected by test performance, such as whether a student is . . . admitted or placed into a desired program, the test use is said to have high stakes” (p. 139).

Further, in describing the use of single test scores, the *Standards for Educational and Psychological Testing, Standard 13.7*, included this warning:

In educational settings, a decision or characterization that will have major impact on a student should not be made on the basis of a single test score. Other relevant information should be taken into account if it will enhance the overall validity of the decision (AERA, 1999, p. 146).

The Joint Committee on Testing Practices (2004); *Code of Fair Testing Practices in Education* also cautioned test users to:

Avoid using tests for purposes other than those recommended by the test developer unless there is evidence to support the intended use or interpretation . . . avoid using a single test score as the sole determinant of decisions about test-takers. Interpret test scores in conjunction with other information about individuals. (p. 9)

In the College Board's (2002b) *Guidelines on the Uses of College Board Test Scores and Related Data*, these statements were included. When:

College Board test scores are used for admissions purposes, the responsible officials and selection committee members should . . . view admissions test scores as . . . approximate indicators rather than as fixed and exact measures of a student's preparation for college-level work. Ensure that small differences in test scores are not the basis for rejecting an otherwise qualified applicant. Guard against using minimum test scores unless used in conjunction with other information . . . unless properly validated. [Institutions should] regularly validate data used in the selection process to ensure their continuing relevance. (p. 9)

Clearly, sponsors of admissions tests and psychometricians alike are cautioning test users about the inferences that may be made based on test scores. In other words, admissions officers are treading on dangerous ground if they make decisions such as these: admitting one college applicant over another because test scores are higher or using a test score to predict which applicant is the most likely to be successful in college. Testing professionals continue to assert that the vast amount of research on admissions testing for both undergraduate and professional colleges supports that admission tests a) are predictive of academic performance, b) provide "value-added-ness," and c) when combined with prior grades, prediction is enhanced and, therefore is, more beneficial than using grade-point average alone (Linn, 1990; Nobel, 2003; Sawyer, 2007; Zwick, 2002). These assertions represent a test's predictive validity.

### **Predictive Validity**

Predictive validity is defined as “how accurately test data can predict criterion scores. . . obtained at a later time” (AERA, 1999, p. 180). Many of the scholars who have conducted research on admissions testing have examined how well test scores and high school cumulative grade-point average predicts first year freshman cumulative grade-point average (Rigol, 1997). The statistical procedure typically used for a predictive validity study is regression analysis (Kuncel & Hezlett, 2007; Kurpius & Stafford, 2006). When regression analyses are performed, one product is the correlation coefficient (also called the validity coefficient). When a positive relationship exists between two factors, the correlation coefficient ranges from 0 to 1 and is an indicator of predictor effectiveness; 0 indicates no relationship, whereas 1 indicates a perfect relationship. The higher the correlation coefficient, the greater the relationship between the predictor and the criterion variable (Grimm & Yarnold, 1995; Zwick, 2002). Correlation coefficients are considered large when equal to or greater than .5, moderate when between .3 - .5, and small when less than .3 (Zwick, 2002). When more than one predictor variable is tested, multiple regression and correlation are used. Predictive accuracy is enhanced with use of multiple regression and is demonstrated statistically when the correlation coefficient increases incrementally as additional predictor scores are added to the prediction model (Grimm & Yarnold, 1995).

The following review of test validity theory, as well as predictive validity research in undergraduate admissions and graduate/professional school admissions, will provide a basis for comparison of current predictive validity research examining standardized testing in the field of nursing. Test usefulness in predicting academic success rests on sound logical argument, empirical evidence, and test validity theory. Test validity theory has evolved from

the earlier three-part conception of content, criterion, and construct validity to *validity* as a broader and unitary concept (AERA, 1999; Messick, 1995). This unitary concept covers all elements of test validity, including predictive validity and differential validity, in that test usage specifically the social consequences of testing are taken into account. In the following narrative the author will provide an overview of validity theory, integrating the classical test theoretical concepts of reliability, test bias, and predictive validity.

### **Validity**

Messick (1995) asserted that “Validity is an overall evaluative judgment of the degree to which empirical evidence and theoretical rationales support the adequacy and appropriateness of interpretations and actions on the basis of test scores or other modes of assessment” (p. 741). Proponents of the accountability and testing movement in higher education heavily weight the use of tests and performance-based measures in drawing conclusions about the performance of individuals as well as educational institutions. This being so, validation must apply not only to test construction based on measurement principles but also to score interpretation and social consequences. In the Facets of Validity Framework, Messick (1995) demonstrated a four-construct classification that encompassed the various components of evidence related to validity (Table 1).

Construct validity represents one form of evidence “for the proper interpretation of test scores” (Young, 2001, p. 2). Test validation experts agree that test validity studies are most concerned with construct validity (AERA, 1999). The following six aspects of construct validity exist: a) content, b) substantive, c) structural, d) generalizability, e) external, and f) consequential. These aspects represent forms of construct validity evidence. The content aspect of construct validity is the degree to which the content of the test is relevant as well as

representative and matches what it is designed to measure (Gall, Gall, & Borg, 2005).

Substantive refers to appropriate sampling of content supported by empirical evidence while structural refers to the internal structure of the test being consistent with known structural qualities of the measured domain. Generalizability relates to the degree to which content correlates with other measures of the same construct. External aspects deal with evidence (i.e., that score interpretation can be based on another measure). This factor represents the concept of *predictive validity* evidence, resting on demonstrated relationships between scores and criterion measures (Shepard, 1993). According to *Standards for Educational and Psychological Testing* (AERA, 1999), predictive validity is a type of criterion-related validity that “indicates how accurately test data can predict criterion scores that are obtained at a later time” (AERA, 1999, p. 180). Last, consequential validity refers to the evaluation of “intended and unintended consequences of test score interpretation and use . . . both long term and short term” (AERA, 1999, p. 746).

Table 1

*Messick’s Facets of Validity Framework*

	Test Interpretation	Test Use
Evidential Basis	Construct Validity	Construct Validity + Relevance/Utility
Consequential Basis	Value Implications	Social Consequences

Messick, S. (1995). Validity of psychological assessment: Validation of inferences from person's responses and performances as scientific inquiry into score meaning. *American Psychologist*, 50(9), 748.

Messick (1995) pointed out these two main threats to construct validity: construct underrepresentation and construct irrelevance. These considerations are important, particularly in the context of high-stakes testing. When a test contains construct

underrepresentation, it may be too narrow in scope to assess adequately the intended domain. If a test inadequately measures a domain, test-takers are disadvantaged and do not have an adequate opportunity to demonstrate knowledge or skill in a particular area measured. If construct irrelevance is present, content may be included that is not related to the construct, thus providing clues for some test-takers and inaccurately causing inflation in test scores. According to Brualdi (1999), irrelevant material may exist and pose a distraction, making the content more difficult for some test-takers, causing scores to be invalidly low, and encouraging erroneous assessments to be made about the test-taker. Not only must a test be valid, but it must also be a reliable measure of the construct assessed (AERA, 1999). Reliability will be discussed next.

### **Reliability**

Reliability refers to the ability of a test to measure a domain consistently (AERA, 1999). When a test is reliable, scores are reproducible on repeated measures (McDonald, 2007). Test reliability is related to validity in that a test cannot be valid without being reliable (Oermann & Gaberson, 2006). One measure of a test's reliability is the *standard error of measurement*, which is "the standard deviation of an individual's observed scores from repeated administrations of a test under identical conditions" (AERA, 1999, p. 182). A second measure of a test's reliability is the reliability coefficient, defined as correlations obtained between sets of test scores (AERA, 1999, p. 180). When a test is considered reliable, the reliability coefficient is .80 or higher (Gall et al., 2005). The *reliability* coefficient is specific to the test or measurement instrument and must be distinguished from the *validity* coefficient both practically and conceptually.

### **Validity Coefficient**

The complex study of predictive validity in admissions testing cannot be undertaken without a review of measurement principles anchoring such a study. The correlation of a predictor with a criterion variable yields the validity coefficient. The most common statistic used to report the validity coefficient is the Pearson product-moment correlation coefficient (McDonald, 2007). As Young (2001) pointed out:

For historical and scientific reasons, the most common approach used to validate an admission test for educational selection has been through the computation of validity coefficients and regression lines. [However] a cautionary note about interpretation of validity coefficients [must be understood, since] these coefficients are . . . calculated on only those individuals who are selected for admission, therefore values are based on a restricted [sample]. (p. 2)

The calculated validity coefficients have historically been the main indicators used for empirical evidence of a test's validity/predictive validity and for the comparison of a test's predictive validity across populations. Predictive validity of a test is defined as "how accurately test data can predict criterion scores . . . obtained at a later time" (AERA, 1999, p. 180). In addition, the following two important concepts are related to predictive validity and are at the center of the testing controversy: *differential validity* and *differential prediction*.

### **Differential Validity and Differential Prediction**

The theories of differential validity and differential prediction will be discussed next as test validation is further examined in the context of test bias and test fairness in college in the section of this chapter on admissions testing. Differential validity is present when a test is predictive for all groups, but validity coefficients are markedly dissimilar for different groups

(Young, 2001). Differential prediction occurs when the best prediction equations are different between different groups. Differential validity and differential prediction are related but do not always co-exist. When two or more groups are tested, differences between the predictor correlation and the criterion measure may be identified without differential prediction occurring (Young, 2001).

The prominent issue with differential validity and differential prediction is that when lower admissions selection rates occur for a group as a result of lower predictor scores, an adverse effect has occurred (Linn, 1984; Young, 2001). Another issue related to differential prediction is *misprediction*. Overprediction occurs when students do less well than predicted based on predictor scores, while underprediction means that students do better than predicted based on predictor scores (Rigol, 1997). For instance, when actual mean first-year GPA is over-predicted or under-predicted for a group based on predictor scores, misprediction has occurred (Cleary, 1968). In standardized testing for college admissions, differential validity and differential prediction have been found between groups on both undergraduate and professional school admissions tests (Kyei-Blankson, 2005; Linn, 1990; Mattern, Shaw, & Williams, 2008; Nobel, 2003; Pennock-Roman, 1994; Rigol, 1997; Young, 2001).

### **Group Differences in Prediction**

Most studies on test differential prediction have used whites as the reference group for racial/ethnic comparisons, males as the reference group for gender comparisons, and native English speakers as the reference group in comparing native versus non-native speakers (Young, 2001). Results of studies on gender differences have documented that women's first-year GPA was under-predicted in comparison to men's based on admissions test scores as the predictor (Kyei-Blankson, 2005; Linn, 1990; Pennock-Roman, 1994; Rigol, 1997;

Young, 2001). Differential prediction has also been demonstrated in studies focused on racial/ethnic group differences, with overprediction of college grades for all minority groups except Asian Americans (Kyei-Blankson, 2005; Linn, 1990; Nobel, 2003; Rigol, 1997; Young, 2001). Socioeconomic status (SES) has also been studied, and differences have been noted. When students were grouped by SES, lower SES correlated with lower standardized test scores (Mattern, Shaw, & Williams, 2008). For non-native English speakers, lower test validities have also been reported while results of the studies on predictive validity are mixed, with many showing underprediction of first-year grades for non-native English speakers (Abedi, Hofstetter, & Lord, 2004; Ramist, Lewis, & McCamley-Jenkins, 1994; Zwick, 2002). When testing scores are used as a main consideration in college admissions, test bias should be an issue of major concern for decision-makers.

### **Test Bias and Test Fairness**

Test bias has been described as “a multifaceted concept with many different meanings for both measurement specialists and non-specialists” (Linn, 1990, p. 309). In order to have fair test use, an examination must be free from bias, and this condition results when a test has different score meanings for different sub-groups (AERA, 1999). One area for focus of possible bias is test content. When a test item consistently measures a construct, test-takers with similar abilities should receive the same score on the tested item representing the construct. If score differences are noted on test items by sub-group, the item has *differential item functioning* (AERA, 1999; Gierl, 2005; Zwick, 2002). Differential item functioning (DIF) is a concept related to test construction for which statistical and review procedures have been developed. Proper test development should include procedures for the examination

of DIF. According to the *Standards for Educational and Psychological Testing* (AERA, 1999):

When credible research reports that differential item functioning exists across age, gender, racial/ethnic, cultural, disability, and/or linguistic groups . . . developers should conduct appropriate studies. Such research should seek to detect and eliminate aspects of test design, content and format that might bias test scores for particular groups. (p. 81)

Differential item functioning has led to the development of standardized statistical methods and analysis procedures for identifying DIF. These procedures include a) substantive analysis of test content, b) hypotheses generation for DIF, c) statistical analysis, and d) hypotheses confirmation (Gierl, 2005). A computer program, SIBTEST, can be used for statistical analysis of test items for DIF. In an article entitled *Using Dimensionality-Based DIF Analyses to Identify and Interpret Constructs that Elicit Group Differences*, Gierl (2005) explained the statistical procedure and utility of SIBTEST for the testing of the DIF null hypothesis.

Other explanations for differential prediction have been posed by researchers. In examining gender differences in the prediction of college freshman grades using SAT scores as the predictor, one explanation posed was that women engage in college majors traditionally associated with greater grading leniency than men (Pennock-Roman, 1994). Pennock-Roman (1994) studied this possibility and found that when college major was controlled for and grading leniency was corrected for, the underprediction of women's grades was reduced but not eliminated.

This explanation of course-taking patterns and grading leniency has also been posed as an explanation for differential prediction findings for overprediction of grades for minority students. However, as Linn (1990) pointed out, “Whatever the reason for the lower predictive validities and overprediction finding, it is important to recognize that inferences about the lack of bias . . . require assumptions that grades themselves are unbiased” (p. 311).

Users of tests for admissions must be cognizant not only of the overall validities of the admissions test being used but also the persistent differences in predictive validity across groups. The implications for admissions decision-making are numerous, and avoiding adverse impact for sub-groups is a social imperative.

### **Admissions Bias**

Admissions decisions may be increasingly subject to bias if selection criteria are based on biased predictors. From the theoretical framework provided by Messick (1995), the use of test scores, interpretations based on test scores, and ultimately decisions based on test scores must be empirically and theoretically grounded as well as derived from logical reasoning. Based on this review of literature, the researcher has identified substantial support for use of quantifiable admissions predictors. Such measures provide a common metric and can be subjected to rigorous statistical and hypotheses confirmatory testing.

However, initial academic preparation, as reflected in part by scores on standardized tests, is only one measure and may be subject to bias. The collection of other data relevant to and possibly indicative of the potential for academic success in college should be undertaken in the admissions process. Rigol (2003) found that faculty at many higher education institutions are beginning to add more factors to their review criteria to reduce bias in

admissions. These additional measures assess academic achievement potential as well as non-academic characteristics to determine the students' fit with institutional goals. Non-cognitive variables that may correlate with college success have also been explored. Sedlacek (2003) reported moderate to high correlations between scores on the Non-Cognitive Questionnaire (NCQ) and college grades in minority-group students and also noted some validity evidence for majority-group students.

Another measure utilized to control for bias in admissions is the practice of "adding points" to the admissions index or sorting for "special reading" of the applications from underrepresented minorities as part of the non-academic review of the application (Rigol, 2003). These practices have received public attention recently due to a number of high profile lawsuits.

In conclusion, based on this review, the investigator has established these two principles: a) factors which correlate positively with academic success should be identified; and b) when test scores are used as selection criteria, test bias must be examined (Kuncel & Hezlett, 2007). Predictors used for college admissions decisions should also be supported by documented evidence of their historic accuracy in initial admissions classifications (Sawyer, 2007). Additionally, establishing a set of predictors to increase the likelihood of unbiased admissions in selection can be accomplished by extending the predictor set beyond traditional measures to include new variables such as non-cognitive elements, admissions essays, and possibly portfolios (Linn, 2001; Rigol, 2003; Sawyer, 2007; Sedlacek, 2003).

### **Predictive Validity in Undergraduate Admissions Testing**

Numerous studies have been conducted on the predictive validity of the two major undergraduate college entrance examinations, the ACT and SAT. As summarized by Linn

(1990), the “typical study at the undergraduate level relies on freshman grade-point average as the criterion measure and reports correlations of test scores, high school grades or class rank, and multiple correlations for the combination of test and high school record” (p. 303). A summary of some of the major studies examining large numbers of students will be provided next as the empirical base/scientific foundation for admissions testing is further examined.

Nobel and Sawyer (2002) examined the effectiveness of the ACT composite score combined with high school grade-point average for predicting college freshman year-end GPA and the effectiveness of predicting GPA at various levels, ranging from 2.00 to 3.75. In their study the researchers examined data of 219,435 college first-year students from 301 postsecondary institutions during the 1996-97 academic year. The high school GPA was obtained from self-reports and represented the average grade-point from 30 college preparatory courses. The ACT composite scores were obtained from the ACT Class Profile History, and first-year grades were obtained from institutions participating in this study. Nobel and Sawyer (2002) found that both high school GPA and the ACT composite score were predictive of first-year grades. The high school GPA was more accurate than ACT composite at first-year GPA ranges of 2.00, 2.50, and 3.00. When a multiple predictor model was applied, ACT composite score plus high school GPA yielded a stronger prediction of first-year grades across grade-point averages than the single predictor models alone (Nobel & Sawyer, 2002).

In 2003 Nobel studied the effectiveness of ACT composite score and high school GPA models in making admissions decisions for students of differing racial/ethnic groups. The purpose of this study was to elucidate if a differential effect might occur in admissions

decisions based on racial/ethnic group affiliation when using ACT composite scores and or high school GPA. Data were analyzed in the following two groupings: African American/Caucasian-American and Hispanic/Caucasian-American. The African American/Caucasian American group consisted of 262,553 students at 43 postsecondary institutions, while the Hispanic/Caucasian American group consisted of 174,890 students from 25 institutions. This study represented institutions from southern, south-central, and Midwestern states rather than being representative of postsecondary institutions nationally. In this investigation, the correct admissions decision was defined as students who “would be admitted who were successful and students who would not be admitted who would have not been successful, had they been admitted” (p. 8). Nobel (2003) found that African American and Hispanic students had lower ACT composite scores and high school GPAs than did Caucasian-American students. After examining prediction models, the author noted that admissions decisions were biased in the selection of Caucasian-American students over students in other groups if high school GPA or ACT composite score was used as a single predictor; models using both ACT composite score and high-school GPA demonstrated more accurate admissions decisions and reduced differences between racial/ethnic groups (Nobel, 2003).

Similarly, large studies of SAT scores and high school GPA as well as their effectiveness in predicting first-year college grades have been conducted. An early meta-analysis conducted by Bejar and Blew (1981) explored SAT scores and high school GPA trends over 15 years. Their purpose was to ascertain if grade inflation had occurred and, if so, how this situation might affect the prediction of college first-year grades when high school GPA alone was used as a predictor of first-year college GPA as compared to SAT scores plus high

school GPA. The analyses were conducted on previous studies from the College Board Validity Study Service. Mean GPA was examined for each incoming freshman cohort along with mean SAT verbal and mathematics scores; then these data were trended longitudinally. Bejar and Blew (1981) found that mean GPA, both high school and freshman year college grades increased over time. However, SAT verbal and mathematics scores did not and, in fact, declined. Due to these findings, the authors concluded that grade inflation was evident, thus causing a restriction in range for GPA that they asserted may cause the validity of GPA as a predictor for first-year college GPA to decline in the future (Bejar & Blew, 1981).

Additionally, correlations of high school GPA with first-year college GPA were found to range from .41 to .48 for males and from .46 to .57 for females (Bejar & Blew, 1981). When the incremental contribution of SAT scores beyond the predictive power of high school GPA was examined, the contribution ranged from .05 to .09 for males and .06 to .11 for females, with the highest correlations being seen in data from 1974 to 1978 (Bejar & Blew, 1981). The multiple correlations of SAT verbal score, SAT mathematic score, and high school GPA ranged from .50 to .55 for males and .55 to .65 for females. In this study, prediction of first-year grades in college remained most strongly predicted by high school grade-point average, however, SAT scores added incremental predictive power (Bejar & Blew, 1981).

In 1994, Pennock-Roman reported the results of a study on SAT scores and their correlation to college grades in certain college majors, with a focus on differential prediction by gender. Data were collected at these four types of postsecondary institutions: a public university in Texas, a private university in Massachusetts, and two universities (one public and one private) in California. The following four categories of college majors were studied: a) physical sciences/engineering, b) biological/health sciences, c) humanities/prelaw/social

sciences, and d) business/education/communication/home economics. Regression models were examined using college majors controlled for and not controlled for. The predictor variables were high school GPA, SAT verbal score, SAT mathematics score, gender, and category of major. The criterion variable was college GPA. The standard regression models were: a) high school GPA + SAT verbal score + SAT mathematics score + gender without major controlled for, and b) high school GPA + SAT verbal score + SAT mathematics score + gender, with major controlled for. Additionally, several single predictor models and various multiple predictors were compared.

Pennock-Roman (1994) found that when using a single predictor model, SAT test scores, particularly SAT mathematics scores, overpredicted college grades for males and underpredicted college grades for females even after controlling for grading leniency through a classification system of students by college major. Overprediction in this context meant that the actual GPA was lower than predicted based on test scores, while underprediction meant that the predicted GPA, based on test scores, was less than the actual GPA. Further results of this study showed that when results were examined by race/ethnicity for women, African American females showed the greatest underprediction of college grades, while Asian American females showed the least underprediction of college grades. The investigator concluded that differential prediction and differential validity should be studied further (Pennock-Roman, 1994).

In a review of SAT predictive validity studies, Rigol (1997) reported that the median correlations found in College Board validity studies overall demonstrated a correlation of .42 for SAT verbal and mathematics scores on first-year college GPA, .48 for high school GPA alone, and .55 when SAT scores were combined with high school GPA. The average

incremental value of the SAT was .10 to .15 over high school grade prediction on first-year college GPA alone. Rigol (1997) acknowledged that differential prediction exists in SAT predictive validity studies by gender, racial/ethnic, and English-as-a-second language groups. Rigol (1997) noted that many of these studies have utilized a single prediction model of SAT scores alone or SAT scores in combination with high school GPA. Moreover, according to Rigol (1997), researchers have shown consistent underprediction of women's college grades and those of English-as-a-second language students' college grades, while overprediction of college grades based on test scores has been documented for males, African-Americans, Hispanic, and American-Indian students. Rigol (1997) concluded that when course selection (grading leniency) is taken into account, over- and underpredictions can be reduced or eliminated for all groups.

In a comprehensive review by Young (2001), differential validity and differential prediction were examined further through a review of more than 49 published studies spanning over 25 years. Included in Young's (2001) review were studies of ACT and SAT test scores along with other predictors of first-year college GPA. Young's (2001) main conclusions were the following: a) the predictive validity of the ACT and SAT examinations are similar; b) group differences in prediction and validity do exist; c) test scores consistently under-predict college grades for women; and d) test scores consistently over-predict college grades for minority groups (except for Asian Americans). Young (2001) suggested that further study of additional factors beyond and within group, such as geographic location, socioeconomic status (SES), native language, and broader classifications of ethnicity warrant additional investigation.

Young (2001) also noted that socioeconomic status may play a substantial role in students' standardized college examination scores. Socioeconomic status and its relationship to SAT test scores were recently examined in a College Board research report by Mattern, Shaw, and Williams (2008). These researchers studied data from 1.5 million students who took the SAT in 2007. Correlations were computed between the following measures: a) SAT mean score for mathematics, critical reading, and writing; b) self-reported high school grade-point average; c) self-reported high school rank; and d) SES, as measured by father's education, mother's education, and combined household income.

Total group data analyses showed that SAT scores and SES were moderately correlated, with correlation coefficients ranging from .30 to .37. However, when data were pooled and analyzed within group for high schools rather than across high schools, correlations between SAT scores and SES dropped, ranging from .16 to .24. Correlations between high school GPA and SES were .13 to .20 (Mattern, Shaw, & Williams, 2008). This research documented that the variability between high schools and the increase in correlation coefficients may be due to uncorrected statistical artifacts or unidentified moderators. Nevertheless, SAT scores were still seen to be more highly correlated with SES than that of high school GPA or high school rank. Unquestionably, further study is needed on the relationship between SES and college entrance examination test scores (Mattern, Shaw, & Williams, 2008).

Studies of predictive validity of college entrance examinations have shown that substantial evidence exists that college tests provide some information regarding future academic performance in college as measured by first-year college grade-point average. However, substantial concern remains about the inappropriate use of single examination

scores in making college admissions decisions. Additionally, based on the empirical evidence, particular concerns exist about how effectively college entrance examination scores inform the prediction of academic success in college for women, minority groups, and English-as-a-second-language students.

As stated previously, all admissions testing has a common, single purpose, namely the identification of students most likely to be successful in college. Historically, leaders of professional programs and graduate studies have similarly searched for a measure to aid in the selection of the students most likely to succeed in graduate studies or in a particular professional field. In the following section, the writer will provide a review of admissions testing for entrance into professional programs and graduate studies. This information combined with the review of undergraduate admissions testing will provide the basis as well as a broad overview of testing in college admissions necessary to properly situate the issue of admissions testing for nursing programs in today's postsecondary environment.

### **Predictive Validity in Professional/Graduate School Admissions Testing**

Personnel in graduate and professional programs are similarly confronted with the need to assess students' ability to succeed in post-baccalaureate education. Due to the academic rigor, limited capacity, and competitiveness of graduate education, admissions decisions are carefully made and include a comprehensive review of multiple factors, including standardized test scores. In the narrative that follows, recent predictive validity studies of prominently used entrance examinations for graduate and professional programs will be reviewed. A concern regarding graduate and professional program standardized entrance examinations is the "value-added-ness" component of these test scores over undergraduate GPA and other scholastic as well as background data examined for admissions decisions.

The predictive validity of these tests is an issue of concern for graduate education students, faculties, and administrators and, thus, has been widely studied.

Kuncel and Hezlett (2007) provided a review and synthesis of studies of commonly administered graduate and professional program standardized tests. This analysis included reviews of 3 to 1,231 studies of 244 to 259,640 students. The studies focused on the correlation between graduate and professional program test scores and student success measured in a variety of ways including first-year GPA and graduate-program GPA. Tests reviewed in Kuncel and Hezlett's (2007) study included these: the Graduate Record Examination (GRE), the Law School Admissions Test (LSAT), the Medical College Admissions Test (MCAT), the Pharmacy College Admissions Test (PCAT), the Miller Analogies Test (MAT), and the Graduate Management Admissions Test (GMAT). Their review demonstrated that standardized test scores were positively correlated with the criterion variable of student success. The following primary conclusions were drawn:

- 1) standardized tests are effective predictors of performance in graduate school,
- 2) both tests and undergraduate grades predict important academic outcomes beyond grades earned in graduate school,
- 3) standardized admissions tests predict most measures of student success better than prior college academic record, and
- 4) the combination of tests and grades yields the most accurate predictions of success. (Kuncel & Hezlett, 2007, p. 1080)

Additionally, these researchers concluded that, unlike undergraduate admissions tests, graduate and professional program admissions test do not underpredict performance of women in graduate school (Kuncel & Hezlett, 2007).

Kyei-Blankson (2005), in a doctoral dissertation research study, explored the predictive and differential validity of the MCAT using 3,187 students from 14 medical schools, and this author's findings were similar to those of Kuncel and Hewlett (2007). According to Kyei-Blankson (2005), MCAT test scores a) were good predictors of first-year grades; and b) when test scores were combined with prior (undergraduate) GPA incremental improvement in the prediction of first-year medical school GPA was demonstrated. However, in contrast to Kuncel and Hewlett (2007), the results of Kyei-Blankson's dissertation research demonstrated that differential prediction did exist, with underprediction of medical school grades for whites and overprediction of first-year medical school grades for African American and Hispanic students. Validity coefficients for the combination of MCAT sub-test scores plus undergraduate GPA ranged from .29 to .69 (Kyei-Blankson, 2005).

Meagher, Lin, and Stellato (2006) reported findings of a predictive validity study of the PCAT. Students from 11 colleges/schools of pharmacy were involved in this study. The predictor variables were PCAT test scores, pre-program cumulative GPA, and pre-program mathematics/science GPA. The criterion variables were pharmacy program cumulative GPA for years 1 – 4 and student status after year 4 of the program (i.e., graduated with BS, graduated with PharmD, withdrew, or still enrolled). The research methodology included multiple correlation and regression analyses, discriminant analyses, and diagnostic accuracy analyses. The main findings were a) entering cumulative and mathematics/science GPA correlated most highly with first-year grades and subsequent grades; b) PCAT composite

scores when combined with entering cumulative GPA provided incremental predictive value over GPA; and c) decreasing correlations were demonstrated over years 2 – 4 in the program, likely owing to the restricted range for the GPA. Discriminant analyses and diagnostic accuracy were proposed as a means of arriving at more accurate admissions decisions. Differential prediction was not addressed in this study (Meagher, Lin, & Stellato, 2006).

A large scale meta-analysis of the PCAT's validity was conducted by Kuncel, Crede, Thomas, Klieger, Seiler, and Woo in 2005; they found similar correlations between PCAT scores and students' GPA for years 1 – 3 in the pharmacy program. The strongest correlations were noted between PCAT scores and first-year GPA. In their analysis, the researchers also examined the correlation of PCAT scores to sub-scales of the pharmacy licensing examination and demonstrated stronger correlations between the PCAT scores and sub-scales of the pharmacy licensing examination than between pre-pharmacy program GPA and subscales of the pharmacy licensing examination (Kuncel, Crede, Thomas, Klieger, Seiler, & Woo, 2005).

In a local validation study of the PCAT, Kelley, Secnik, and Boye (2001) examined PCAT scores of 360 students in The Ohio State University (OSU) College of Pharmacy to determine the ability of the PCAT to predict academic success in the OSU pharmacy program. Predictor variables included pre-pharmacy program GPA and PCAT composite score; the criterion variable was first quarter pharmacy program GPA. Similar to prior studies, Kelley et. al. (2001) found the strongest predictor of pharmacy program GPA to be the combination of PCAT composite score and pre-pharmacy GPA. Additionally, Kelley et al. (2001) found that a PCAT composite score below the 40<sup>th</sup> percentile correlated with a first-semester GPA of less than 2.00. Kelley (2001) concluded that the PCAT is a valid

predictor of first-quarter grades in this local setting (i.e., OSU) and that students who score below the 40<sup>th</sup> percentile warrant careful attention for admissions. However, the author cautioned against utilizing a cut score for admissions decision-making, stating that “one piece of data gathered by a one-day test should not function as the sole determinant or gatekeeper to the profession of pharmacy” (Kelley et al. 2001, p. 230).

Another professional school entrance examination is the GMAT. A meta-analysis of the predictive validity of the GMAT for determining student performance in business school was conducted by Kuncel, Crede, and Thomas in 2007. In this study the researchers examined data from 64,583 students at more than 402 different institutions. Similar to the results of other studies of professional school entrance examinations, their analysis confirmed that: a) GMAT scores positively correlated with undergraduate GPA in business programs; b) pre-program GPA combined with GMAT scores provided stronger correlations to students’ business program first-year grades; and c) GMAT sub-scores on verbal and quantitative scales were superior to undergraduate GPA alone in predicting graduate school performance. Differential prediction based on gender, part-time versus full-time status, type of undergraduate major, and English-as-a-second-language was also examined; and no prediction differences were found (Kuncel, Crede, & Thomas, 2007).

Two major standardized tests used for admissions testing in graduate school are the Graduate Record Examination (GRE) and the Miller Analogies Test (MAT). In completing the discussion of admissions testing for graduate and professional school, empirical evidence for predictive validity from these two widely used tests will be explored next.

Graduate Record Examination scores have been reported to be required by as many as 93% of doctoral programs and 81% of master’s programs nationally (Kuncel, Hezlett, and

Ones, 2001). In a meta-analysis Kuncel, Hezlett, and Ones (2001) explored the predictive validity of the GRE for graduate school admissions. In this study the researchers examined several predictor variables (i.e., GRE verbal/quantitative/analytical/subject test scores, undergraduate GPA) on multiple criterion variables, representing graduate school performance (i.e., first-year graduate school GPA, comprehensive examination scores, faculty ratings, number of publications, number of times publications are cited, degree attainment, and time-to-degree completion). Differential prediction for non-native English-speaking and nontraditional graduate students was also explored (Kuncel & Hezlett, 2007).

The main findings of this study were that a) the GRE verbal, GRE quantitative, GRE analytical, and GRE subject tests were valid predictors of overall graduate GPA, first-year graduate GPA, comprehensive examination scores, number of publications cited, and degree attainment; b) GRE subject tests were better predictors of all criteria; c) validity coefficients of undergraduate GPA, GRE verbal, GRE quantitative, GRE analytical on graduate performance criterion were very similar; and d) validities for non-native English speaking students were similar to native English-speaking students.

In summary, these researchers argued that low correlations reported in previous validity studies of the GRE were likely due to statistical artifacts of restricted range and sampling error. They concluded that the GRE provides incremental validity over undergraduate GPA alone. When incorporated as part of a set of predictors for graduate school student selection, such use should increase the identification of successful students, particularly in highly selective programs (Kuncel & Hezlett, 2007).

The second most widely used graduate school admissions test is the Miller Analogies Test (MAT). In use for over 70 years, the MAT was designed to measure cognitive abilities

considered to be critical to successful performance in graduate school and “is often used as an alternative to the GRE” (Meagher, 2006, p. 11) by graduate school officials for admissions decisions. A recent meta-analysis of the predictive validity of the MAT for graduate school performance was conducted by Kuncel, Hezlett, and Ones in 2004. In this research study the MAT was examined as a predictor for both academic-outcome criteria and work-related outcome criteria. These researchers also examined correlations of the MAT to the GRE in predicting academic outcomes (Kuncel, Hezlett, & Ones, 2004).

The following summary of the main findings is restricted to academic outcomes consistent with the focus of this broader discussion of standardized testing in admissions. The main findings of this meta-analysis (Kuncel, Hezlett, & Ones, 2004) were that the MAT a) showed significant correlation with first-year graduate GPA, .41, graduate GPA, .39, and comprehensive examination scores .58; b) had a weaker relationship to research productivity, .19; and c) with regard to GRE correlations, is correlated most strongly with GRE verbal scores, .88 and moderately strong with GRE quantitative and mathematical scores, .57. An additional interesting finding that resulted from this study was an instance of an absence in correlation. Researchers found zero correlation between the MAT scores and faculty ratings of student teachers (Kuncel, Hezlett, & Ones, 2004).

In a predictive validity study of the MAT conducted by Meagher in 2008 for the Psychological Corporation, data from nine graduate schools composed of 1,000 student cases were examined. The focus of this study was to investigate the predictive validity of MAT scores with first-year graduate school GPA. Predictors examined included these: MAT scores, undergraduate GPA, previous graduate GPA, GRE verbal, GRE quantitative, GRE analytical writing scores, undergraduate major, graduate major, enrollment status (full-time

versus part-time), and number of credits completed. In addition to correlations, Meagher (2008) examined the diagnostic accuracy of the MAT scaled scores for admissions decision-making. Diagnostic accuracy analysis was defined as identifying the qualified candidates by first-year graduate GPA in the top 95% and unqualified candidates by first-year graduate GPA in the lowest 5% (GPA of less than 3.30).

The main findings of this study (Meagher, 2008) were that the MAT scores a) correlated positively with first-year GPA, averaging .29 (corrected average .41), and overall graduate GPA, averaging .27 (corrected average .39); and b) correlated positively with GRE scores. In diagnostic accuracy analysis, when an MAT cut score was applied, utilizing the 44<sup>th</sup> percentile, 28% of unqualified entering students should have been identified and 80% of qualified students should have been identified. Further refining the cut score to the 85<sup>th</sup> percentile should have yielded 14% of the unqualified entering students admitted and 28% of qualified entering students admitted (Meagher, 2008).

The main conclusions drawn by Meagher (2008) were that MAT scores positively correlate with first-year graduate school GPA and can, therefore, be useful in graduate admissions decisions. However, Meagher (2008) cautioned that cut scores should not be used as the sole criterion for admissions decisions. Use of this score alone could inadvertently influence the admissions of a significant number of unqualified students and similarly could cause a significant number of qualified students not to be admitted. Additionally, as Meagher (2008) nicely pointed out, the findings of this study are not generalizable since the subjects tested came mainly from private institutions, with many (36%) located in the Midwest.

This overview of predictive validity evidence from researchers of the most widely used tests in graduate admissions included information about the GMAT, GRE, MCAT, MAT, and PCAT. Based on this review, the writer maintains that these tests provide some information regarding future academic performance in graduate school and professional programs as measured by first-year graduate school or professional program grade-point average. These studies also demonstrated intercorrelations between graduate/professional school examinations when examined by researchers. Many of the studies reviewed were meta-analyses and did not report detailed differential validity and differential prediction by group as previously was seen in examining research on undergraduate admissions tests.

Concern about the use of single examination scores, or cut scores, when making graduate or professional program admissions decisions was addressed in some of the studies reviewed. Additionally, questions remain as to how effectively these admissions tests predict the likelihood of academic success in graduate school or professional programs for women, minority, and English-as-a-second language students. With these concerns in mind, a review of the contemporary arguments for and against standardized testing for college admissions will be addressed next.

### **Arguments in Favor of Admissions Testing**

Most important in this discussion is the issue of test-score usefulness (i.e., the concept of “value-added-ness”) in making admissions decisions. Proponents of testing have cited several benefits of test use. One such benefit is that tests contribute to quality decisions in admissions. Supporters have contended that high admissions test scores for applicants with overall lower high school or undergraduate GPAs lead to the admissions of students who might have otherwise been excluded (Linn, 2001). Alternatively, low test scores could be

useful in identifying college readiness or “at-risk” students who may benefit from educational interventions to prepare them better for college-level coursework (Kobrin, 2007; Sawyer, 2007). Additionally, supporters have contended that test scores provide consistent, objective data that can be used for comparison of applicants, whereas grade-point averages are less consistent measures (Bejar & Blew, 1981; The College Board, 2002b). Tests are recognized by proponents as being imperfect but fairly reliable predictors; most likely, tests are more reliable than alternative selection criteria such as letters of reference and or admissions essays (American Educational Research Association (AERA), 1999; Shaw & Milewski, 2004; Zwick, 2007).

The major institutional benefit cited by proponents of testing is that institutional personnel are empowered to select students most likely to be successful; this action conserves both student and institutional resources, specifically by decreasing remediation costs and saving students’ time and resources on a “failed venture” (Noble, 2003; Sawyer, 1996; Sawyer, 2007). Furthermore, institutions benefit in that their employees are able to work more efficiently in sorting large numbers of applications by using test data to help construct academic indexes for judging applicants. Using test data is preferable to utilizing more time intensive methods that require additional admissions staff that many institutions do not have (Rigol, 2003).

For these reasons, proponents have argued that admissions tests should continue to be used, not as the sole criterion, but as part of college, graduate studies, and professional school admissions criteria. Critics, however, have strongly objected to the continued use of admissions tests, citing several factors centered on test fairness. These arguments will be examined next.

### **Arguments Against Admissions Testing**

One of the strongest objections to the use of admissions tests is the relative weight given to test scores in college, graduate studies, and professional school admissions decisions. Critics have been quick to point out that tests are incomplete measures, capturing only a small subset of criteria reflective of educational achievement, but heavily assessing verbal and quantitative ability (Koretz, 2008; Sedlacek, 2003). The mounting empirical evidence regarding differences in average test scores on admissions tests by groups has revealed many concerns about test bias against women, minorities, English-as-a-second language students, and students with disabilities. Unequal access to higher education can be a result of weighing test scores heavily in admissions decisions; this situation is particularly damaging to groups with traditionally lower achievement scores on admissions tests (U.S. Department of Education, 2000; Zwick, 2002; Zwick, 2007). The institutional impact of tests effectively acting as barriers to accessing higher education impedes efforts of institutional personnel to reach critical diversity goals.

Additionally, critics have argued that admissions tests add little to the prediction of first-year student grades and of college success over high school or undergraduate grade-point average. Scholars in the higher education environment should conduct validity studies to ascertain the “value-added-ness” concept associated with a continued policy of requiring admissions test scores (National Association for College Admission Counseling [NACAC], 2008).

The recent phenomena of test coaching and inappropriate test preparation have been cited as leading to exaggerated test scores or test-score inflation. According to critics of testing, these behaviors inappropriately advantage some students over others and should become a

matter of serious concern for leaders of educational institutions as well as policy-makers (Koretz, 2008; NACAC, 2008).

### **Summary**

Most educators agree that the ongoing debate over the use of admissions tests is not likely to subside in the near future. The members of the National Association for Admission Counseling recently issued a *Report of the Commission on the Use of Standardized Tests in Undergraduate Admission* (2008) in which they strongly urged faculty and staff in postsecondary institutions to take back the conversation around admissions testing. They also suggested that institutions conduct their own validity research on the admissions criteria they are using, including the “value-added-ness” of admissions test scores to the overall review of student admissions criteria.

This mandate further encourages institutional leaders and faculty to develop an admissions process that is efficient, predictive, and unbiased; in addition, the process should effectively maximize the selection of students most likely to succeed/reach their educational goals. Finally, the admissions process must contribute to the achievement of the postsecondary institution’s overall educational goals. With this background in mind, awareness of the current debate about testing, and these overarching external mandates, the examination of using a standardized test for admissions to nursing programs was undertaken.

## CHAPTER 3: RESEARCH METHODOLOGY

This correlational study focused on the validity of testing used in nursing admissions decision-making. As such, this research is a test validity study, specifically a predictive validity study. Rationale for the methods applied in this investigation is rooted in the theoretical and scientific basis for test validity. In examining evidence of a test's validity, Messick (1995) noted that "validity is an overall evaluative judgment of the degree to which empirical evidence and theoretical rationales support the adequacy and appropriateness of interpretations and actions on the basis of test scores" (p. 741). The *Standards for Educational and Psychological Testing* (AERA, 1999) further document that validity is the "most fundamental consideration in developing and evaluating tests and [that] the test user is ultimately responsible for evaluating the evidence in the particular setting in which the test is to be used" (p. 9). Empirical evidence for test use is collected through test-validation studies.

Predictive validity is typically used in testing the validity of admissions tests examining predictor-criterion relationships. Young (2001) pointed out the rationale for examining predictor-criterion relationships in the following: "For historical and scientific reasons, the most common approach used to validate an admission test for educational selection has been through the computation of validity coefficients and regressions lines" (p. 2). Predictive validity is demonstrated when a statistically significant relationship is found between the predictor (admissions test score) and criterion variable (academic outcome).

For this quantitative study, the researcher employed a descriptive and exploratory, non-experimental design. Permission for this study was granted by members of the dissertation committee and the Human Subjects Review Committees at Eastern Michigan University and the study institution. Following the receipt of all approvals, the research was conducted as

described in detail in the following methods sections: study population, subject-sampling techniques, instrumentation, research design, data-collection procedure, research methods, data analysis, and statistical procedures.

### **Study Population**

The population and sample of participants for this study were students who had attended the selected institution between the fall of 2003 through the fall of 2008. The sample consisted of all baccalaureate nursing students who completed the program or had been enrolled at the site institution from Fall 2003 to Fall 2008 and had completed or been enrolled in all first-semester (term-one) nursing courses during the following 11 semesters: Fall 2003, Winter 2004, Fall 2004, Winter 2005, Fall 2005, Winter 2006, Fall 2006, Winter 2007, Fall 2007, Winter 2008, and Fall 2008. These semesters were identified as the period during which the selected institution instituted admissions testing. Testing for admissions into the nursing program began in Fall 2003, utilizing the Nurse Entrance Test (NET). Later in the fall of 2006, the Test of Essential Academic Skills (TEAS) was adopted for admissions testing (K. Cross, personal communication, September 16, 2008). Data collection over this time period allowed for comparison of predictive effectiveness between the NET and TEAS.

### **Subject-Sampling Techniques**

Participants were selected based on their designation of having completed term-one nursing courses, either successfully or unsuccessfully, and having completed one of the nursing entrance examinations, (i.e., the Nurse Entrance Test [NET], or the Test of Essential Academic Skills [TEAS]) plus one of the associated critical thinking tests (CTT). The sample included a total of 651 students.

### **Data-Collection Procedure**

Data were collected from a retrospective review of academic student records and an established database containing scholastic as well as demographic information. Official University records were utilized as instruments for data collection. One source of data from which age, race, and gender were obtained was a self-report form completed by the students when taking the nursing entrance examinations. Review of these records provided information on seven nominal categorical variables and 12 interval/ratio variables. The categorical variables were as follows: a) gender; b) race/ethnicity; c) English-as-a-second language; d) educational background; e) admissions type; f) enrollment status; and g) term-one outcome (pass, fail, withdrew passing, or withdrew failing from one or more term-one nursing courses).

The interval/ratio variables were a) age; b) pre-nursing college cumulative grade-point average; c) pre-nursing “critical seven” grade-point average; d) NET mathematics score; e) NET reading score; f) NET comprehensive score; g) critical thinking entry test score; h) TEAS reading score; i) TEAS verbal score; j) TEAS mathematics score; k) TEAS science score; and l) TEAS composite score.

The criterion variable in this study was “term-one outcome” achievement. For the purposes of this study, the criterion variable was analyzed in two ways, as nominal categories and as ratio, so that robust statistics could be used. For the nominal categorization of term-one outcome achievement, students were assigned into one of three groups. Students who passed all term-one courses successfully were classified as “passing.” Students who failed one or more term-one courses or withdrew from a course because they were failing were coded as “failed.” The third and last grouping was composed of students who withdrew from

courses but had passing grades; these students were coded as “withdrew passing.” Term-one grade-point average was also calculated, based on the combined average of these four required term-one nursing courses: NUR 3030: Health Assessment; NUR 3060: Foundations of Psychosocial Care; NUR 3220: Introduction to Nursing Therapeutic Interventions; and NUR 3270: Introduction to Professional Nursing Seminar. Additionally, classifying the term-one outcome as an interval/ratio variable was done to allow more robust statistical analyses.

The predictor variables for this study were as follows: a) grade-point average, b) NET mathematics score, c) NET reading score, d) NET comprehensive score, e) critical thinking entry test score, f) TEAS reading score, g) TEAS verbal score, h) TEAS mathematics score, i) TEAS science score, and j) TEAS composite score. Specific group comparisons were examined based on these factors: a) gender (male versus female); b) race/ethnicity (White versus African American, White versus Hispanic, White versus Asian, and White versus Native American); c) English-as-a-second-language (native versus non-native speakers); d) educational background; e) admissions type; and f) enrollment status.

### **Protection of Human Subjects**

For the protection of human subjects, a form was used to record data and had no personal identifiers on it (Appendix A). To avoid possible identification of subjects on the data collection form, information was coded using a 5-digit coding system, and data were entered into the SPSS 17.0 analysis program. Students’ names were coded to a numeric identifier to maintain confidentiality. A 5-digit coding system was used, with the first number representing the cohort year (i.e., 3-8), the second 2 numbers representing the term (i.e., 01 for fall; 02 for winter), and the last 2 numbers representing student 1-99 of the cohort group. The list with student names and 2-digit identifiers was maintained as a separate list and kept

in a locked file cabinet separate from the data forms used to enter data in SPSS. Once data were cleaned, this list of names and 2-digit identifiers was destroyed. Academic and demographic information was tracked by student identification number only. Data were coded to protect subject anonymity; findings of the study were reported as group data; no individual data were revealed.

Print and electronic record review took place in a locked office to safeguard the confidentiality of student records. The researcher, at no time, removed student records from the study institution. Data transferred to the data-collection form were kept under lock and key in a file cabinet at the researcher's home to which only the researcher had access. Electronic data were maintained on a password-protected laptop computer to which only the researcher had access. Upon completion of the dissertation, the lists linking names to 2-digit identifiers were destroyed.

The study institution was contacted to obtain permission to access Nursing Department academic files and the Jenzabar database system that contained official University student academic records. Permission was granted and a copy of the letter granting permission to access these data and to conduct the investigation was provided to the researcher.

### **Instrumentation**

A review of the two nursing admissions tests and two critical thinking tests from which scores were derived and utilized in this study will be provided next. The instruments used in this study were the NET, TEAS, California Critical Thinking Test, and ATI Critical Thinking Test. The NET and TEAS are two commonly used standardized nursing admissions tests that are administered to students either by paper-pencil examination or computer-based testing. Students seeking admissions to the study institution's nursing program may take the

entrance examination at any approved testing center. They then request that their scores be sent to schools/colleges of nursing to which they wish to apply for admissions. The site institution allows students to submit test scores that are up to two years old. Students who do not meet the stated minimum score on the admissions test are allowed to repeat the test one additional time.

In addition to the nursing entrance examination scores, scores from the critical thinking tests taken by students during their first semester of nursing coursework were also collected and analyzed for correlation with the criterion variable (i.e., the California Critical Thinking Test or the ATI Critical Thinking Assessment). However, scores on these examinations did not have any effect on admissions to the nursing program. These tests assert to measure general critical thinking ability (Assessment Technologies Institute, 2001b; Facione, 1990). Developers of widely used critical thinking tests have promoted these tests for use by academic nursing-program faculty members in tracking the educational achievement of students' improvement in critical-thinking by testing students prior to coursework and at program exit/completion. Scores from the California Critical Thinking Test and ATI Critical-Thinking Assessment were collected and analyzed for correlation with early in-program success.

### **Test of Essential Academic Skills**

The *Test of Essential Academic Skills (TEAS)* is a scholastic achievement examination developed in 1999 by Poggio and Glasnapp of the University of Kansas for Assessment Technologies Institute, LLC. This examination was constructed to assess academic “knowledge and skills acquired as part of a typical schooling experience” (Assessment Technologies Institute, 2001b, p. 2). The test includes these four sections: a) reading, b)

mathematics, c) science, and d) English language usage. Nursing curriculum experts reviewed the examination and identified these measures as relevant indicators for assessing the preparedness of students to enter nursing programs. The examination underwent further development to become an admissions examination for applicants to nursing programs as part of a state-mandated testing program.

The TEAS examination, a 170-item, multiple-choice examination with one correct answer per question has the following four sub-tests: reading, mathematics, science, and English, with 21 sub-scores provided. Each of the four assessment tests is timed; the total test-taking time for all four tests is 3 hours and 29 minutes. Students may take the examination by paper-and-pencil or in a web-based testing format. For test preparation, a pre-test study manual is available as is a student practice sample test. Content and testing time for the examination are summarized in Table 2.

ATI scores individual tests and provides an individual performance profile for each student as well as an aggregate report to college. Results are reported as scores on the four sub-tests and test-item subscales; percent scores and individual percentile rank scores by program and national norms are reported (Assessment Technologies Institute, 2001a).

Test reliability for the TEAS is reported as exceeding .90. Reliability coefficients on the sub-sections of the TEAS are reported as mathematics .80, reading and English language usage .70, and science .60. Test validity in Registered Nurse programs as reported by ATI (2001) for TEAS scores measured on end-of-program comprehensive achievement and specific course achievement ranged from .25 (medical-surgical nursing course) to .39 (nursing care of children).

Table 2

*Test of Essential Academic Skills Content*

Subtest	Number of Questions	Time Allotted in Minutes	Content
Mathematics	45	56	Whole numbers, metric conversion, fractions, decimals, algebraic equations, percentages, ratio/proportion, data interpretation
Science	30	38	Science reasoning, general science, life science, chemical science, human body science, general science
English	55	65	Punctuation, grammar, sentence structure, contextual words, spelling
Reading	40	50	Paragraph comprehension, passage comprehension, inferences, conclusions

Assessment Technologies Institute, 2001

**Nurse Entrance Test**

The Nurse Entrance Test (NET) is a standardized scholastic achievement examination developed by Educational Resources, Inc. (ERI) to aid in the evaluation of students applying to nursing programs (ERI, 2009). The NET was constructed to assess “critical reading ability [and] basic mathematics necessary for academic courses and clinical practice and a social profile” (ERI, 2009, p. 5). The test includes these seven sections: a) essential mathematics

skills, b) reading comprehension, c) critical-thinking appraisal, 4) social decisions, d) stressful situations, e) learning styles, and f) test-taking skills. The essential mathematics skills sections and reading comprehension section are scored separately but can also be combined to yield a composite score (Frost, 2004). A total of 30 diagnostic scores covering all sections of the NET can also be reported.

The academic-scored sections of the NET are essential mathematics skills and reading comprehension. Total time allotted for completion of all sections of the NET is 150 minutes. Information about the total number of items, item content, and testing time allocated is provided in Table 3.

Table 3

*Nurse Entrance Test Content*

Subtest	Number of Questions	Time Allotted in Minutes	Content
Math	60	60	Whole numbers, number system conversions, algebra equations, percentages, decimals, and fractions
Reading	33	30	Comprehension, reading rate, and reading placement

ERI, 2009

The mathematics and reading sections of the NET are scored as total number of questions answered correctly, percentage, and norm-referenced by percentile rank. Additionally, a simple descriptive rating is reported for students' scores; these are a) pre-junior high, b) junior high, c) high school, and d) post-high school.

Test validity was reported as .81 for mathematics, and .98 for reading. Criterion-related validity was reported as compared to corresponding sub-scores on the ACT at .79 to .83 (Frost, 2004). Test validity in baccalaureate programs has been reported by ERI, 2009. When NET scores were compared to academic success or failure (i.e., overall failure, failure in the first half of the program, failure in the second half of the program), the NET composite score and reading comprehension score were found to be statistically significant at the  $p < 0.01$  level for “successful students and . . . students who experienced academic failure in the first half of the program” (Simmons, Haupt, & Davis, 2004, p. 15).

### **ATI Critical Thinking Test.**

The critical thinking assessment examination offered by ATI is a test covering six critical-thinking skills (i.e., interpretation, analysis, evaluation, inference, explanation, and self-regulation). The examination is designed to be administered as a pre/post-test to students in nursing programs following the development of critical-thinking skills (ATI, 2001a). According to ATI officials, the goal of this assessment is “for faculty . . . to use this diagnostic information to enhance instructional strategies and to improve student’s critical thinking skills” (ATI, 2000, p. 1).

The examination is a 40-item, multiple-choice test with four possible responses and only one correct answer. Each of the six sections of the test contains 6-8 questions per critical-thinking skill. Questions are distributed as follows: 15%, interpretation; 15%, analysis; 20%, evaluation; 22%, inference; 18%, explanation; and 10%, self-regulation (ATI, 2001a). The examination is scored giving one point per correct item. Students are allowed up to one minute per item for a total of 40 minutes for test-taking time. Both web-based on-line and pencil-paper formats are available for testing (ATI, 2000). Seven scores are reported for

each examinee including a composite score and one score for each of the six critical thinking skills. Individual scores are reported as percent correct for each section, and a composite percentage score, as well as percentile rank scores. Percentile rank scores are reported as an individual score compared to nationally grouped data (ATI, 2001a).

Reliability of the ATI Critical Thinking Assessment for internal consistency was reported as a Cronbach's alpha coefficient of .69. As noted in the ATI report (2001a), *Critical Thinking Assessment: Development and Statistical Report 2001*, the predictive validity of this test (i.e., for scores to be correlated with subsequent successful academic outcomes such as graduation from the nursing program and passing the NCLEX-RN) has yet to be investigated. Additionally, the authors of the report (ATI, 2001a) encouraged other researchers to contribute to the establishment of the validity and reliability of the Critical Thinking Assessment through replication studies and submission of their findings to ATI (ATI, 2001a, p. 31).

### **California Critical Thinking Skills Test (CCTST)**

The *California Critical Thinking Skills Test* is a standardized scholastic achievement examination provided by Insight Assessment, a division of California Academic Press. The test is intended to be a tool for measuring critical thinking skills that may correlate positively with college achievement. This instrument is marketed as an accurate predictor of academic success as well as a useful tool for college and professional program admissions (Facione, 1991).

The test is composed of 34 multiple-choice questions with one response being the best choice. The instrument is available in both paper-pencil and on-line format. These six scores plus a total score are reported: a) Analysis, b) Evaluation, c) Inference, d) Deductive

reasoning and e) Inductive reasoning. The total score is tallied from these sub-scores to indicate the test-taker's "overall reasoning or critical-thinking skill level" (Facione & Facione, 1994, p. 4). Scores are reported as percentiles (i.e., 1 to 99), and the test-takers' scores are ranked relative to other test-takers in the group.

The *California Critical Thinking Skills Test* scores have been positively correlated with the SAT Verbal score ( $r=.55, p \leq .000$ ), the SAT mathematics score ( $r=.44, p \leq .000$ ), and college GPA ( $r=.20, p \leq .000$ ; Facione, 1990). One test-bias concern was reported in the literature: finding that CCTST results heavily correlate with English-reading ability, and English-as-a-Second language test-takers are likely to be disadvantaged (Facione, 1990).

In summary, the scores used in this predictive validity study were collected from these nursing entrance examinations. The following section provides an overview of the research design and data-analysis procedures.

### **Research Design**

The quantitative variables in this study were a) age; b) pre-nursing college cumulative grade-point average; c) pre-nursing "critical seven" grade-point average; d) NET mathematics score; e) NET reading score; f) NET composite score; g) critical thinking entry test score; h) TEAS reading score; i) TEAS verbal score; j) TEAS mathematics score; k) TEAS science score; and l) TEAS composite score.

The predictor variables for this study were a) grade-point average; b) NET mathematics score; c) NET reading score; d) NET composite score; e) critical-thinking entry test score; f) TEAS reading score; g) TEAS verbal score; h) TEAS mathematics score; i) TEAS science score; and j) TEAS composite score.

Specific group comparisons were examined based on a) gender (male versus female); b) race/ethnicity (i.e., White versus African American, White versus Hispanic, White versus Asian, White versus Native American); c) English-as-a second language (i.e., native versus non-native speakers); d) educational background (i.e., FTIAC, transfer, second-degree, e) admission type (i.e., NUR versus PNUR), f) enrollment status (i.e., full-time versus part-time) and g) term-one outcome (i.e., passed, failed, withdrew passing, or withdrew failing from one or more term-one nursing courses).

The criterion variable in this study was term-one outcome measured in these two ways: a) categorically as passed, failed, withdrew passing, withdrew failing and b) term-one course cumulative GPA (success,  $GPA > 2.0$ ; failure  $GPA < 2.0$ . grade-point average). These variables were defined by the following classification. For term-one outcome achievement, students were placed into three groups. Students who passed all term-one courses successfully were classified as “passing.” Students who failed one or more term-one courses or withdrew from a course failing were coded as “failed.” The last grouping was students who withdrew from courses but had passing grades; these students were coded as “withdrew passing.” Term-one grade-point average was calculated based on the combined average of the four term-one nursing courses (i.e., NUR 3220: Introduction to Nursing Therapeutic Interventions, NUR 3030: Health Assessment, NUR 3060: Foundations of Psychosocial Care, and NUR 3270: Introduction to Professional Nursing Seminar).

The predictor sets included the following:

- 1) Pre-nursing cumulative GPA alone.
- 2) Critical seven pre-nursing GPA alone.
- 3) NET composite score alone.

- 4) NET mathematics score alone.
- 5) NET reading score alone.
- 6) TEAS composite score alone.
- 7) TEAS mathematics score alone.
- 8) TEAS reading score alone.
- 9) TEAS verbal score alone.
- 10) TEAS science score alone.
- 11) ATI critical-thinking score alone.
- 12) Pre-nursing cumulative GPA and TEAS composite score.
- 13) Pre-nursing cumulative GPA and NET composite score.
- 14) Critical seven pre-nursing GPA and TEAS composite score.
- 15) Critical seven pre-nursing GPA and NET composite score.

These data sets were computed to test the study hypotheses.

### **Data Analysis and Statistical Procedures**

Data were entered into an SPSS data file and analyzed using the Statistical Package for the Social Sciences (SPSS) version 17.0. An alpha level of 0.05 was applied to discern statistical significance for the posed null hypotheses. Data analysis was conducted in these three phases: descriptive statistics, analyses of research hypotheses 1-3, and analyses of research hypotheses 4-6.

#### **Phase 1: Descriptive statistics**

Descriptive statistics were used to organize, summarize, and characterize the sample by counts, frequencies, mode, and percentages for student demographics, background characteristics, and scholastic data. Means, median, and standard deviations were computed

for GPA, composite test score and sub-test score data. Data were also computed by group on the following variables: a) gender, b) race/ethnicity, c) enrollment status, and d) educational background. Descriptive statistics represent an appropriate starting point in data analysis as these tools provide important information about the characteristics of the study population and contribute to the researcher's overall understanding of the subjects (Gall, Gall, & Borg, 2005; Minium, Clarke & Coladarci, 1999).

### **Phase 2: Research hypotheses 1-3 analyses**

In addressing research hypotheses 1 – 3 (i.e., There will be no significant difference in grade-point average, achievement scores on nursing examinations, or term-one outcome by educational background, enrollment status, or admissions status), inferential statistical procedures were applied. Independent sample *t* tests were used to examine group differences in GPA and NET/TEAS scores based on educational background, enrollment, and admission status.

Additional analyses using Chi-square were conducted to determine the extent of differences between groups in examining term-one outcome by categorical classification. In the posed hypotheses, both of these analyses were indicated since a single-factor effect on one or more groups was being examined and the joint effect of two or more factors was being examined on one or more groups. Results of these analyses allowed the examination of the null hypotheses posed. If the null hypotheses were true, within-group scores and between-group scores would vary similarly. If the null hypotheses were false, inherent within-group variation would similarly be seen; however, between-group variation would be marked and could be attributed to the inherent variation plus differential effect (Minium, Clarke, & Coladarci, 1999). Additionally, these statistical procedures were appropriate for use in this

study because the following assumptions/considerations of the tests were met: a) samples were independent, b) populations are normally distributed, and c) observations were equally distributed.

### **Phase 3: Research hypotheses 4-6 analyses**

To explore research hypotheses 4 and 5 (i.e., There will be no significant relationship between term-one outcome and critical-thinking test score or nursing entrance test scores) *t*-tests and correlation and regression procedures were used to examine the relationship of the predictor variables (i.e., nursing entrance test and critical thinking test scores) on the criterion variable (i.e., term-one outcome as measured by GPA). Multiple regression and correlation (MRC) were employed to assess the potential predictive power of a set of predictors on the criterion variable (Gall, Gall, & Borg, 2005). The rationale for utilizing regression, correlation, and multiple regression and correlation procedures in this study will be examined next.

Regression and correlation analyses can be used when one wishes to estimate future performance based on past performance and to compare predicted scores to actual scores as in this research study's design. The prediction of a dependent variable from an independent variable can be made in regression equations by plotting the predicted score (criterion) based on an actual score on a predictor variable (Minium, Clarke, & Coladarci, 1999). Since linear regression tests show how well a single independent variable can predict a dependent variable, the statistical tool will be useful in testing the hypotheses investigated in this study. If the null hypotheses are true, the regression line slope and the correlation coefficient will be equal to zero (Green & Salkind, 2005).

In this study, multiple predictors were being evaluated; therefore, multiple regression procedures were used in addition to the bivariate procedures earlier described. Green and Salkind (2005) noted the value of multiple regression analysis when they said: “Multiple regression analysis examines the validity of each set of predictors, the incremental validity of each set of predictors over other sets of predictors, and the validity of all sets in combination” (p. 284). When experimental control is not possible, as was the case in this study, MRC provides a means for statistical control in analyzing the possible contributions of single and combined predictors (Licht, 2008). This multiple regression and correlation procedure was intended to demonstrate the model with the best predictive power.

Prior to performing multiple regression analyses, the following underlying assumptions related to MCR were tested: a) the dependent variable (criterion) was normally distributed, b) variables were multivariately normally distributed in the sample population, and c) scores on variables were independent of other scores on the same variable (Green & Salkind, 2005, p. 286).

First, normality was examined for the predictor and criterion variables through the assessment of histograms. Both predictor and criterion continuous data variables were found to be normally distributed. Second, correlations of predictor variables were examined for intercorrelation. Since multiple regression and correlation use multiple predictors, the intercorrelation of these predictors was assessed in order to avoid drawing erroneous conclusions about predictions. Licht (2008) pointed out that “correlations of  $r > .80$  between predictors should be considered very problematic...and suggest that the two variables largely measure the same construct” (Litch, 2008, p. 45). To detect multicollinearity, the intercorrelation of predictors was analyzed. No significant intercorrelations for predictor

variables as utilized in the multiple regression analyses were demonstrated. If one or more predictors had been perfectly correlated with another, that predictor would have been excluded from the predictor set to avoid redundancy and the increased likelihood of a Type 1 error.

Last, linearity was analyzed by examining a single predictor on the outcome predictor Pearson correlation coefficients. Additionally, examination of predictor variables on criterion variable scatterplots was assessed for a straight-line relationship between predictors and the outcome variable. Following the predictor assessment for intercorrelations, the underlying assumptions for MRC were assured to have been met; therefore, multiple regression and correlation (MRC) procedures were employed.

Two unordered multiple regression analyses were conducted. First, a multiple regression analysis was conducted to create a model to represent the combination of admission factors that would best predict term-one outcome for students who completed the NET and CCTST examinations. Second, a multiple regression analysis was conducted to create a model representing the combination of admission factors that would best predict term-one outcome for students who completed the TEAS and ATI-CTT examinations. Last, to examine hypothesis 6, the two resulting regression analyses, regression slopes, intercepts, and Beta coefficients were examined and compared for strength of prediction.

### **Statistical Rigor**

Multiple regression and correlation present unique issues in statistical rigor and control. In bivariate correlation, the contribution of a single predictor on the criterion predictor is seen in the context of ignoring other predictors. Multiple regression and correlation can examine the independent contribution of each predictor on the criterion variable while controlling for

variables separately. This statistical control is referred to as *partialing* and is examined statistically by identifying the “*residual* difference between a predicted score and the actual observed score...[which] represents the part of the actual score that cannot be predicted from the combined predictors” (Licht, 2008, p. 37).

Finally, the level of significance for hypothesis testing in this study was set at  $<0.05$ . Licht (2008) notes that in social science research the level of significance is usually set at 0.05; however, when MRC is used he cautioned researchers to consider the following: when hypotheses are mutually dependent, to some extent, the level of significance may need to be set lower due to the increased probability of Type 1 error. A measure employed to address this phenomenon is that variable relationships were examined at each level of significance (i.e., 0.05, 0.010, 0.001) while retaining the value of  $< 0.05$  as the level of significance for hypothesis testing.

### **Threats to Validity**

Threats to both internal and external validity must be examined and controlled for to the extent possible in creating good research design (Gall et al., 2005). Factors possibly affecting the internal validity of this study were testing effect and differential selection. Since ATI offers pre-test preparation for the TEAS examination, some students may have taken one or more pre-tests prior to completing the TEAS examination. The effect of pre-testing can result in students becoming more “test-wise” and, therefore, performing better on the actual test than they might have otherwise, inflating their score. Second, differential selection may occur, in that some cohorts of test-takers may have different characteristics than other cohorts, such as increased or decreased numbers of males, FTIAC students, or

English-as-a-second-language students. This effect will be controlled for by examining data for the total population.

Threats to external validity were present in this investigation, in that the study population is from only one college; therefore, generalization of findings to other populations is impossible. In other words, population validity was not sought in this study. In contrast, *ecological validity* was sought in this study. Ecological validity is defined as “an estimate of the degree to which an experimental result can be generalized to a local setting” (Gall, Gall, & Borg, 2005, p. 255). Last, the importance placed on the practical significance of this study and the potential to contribute to improving the assessment practices currently used in nursing admissions underpinned the researcher’s choice of research design, and the conscious decision of “trading off” generalizability in this study.

## CHAPTER 4: PRESENTATION AND ANALYSIS OF DATA

This descriptive, correlational, retrospective study focused on these two main goals: first, to examine academic and non-academic variables as predictors for early academic success in an upper-division, baccalaureate-major nursing program; and second, to compare the predictive efficiency of two commonly used nursing entrance examinations. Additionally, the predictive validity of using nursing entrance examinations as part of nursing program admissions criteria was investigated.

In this chapter, information regarding the results of selected statistical analyses performed to test the hypotheses and to answer research questions is presented. Results are reported in three main sections. In the first section, descriptive information about the study sample is presented. Correlational data regarding academic and non-academic variables as predictors of early academic success are reported in the second section. Last, validity data regarding the two nursing entrance examinations, (i.e., the Nurse Entrance Examination [NET] and the Test of Essential Academic Skills [TEAS]) as well as the two critical thinking examinations (i.e., the Assessment Technologies Institute [ATI] Critical Thinking Test [ATI-CTT] and the California Critical Thinking Skills Test [CCTST]) as predictors of early academic success in the nursing major are presented in the third and final section of Chapter 4.

### **Descriptive Statistics**

The study sample was composed of 651 students enrolled in an upper-division nursing major of a baccalaureate nursing program at one private Catholic university in the Midwestern United States. Data were collected on 651 students enrolled in term-one nursing courses who had taken a required nursing entrance examination prior to admissions to the

nursing major during the past 5 years. The sample included all students meeting these criteria over the study period of 11 semesters, dating from Fall 2003 through Fall 2008.

Of the 651 nursing students, the majority, or 584 (89.7%), was female, with 66 (10.1%) being male. The age of students ranged from 18-73, with a median age of 22 and a mean age of 25. Caucasians composed the majority of the students at 535 or 82.2%. African-American (AA) students represented the next largest number, 63, or 9.7%, followed by 24, or 3.7%, Asian students, and then 15, or 2.3%, Hispanic students. Only two (0.3%) students self-identified as Native American (NA). Therefore, traditional-age Caucasian females composed the largest number of students in this study. Fifty-one students (7.8 %) self-identified as using English-as-a-second-language (ESL); consequently, the majority of students in this study were native English speakers.

These data are similar to national statistics reported by the American Association of Colleges of Nursing (AACN; 2009) on Baccalaureate of Science in Nursing (BSN) program enrollment, which showed the majority of baccalaureate students to be female (89.6%) versus male (10.4%) and predominantly Caucasian (74%). While the racial composition of the study group was similar to that of national enrollment data, numbers of minority students were somewhat lower than reported nationally. AACN (2009) reported the racial/ethnic composition for BSN enrollment on a national scale as follows: 11%, African American; 8.2%, Asian; 6.1%, Hispanic; and 0.7%, Native American. In Table 4, student demographic data are displayed by gender, race/ethnicity, and ESL status.

Table 4

*Numbers and Percentages of Students by Gender, Race/Ethnicity, and English-as-a-Second Language Status*

Category	N (651)	Percent	AACN National Data*
<b>Gender</b>			
Female	584	89.7%	89.6%
Male	66	10.1%	10.4%
<b>Race/Ethnicity</b>			
Caucasian	535	82.2%	74%
African American	63	9.7%	11.0%
Asian	24	3.7%	8.2%
Hispanic	15	2.3%	6.1%
Native American	2	0.3%	0.7%
<b>English-as-a-Second Language</b>			
Language	51	7.8%	

\*Source: AACN (2009).

Religious background data were also collected as part of the student demographics. Of the 651 students, 649 indicated a religious-background preference; 2 missing cases occurred when students did not provide data about their religious interests. Frequencies and percentages showed that from the total of 649 students, 297 (45.6%) students self-identified as Catholic, 151 (23.2%) self-identified as Protestant, 5 (0.8%) students self-identified as Muslim/Islamic, 2 (0.3%) students self-identified as Jewish, and 194 (29.8%) students self-identified as “Other” (i.e., “none,” or “undeclared” for religious status. The majority of students, 448 (69%), reported their religious background as Christian, with 297 (45.6%) being Catholic and 151 (23.2%) being Protestant. In Table 5, the religious-background distribution is displayed in numbers and percentages.

Table 5

*Numbers and Percentages of Students by Religious Background*

Category	Number	Percentage
Catholic	297	45.6%
Protestant	151	23.2%
Other	194	29.8%
Muslim/Islamic	5	0.8%
Jewish	2	0.3%
Missing	2	0.3%
Total	651	100%

**Educational Background**

Data were collected on the students' educational backgrounds, in terms of these variables: a) prior educational preparation (i.e., first-time-in-any-college [FTIAC], transfer from another college, or second-degree seeker); b) admissions type (i.e., nursing or pre-nursing designation); and c) enrollment status (i.e., part-time or full-time student status). Of the 651 students included in this study, the majority 445 (68.4%) were transfer students; 119 (18.3%) were FTIAC students; and 86 (13.2%) were second-degree seeking students.

Also, 293 (45%) of the transfer students were from two-year colleges while 46 (7.1%) came from four-year colleges. Of the 437 transfer students, 138 (21.2%) could not be coded as two-year or four-year transfer students because they had earned transfer credits from one or more colleges. In this category, 174 (26.7%) missing cases existed due to lack of data available in the computerized student records. Most, 588, or 90.3%, of the students were admitted under "nursing" (NUR) status (meeting the requirements for the nursing major) versus 59, or 9.1%, under "pre-nursing" (PNUR) status.

Additionally, while most of students seeking a nursing major or 498 (76.5%) were engaged in full-time study, 151 (23.2%) had enrolled in the program on a part-time basis.

For informational purposes, the background of students by educational preparation, admissions type, and enrollment status is included as frequencies and percentages in Table 6.

Table 6

*Background of Students by Educational Preparation, Admissions Type, and Enrollment Status*

Category	Number (651)	Percent
<b>Educational Preparation</b>		
Transfer Student	445	68.4%
First-Time-in-Any College student	119	18.3%
Second-Degree Student	86	13.2%
Missing	1	.2%
<b>Transfer Student Type</b>		
From Two-Year	293	45.0%
From Four-Year	46	7.1%
From More than One College	138	21.2%
Missing	174	26.7%
<b>Admissions Type</b>		
Nursing	588	90.3%
Pre-Nursing	59	9.1%
Missing	4	.6%
<b>Enrollment Status</b>		
Full-time	498	76.5%
Part-time	151	23.2%
Missing	1	.2%

### **Academic Background**

Academic background data obtained on students for analysis in this study included the following factors: a) pre-nursing cumulative grade-point-average; b) critical seven grade-point average (i.e., English 101, English 102, Anatomy and Physiology I, Anatomy and Physiology II, Microbiology, Organic Chemistry, and Pathophysiology); c) nursing entrance examination test scores; and d) term-one outcome (i.e., passed, failed, withdrew-passing, or withdrew-failing) including term-one grade-point average (i.e., scholastic grade-point average of the four term-one nursing courses). The mean, median, range, and standard-

deviation scores were computed for the predictor variables of pre-nursing critical seven grade-point average and admissions examination test scores. These data are discussed in the following section.

**Pre-Nursing and Critical Seven Grade-Point Averages.** The pre-nursing cumulative grade-point average (PNUR-CGPA) for the sample of students in the study (which, in fact, was the total population) ranged from 2.32 to 4.00, with a mean of 3.219, a median of 3.380, and a standard deviation of .3792. The critical seven grade-point averages (C-7 GPA) of students ranged from 1.70 to 3.58, with a mean of 3.216, a median of 3.090, and a standard deviation of 2.916. The range, mean, median, and standard deviation calculations of students' PNUR-CGPA and C-7GPA are displayed in Table 7.

Table 7

*Grade-Point-Average of Students for Pre-Nursing and Critical Seven by Range, Mean, Median, and Standard Deviation*

Category	Range	Mean	Median	Standard Deviation
Pre-Nursing Cumulative Grade-Point-Average	2.32 – 4.00	3.37	3.380	.3792
Critical 7 Grade-Point Averages	1.70 – 3.58	3.219	3.090	2.916

\*GPA Scale = 0.00 to 4.00, with 4.00 being the highest GPA possible

**Nursing Entrance Examination Test Scores.** Two nursing entrance examinations were used for admissions to the nursing major during the time period of this study. From Fall 2003 through Winter 2006, the Nurse Entrance Test (NET) was required for admissions to the nursing major. In the fall of 2006 the required examination for admissions to the nursing major became the Test of Essential Academic Skills (TEAS). Two additional tests for the

assessment of critical thinking skills were also completed by students. Although these examinations were not required for admissions purposes, they were taken by full-time students during their first semester in the nursing program and during the second semester of study by part-time students. Scores from these examinations were used as predictors in this research study.

During the time period of NET testing, the California Critical Thinking Skills Test (CCTST) was required of all nursing students admitted to term-one courses. With the change from NET testing to TEAS testing in the fall of 2006, a new assessment test for critical thinking, the ATI Critical Thinking Test (i.e., ATI-CTT) was also adopted and required of all students admitted to term-one courses. The change in required tests for admissions to the nursing major accounts for the unequal numbers of students with NET versus ATI test scores and CCTST versus ATI-CTT test scores. Scores from admissions tests and critical thinking tests taken by entering students were examined as predictor variables on the criterion variable of term-one outcome. In the following section, the researcher will provide a review of the overall frequencies and percentages of test-takers as well as the mean, median, range, and standard deviation of test scores for the entire group.

***Nurse Entrance Test.*** Of the 651 students involved in this study, the majority or 513 (78.8%) completed the NET as their nursing entrance examination. The NET scores for students included a composite score, mathematics score, and reading score. The NET composite score is the mean of the individual test-takers' mathematics and reading scores. Additionally, the CCTST scores are reported. The NET possible score is 100% on a scale of 0 to 100. For NET test-takers in this study, the composite test scores ranged from 11% to 94%, with a mean score of 74.93%, a median of 76.0%, and a standard deviation of 9.457.

Mathematics scores ranged from 48% to 98% (the percentage correct of 60 items), with a mean score of 84.42%, a median of 87.0%, and a standard deviation of 10.248. Reading scores ranged from 18% to 94% (the percentage correct of 33 items), with a mean score of 65.38%, a median score of 67.0%, and a standard deviation of 12.96. Interestingly, the means achieved by test-takers at the study institution were higher for NET composite and NET mathematics scores than those reported for test-takers nationally for 2005-06, which were 69% on NET composite, 66% on NET reading, and 72% on NET mathematics (A. Wolkowitz, ERI, personal communication, March 16, 2010).

Scores on the CCTST were available for 324 (49.8%) students; these scores ranged from 5 to 27 (out of a possible score of 34), with a mean score of 16.19, a median score of 16.0, and a standard deviation of 3.894. The mean score on the CCTST was higher at the study institution than the national mean, which was reported as 15.89 (Cross, K. personal communication, October, 2008).

At the study institution, faculty and staff members in the nursing program use a NET cutoff composite score of 64 for admissions to the nursing major. In this study, students achieving a NET composite score of 75 or lower or a CCTST score of 16 or lower were in the lower 50<sup>th</sup> percentile of test-takers. The range, mean, median, and standard deviation for NET test scores are depicted in Table 8.

***Test of Essential Academic Skills.*** Of the 651 students in this investigation, 138 or 21.1% took the *Test of Essential Academic Skills* (TEAS) as their nursing entrance examination. The TEAS scores for students included the following: composite, mathematics, reading, verbal, science, and the ATI Critical Thinking Test. The TEAS composite test scores ranged from 70% to 96% (the percentage of the number correct out of a total of 170

items), with a mean of 82.78%, a median of 82.90%, and a standard deviation of 5.268.

Mathematics scores ranged from 44% to 98% (the percentage of the number correct out of 45 items), with a mean of 76.70%, a median of 77.80%, and a standard deviation of 10.925.

Reading scores ranged from 70% to 100% (percentage of the number correct out of 40 items), with 9 (6.5%) students achieving a perfect score of 100 on the reading section of the TEAS. The English and language usage (English) section test scores ranged from 65% to 98% (the percentage of number correct out of 55 items), with a mean of 84.23%, a median of 84.55%, and a standard deviation of 6.533. Science scores ranged from 53% to 100% (the percentage of the number correct out of 30 items), with a mean of 77.22%, a median of 76.70%, and a standard deviation of 8.671. Two (1.4%) students achieved a perfect score of 100 on the science section of the TEAS.

Table 8

*Nurse Entrance Test Score Range, Mean, Median, and Standard Deviation*

Category	Range	Mean	Median	Standard Deviation
Composite	11% – 95%	74.93%	76.0%	9.457
Mathematics	48% – 98%	84.42%	87.0%	10.248
Reading	18% – 94%	65.38%	67.0%	12.963
California Critical Thinking Test	5 – 27	16.19	16.0	3.894

National data from Assessment Technologies Institute (2009) show test score means as follows: TEAS composite, 78.7%; TEAS reading, 89.3%; TEAS mathematics 71.1%; TEAS science 71.8%; and TEAS English, 81.3%. In comparing the study group's mean scores to national data, the study institution students demonstrated higher mean scores in both the composite score and sub-test score means. The cutoff score on the TEAS composite for admissions to the nursing major at the study institution is 70. Students in this study with a

TEAS composite score of 82% or lower, or an ATI-CTT score of 72.5% or lower, were in the 50<sup>th</sup> percentile or below.

Of the 651 students in this study, 305 (46.85%) took the ATI Critical Thinking Test. Scores ranged from 45% to 95% (the percentage of the number correct out of 40 items), with a mean of 72.88%, median of 72.50%, and a standard deviation of 9.76. Test score means on the ATI-CTT were similar to the national mean, which was 71.10% (ATI, 2009). The range, mean, median, and standard deviation scores for students completing the TEAS and ATI-CTT are included in Table 9.

Table 9

*Test of Essential Academic Skills – Percentile Scores for Range, Mean, Median, and Standard Deviation*

Category	Range	Mean	Median	Standard Deviation
Composite	70 – 96%	82.78%	82.90%	5.268
Mathematics	44 – 98%	76.70%	77.80%	10.925
Reading	70 – 100%	91.87%	92.50%	5.471
English	65 – 98%	84.23%	84.55%	6.533
Science	53 – 100%	77.22%	76.70%	8.671
ATI-CTT	45 – 95%	72.88%	72.50%	9.76

Of the total records for 651 students, 22 missing cases were identified, in which no critical thinking examination scores were available. A likely explanation for this situation is that if part-time students failed a course in their first semester of nursing, they could not have progressed to the second semester nor could they have been enrolled in the seminar course during which the critical thinking assessment examination was administered to students.

### **Term-One Outcome**

Early academic success in the nursing major was the outcome variable in this study and was defined as the passing of all four first-term nursing courses. For full-time students these

courses are taken in one semester; for part-time students, two courses are completed in their first semester and two courses are taken during their second semester. Student academic records were reviewed, and students were coded as “passing” when all four of the term-one courses were completed successfully (i.e., receiving a grade of C or better). Students were coded as “failed” if they did not receive a passing grade in any one of the four term-one courses. Students were coded as “withdrew failing” when the academic record showed one or more term-one course withdrawals due to failing scores (i.e., a course grade average of less than 80%). Students were assigned a “withdrew passing” code when the academic record documented that the student had withdrawn from one or more term-one courses but had passing grades at the time of withdrawal (i.e., a course grade average above 80%).

Because the term-one courses are sequentially offered, failing or withdrawing from one of the courses requires that the student successfully repeat the course before he or she is able to enroll in any second-semester nursing courses. Additionally, term-one outcome was analyzed as cumulative term-one grade-point average. The cumulative grade-point averages of students passing term-one courses were compared to the cumulative grade-point averages of students failing term-one courses. In the following section, these data are reported for both categorical (i.e., passed, failed, withdrew passing, and withdrew failing) and continuous term-one outcome data (i.e., grade-point average).

**Term-One Outcome by Categorical Coding.** Of the 647 students for whom term-one outcome data were available, 480 (73.7%) passed all term-one courses, 118 (18.1%) failed one or more term-one courses, 37 (5.7%) withdrew from one or more term-courses with failing course grades, and 12 (1.8%) withdrew from one or more term-one courses with

passing course grades. Data were missing in 4 separate cases. The details of students' term-one outcomes are included in Table 10.

Table 10

*Students' Term-One Outcome by Frequencies and Percentages*

Category	Number	Percentage
Passed	480	73.7%
Failed	118	18.1%
Withdrew-Failing	37	5.7%
Withdrew-Passing	12	1.8%
Missing	4	0.7%
Total	651	100%

Data were re-coded and analyzed for the total number of students who passed/withdrew passing or failed/withdrew failing from term-one courses. Of the 651 students in this study, 492, or 75.6%, of students passed or withdrew passing in term-one courses, while 155, or 23.8%, failed or withdrew failing. Since early academic achievement is an under-studied area, similar data for comparison were unavailable in the literature. Table 11 contains details about students' term-one outcome when re-coded into these two categories.

Table 11

*Students' Term-One Outcome by Frequencies and Percentages Categorized as Passed or Failed*

Category	Number	Percentage
Passed/Withdrew Passing	492	75.6%
Failed/Withdrew Failing	155	23.8%
Missing	4	0.6%
Total	651	100%

**Term-One Outcome by Grade-Point Average.** The means, medians, and standard deviations for term-one grade-point average were calculated for each outcome group (i.e., passed, failed, withdrew passing, and withdrew failing). Of the 651 students, 624 had term-

one grade-point averages. Unfortunately, 27 cases were excluded primarily due to missing data of students who had withdrawn. Table 12 displays the mean, median, standard deviation, and range of grade-point averages for each outcome group. The groups were then re-coded into two groups which showed that the mean term-one cumulative grade-point average for passing students in this study was 3.20, while the mean grade-point-average for failing students was 1.98.

Table 12

*Mean, Median, Standard Deviation, and Range for Term-one Grade-Point Average by Outcome Group*

Group	Number	Mean	Standard Deviation	Median	Range
Passed	479*	3.20	.396	3.20	2.20-4.00
Failed	119	1.88	.599	2.20	0.37-3.14
Withdrew	3**	3.33	.665	3.33	2.67-4.00
Passing					
Withdrew	23***	2.58	.517	2.66	1.08-3.62
Failing					

\*1 missing case; \*\*9 missing cases; \*\*\*14 missing cases

### Predictor Analysis

Next, the means, medians, and standard deviations of the predictors were computed for the study sample by sub-group, as follows: a) gender, b) race/ethnicity, c) ESL status, d) educational background, e) admissions type, and f) enrollment type. Additionally, independent sample *t* tests and Chi-square tests of difference were conducted, as appropriate, to analyze for significant differences in predictor scores among the groups. Since within each sub-group variables were found to be normally distributed and demonstrated acceptably equal variances, sub-groups determined to be of adequate size were analyzed by *t* test.

**Pre-Nursing and Critical Seven Grade-Point Averages by Sub-Groups**

The pre-nursing cumulative grade-point averages were examined for groups by gender, race/ethnicity, and English-as-a-second language (ESL). The computed means, medians, and standard deviations demonstrated that female ( $M = 3.37$ ,  $SD = .378$ ) and male ( $M = 3.41$ ,  $SD = .383$ ) students did not significantly differ in PNUR-CGPA. Moreover, students with English-as-a-second language ( $M = 3.34$ ,  $SD = .383$ ) did not differ significantly from native-English speakers ( $M = 3.38$ ,  $SD = .375$ ) in average PNUR-CGPA.

However, among the racial/ethnic groups, significant differences were noted between whites ( $M = 3.40$ ,  $SD = .369$ ) and minorities ( $M = 3.22$ ,  $SD = .387$ ). African American students showed significantly lower PNUR-CGPAs ( $M = 3.11$ ,  $SD = .360$ ). Due to the small number of students in the Asian (i.e., 24), Hispanic (i.e., 15), and Native American (i.e., 2) groups, these groups were combined with the African American (i.e., 63) student group to represent a newly coded group of “minority” students as a way of maximizing sample size for the purpose of analysis. Table 13 displays the PNUR-GPA means and standard deviations for groups by gender and racial/ethnic category.

Independent sample  $t$  tests were conducted to evaluate for significant differences among the groups in pre-nursing grade-point averages by gender, ESL status, and race/ethnicity. The test was not significant for gender or ESL status but was significant for race/ethnicity. African American students, on average, demonstrated lower entry grade-point averages than whites,  $t(636) = 5.96$ ,  $p \leq .000$ . When the groups were re-coded with all minorities compared to whites, significantly lower entry grade-point averages were also identified for minorities versus whites,  $t(636) = 4.37$ ,  $p \leq .000$ , as African Americans composed the

largest number in the minority group. The results of the *t* test analyses are detailed in Table 14.

Table 13

*Means and Standard Deviations for Pre-Nursing Grade-Point Average by Gender and Race/Ethnicity*

Group	N	Mean	Standard Deviation
<b>Gender</b>			
Female	583	3.37	.378
Male	66	3.41	.387
<b>Race/Ethnicity</b>			
White	534	3.40	.369
African American	63	3.11	.360
Hispanic	15	3.49	.396
Asian	24	3.37	.352
Native American	2	3.16	.007
Minority	104	3.22	.387
<b>English as a Second Language</b>			
No	575	3.38	.375
Yes	51	3.34	.383

Table 14

*Pre-Nursing Cumulative Grade-Point Averages by Race/Ethnicity as Means, Standard Deviations, and t-test Results*

Group	Number of Students	Mean	Standard Deviation	<i>t</i> -test	<i>df</i>	Significance
White	534	3.40	.369			
Minority	104	3.22	.387	4.37	636	.000
African American	63	3.11	.360	5.96	636	.000

Examination of the means, medians, standard deviations, and score ranges by the sub-groups of a) educational background, b) admissions type, and c) enrollment status were also completed. No significant differences in average PNUR-CGPA by educational background or admissions type surfaced. However, significant differences based on enrollment status emerged. Full-time enrolled students showed significantly higher PNUR-CGPAs ( $M = 3.40$ ,  $SD = .370$ ) than did part-time students ( $M = 3.28$ ,  $SD = .394$ ). In Table 15, the means, medians, standard deviations, and ranges of PNUR-GPA scores are displayed for groups by educational background, enrollment status, and admissions status.

To evaluate the hypotheses that there will be no significant difference in grade-point average by educational background, enrollment status, or admissions status, independent sample  $t$  tests were conducted. Analyses revealed that no significant differences existed in PNUR-GPA by educational background or admissions status. However, counter to the Hypotheses 1, a significant difference was identified based on enrollment status. Full-time students had significantly higher PNUR-GPAs than did part-time students  $t(636) = 4.37$ ,  $p \leq .000$ . Details of the  $t$  test analysis for pre-nursing GPA by enrollment status are provided in Table 16.

The means, medians, standard deviations, and range of scores for critical seven GPA were examined across the sub-groups of gender, race/ethnicity, and English-as-a-second language (ESL). Male students demonstrated slightly higher mean critical seven GPAs ( $M = 3.22$ ,  $SD = .472$ ) than female students ( $M = 3.09$ ,  $SD = .461$ ). No significant difference was found in the mean critical seven GPAs of ESL students ( $M = 3.14$ ,  $SD = .499$ ) or of native English-speaking students ( $M = 3.11$ ,  $SD = .454$ ). However, racial differences persisted in mean critical seven GPAs, with African American students ( $M = 2.86$ ,  $SD = .412$ ) and

minority ( $M = 2.85$ ,  $SD = .412$ ) students having significantly lower mean critical seven GPAs than white students ( $M = 3.13$ ,  $SD = .455$ ) and Asian students ( $M = 3.18$ ,  $SD = .521$ ). The means, standard deviations, and score ranges for critical seven GPA by gender, race/ethnicity, and ESL status are provided in Table 17.

Table 15

*Means, Medians, Standard Deviations, and Score Ranges for Pre-Nursing Grade-Point Average by Educational Background, Enrollment Status, and Admissions Status*

Group	N	Mean	Standard Deviation	Median	Range
Educational Background					
FTIAC	119	3.35	.336	3.37	2.45-4.00
Transfer	444	3.36	.379	3.37	2.32-4.00
Second Degree	86	3.45	.424	3.55	2.54-4.00
Admission Type					
Pre-Nursing	59	3.41	.341	3.38	2.54-4.00
Nursing	587	3.37	.381	3.38	2.32-4.00
Enrollment Type					
Full-time	498	3.40	.370	3.41	2.32-4.00
Part-time	150	3.28	.394	3.29	2.44-4.00

Table 16

*Pre-Nursing Cumulative Grade-Point Averages by Enrollment Status as Means, Standard Deviations, and t-test Results*

Group	Number of Students	Mean	Standard Deviation	t-test	df	Significance
Full-time	498	3.40	.370			
Part-time	150	3.28	.394	4.37	636	.000

Independent sample  $t$  tests demonstrated significantly lower critical seven GPAs for females versus males,  $t(639) = 2.14, p = .032$ , and lower mean critical seven GPAs for minority students versus whites  $t(629) = -1.01, p = .004$ . Details of the  $t$  test analysis for critical seven GPA are provided in Table 18.

Table 17

*Means, Medians, Standard Deviations, and Score Ranges for Critical Seven Grade-Point Average by Gender, Race/Ethnicity, and English-as-a-second-language*

Group	N	Mean	Standard Deviation	Median	Range
Gender					
Female	583	3.09	.461	3.06	1.70-4.00
Male	66	3.22	.472	3.30	2.00-4.00
Race/Ethnicity					
White*	529	3.13	.455	3.11	1.87-4.00
African American**	61	2.86	.412	2.86	1.70-3.75
Hispanic	15	3.27	.446	3.16	2.22-3.82
Asian	24	3.18	.521	3.24	2.00-4.00
Native American	2	2.49	.247	2.49	2.32-2.67
Minority	102	2.99	.477	2.98	1.70-4.00
English as a Second Language					
No+	568	3.11	.454	3.10	1.70-4.00
Yes++	50	3.14	.499	3.14	2.00-4.00

\*6 missing cases; \*\*2 missing cases; +8 missing cases; ++1 missing case

The means, medians, standard deviations, and score ranges for the critical seven GPA were also investigated across the sub-groups by a) educational background, b) admissions type, and c) enrollment status. Differences were noted in the mean critical seven GPA by educational background. Specifically, transfer students ( $M = 3.12, SD = .445$ ) and second-degree students ( $M = 3.16, SD = .559$ ) showed higher mean critical seven GPAs than FTIAC students ( $M = 3.02, SD = .447$ ). Students did not differ in mean critical seven GPA by admissions type. However, differences were found between full-time and part-time students.

Full-time students had somewhat higher mean critical seven GPAs ( $M = 3.12, SD = .458$ ) than did part-time students ( $M = 3.04, SD = .477$ ). The means, medians, standard deviations, and score range for critical seven GPA by educational background, enrollment status, and admissions status are provided in Table 19.

Table 18

*Critical Seven Grade-Point Averages by Gender and Racial/Ethnic Category as Means, Standard Deviations, and t-test Results*

Group	Number of Students	Mean	Standard Deviation	t-test	df	Significance
Gender						
Female	583	3.09	.461			
Male	66	3.22	.472	2.14	639	.032
Race/Ethnicity						
White	529	3.13	.455			
Minority	104	2.86	.412	-1.01	629	.004

To evaluate the hypothesis that there will be no significant difference in grade-point average by educational background, enrollment status, or admissions status, independent sample  $t$  tests were conducted. Analyses indicated that no significant differences existed in the mean critical seven GPA by admissions type. However, counter to the hypothesis, significant differences were found based on educational background. Independent sample  $t$  tests showed significant differences, with FTIAC students having lower mean critical seven GPAs than transfer students,  $t(555) = -2.06, p = .040$ , and second-degree students,  $t(201) = -1.976, p = .050$ . Details of the critical seven  $t$  test analysis by educational background are provided in Table 20.

Table 19

*Means, Medians, Standard Deviations, and Score Ranges for Critical-Seven Grade-Point Average by Educational Background, Enrollment Status, and Admissions Status*

Group	N	Mean	Standard Deviation	Median	Range
<b>Educational Background</b>					
FTIAC	119	3.02	.447	2.98	2.02-4.00
Transfer*	438	3.12	.445	3.10	1.87-4.00
<b>Second Degree**</b>					
	86	3.16	.559	3.25	1.70-4.00
<b>Admissions Type</b>					
Pre-Nursing	59	3.10	.492	3.02	2.22-4.00
Nursing	587	3.11	.460	3.10	1.70-4.00
<b>Enrollment Type</b>					
Full-time+	494	3.12	.458	3.11	1.70-4.00
Part-time	150	3.04	.477	3.04	1.87-4.00

\*7 missing cases; \*\*2 missing cases; +4 missing cases

Table 20

*Critical-Seven Grade-Point Averages by Educational Background as Means, Standard Deviations, and t-test Results*

Educational Background	Number of Students	Mean	Standard Deviation	t -test	df	Significance
Transfer	438	3.12	.445			
FTIAC	119	3.02	.447	2.06	555	.040
Second Degree	86	3.16	.559	-1.976	201	.050

### **Nursing Entrance Examination Scores by Sub-Group**

Analysis of the scores from two nursing entrance examinations, the NET and the TEAS as well as their two associated critical thinking examinations as predictors of early academic success in the nursing major, are presented in the following section. The results of

hypothesis testing (i.e., that there will be no significant difference in nursing examination achievement scores between groups) will also be discussed.

**Nurse Entrance Test.** The mean scores on the Nurse Entrance Test (NET) and the California Critical Thinking Skills Test (CCTST) were examined for groups by gender, race/ethnicity, and English-as-a-second language (ESL). The computed means, medians, and standard deviations demonstrated that overall males had higher mean scores on the NET composite ( $M = 79.59, SD = 5.7$ ) than females ( $M = 74.49, SD = 5.7$ ). Males also had higher mean scores on the NET mathematics sub-test ( $M = 89.23, SD = 7.2$ ) than did females ( $M = 83.97, SD = 10.4$ ). These findings were significant on independent sample  $t$  tests,  $t(511) = -3.45, p = .001$  for the NET composite, and  $t(511) = -3.28, p = .001$  for the NET mathematics sub-test.

Racial/ethnic differences were also seen for NET scores and CCTST scores. White students demonstrated higher mean NET composite scores ( $M = 75.83, SD = 9.1$ ) than African American students ( $M = 69.54, SD = 10.9$ ) and minority students ( $M = 71.54, SD = 10.3$ ). These differences were significant on independent sample  $t$  tests; for the NET composite between non-African American students and African American students, the  $t$  test was  $t(501) = 4.93, p = \leq .000$  while between white students and minority students, the  $t$  test was  $t(501) = 3.63, p = \leq .000$ .

Additionally, mean scores on the NET mathematics sub-test and the NET reading sub-test were higher for white students. The mathematics sub-test mean score for white students was 85.20, with a standard deviation of 9.7, while the minority students' mean score was 81.04, with a standard deviation of 11.7. Independent sample  $t$  tests demonstrated significant

differences between mathematics scores of white students and minority students,  $t(501) = 3.63, p = \leq .000$ .

With regard to the NET reading sub-test mean scores, the white students' mean score was 66.29, with a standard deviation of 12.2, while African American students' mean score was 60.89, with a standard deviation of 15.89; minority students' mean score was 61.85, with a standard deviation of 15.5. Differences in the NET reading sub-test mean scores were shown to be significant on independent sample  $t$  tests, with the NET reading sub-test between African American students and others being  $t(500) = 2.93, p = .003$ ; between whites and minority students, the NET reading sub-test  $t$  test was significant,  $t(500) = 3.03, p = .003$ .

Also, among the racial/ethnic groups, differences were found in the CCTST mean scores. CCTST mean scores were higher for white students ( $M = 16.60, SD = 3.9$ ) than for African American ( $M = 14.05, SD = 3.5$ ) and minority ( $M = 14.21, SD = 3.5$ ) students. The independent sample  $t$  tests demonstrated significantly lower CCTST mean scores for African American students,  $t(320) = 3.57, p = \leq .000$ , and minority students,  $t(320) = 4.35, p = \leq .000$ .

The examination of test scores for English-as-a-second language (ESL) students revealed lower mean test scores on the NET composite ( $M = 71.46, SD = 9.8$ ) and the NET reading tests ( $M = 58.88, SD = 14.5$ ). Independent sample  $t$  tests demonstrated significantly lower mean scores for the NET composite,  $t(488) = 2.82, p = .005$  and NET reading sub-tests,  $t(487) = 3.69, p = .000$ . A summary of NET as well as CCTST means, and standard deviations by gender, race/ethnicity, and English-as-a-second language status is provided in Table 21.

Table 21

*Nursing Entrance Test Score Means and Standard Deviations by Gender, Race/Ethnicity, and English-as-a-Second Language*

Group	N	Composite M (SD)	Math M (SD)	Reading M (SD)	CCTST M (SD) /N
<b>Gender</b>					
Female	469	74.49 (5.7)	83.97 (10.4)	64.6 (13.2)	16.13 (3.9) N=295
Male	44	79.59 (5.7)	89.23 (7.2)	69.64 (9.93)	16.72 (4.1) N=29
<b>Race/Ethnicity</b>					
White	407	75.83 (9.1)	85.20 (9.7)	66.29 (12.2)	16.60 (3.9) N=264
African American	61	69.54 (10.9)	77.92 (12.2)	60.89 (15.89)	14.05 (3.5) N=37
Hispanic	13	*	*	*	*
Asian	20	*	*	*	*
Native American	2	*	*	*	*
Minority	96	71.54 (10.3)	81.04 (11.7)	61.85 (15.5)	14.21 (3.5) N=58
<b>English-as-a- Second-language</b>					
Yes	41	71.46 (9.8)	83.83 (11.6)	58.88 (14.5)	14.08 (3.9) N=25

\*number of students in group too small for reporting means0

The means, medians, and standard deviations for the Nurse Entrance Test (NET) and California Critical Thinking Skills Test (CCTST) were also investigated across the groups by educational background, admissions type, and enrollment status. Among these groups, differences were seen in achievement test scores by educational background and enrollment status. Second-degree students showed higher mean NET composite scores ( $M = 78.16$ ,  $SD = 7.7$ ) than FTIAC students ( $M = 74.48$ ,  $SD = 9.0$ ), with the independent sample  $t$  test significant at  $t(157) = 2.71$ ,  $p = .007$ .

Additionally, part-time students showed lower NET composite and NET reading scores than did full-time students. Full-time students showed a mean NET composite score of 75.98, with a standard deviation of 8.7, while part-time students earned a mean of 72.13 with a standard deviation of 10.8. The independent  $t$  test was significant at  $t(510) = 4.16, p = \leq .000$ . On the NET reading sub-test, the full-time students' mean score was 67.07 with a standard deviation of 11.5, while part-time students' mean score was 60.95 with a standard deviation of 15.4 and a significant  $t$  test of  $t(509) = 4.86, p = \leq .000$ . The details of the NET and CCTST mean and standard deviation scores by educational background, admissions type, and enrollment status are included in Table 22.

**Test of Essential Academic Skills.** The mean scores on the Test of Essential Academic Skills (TEAS) and the ATI Critical Thinking Test (ATI-CTT) were examined for groups by gender, race/ethnicity, English-as-a-second language (ESL), educational background, admissions type, and enrollment status. No significant differences were found in TEAS achievement scores between groups by gender. Differences by racial/ethnic group were not computed because of small sample sizes except for ATI-CTT scores, which had adequate group sizes for comparison. The ATI-CTT test showed differences in mean ATI-CTT scores between white students ( $M = 73.86, SD = 8.5$ ) and minority students ( $M = 67.58, SD = 10.3$ ), with a significant independent  $t$  test of  $t(296) = 4.28, p = \leq .000$ . Tables 23 and 24 provide a summary of TEAS and ATI-CTT means and standard deviations across groups by gender, racial/ethnic, and ESL status as well as by educational background, admissions type, and enrollment status. Table 25 provides details of the  $t$  test results for ATI-CTT by race/ethnicity.

Table 22

*Nursing Entrance Test (NET) Score Means and Standard Deviations by Educational Background, Enrollment Status, and Admission Status*

Group	N	Composite M (SD)	Math M (SD)	Reading M (SD)	CCTST M (SD) /N
<b>Educational Background</b>					
FTIAC	89	74.48 (9.0)	84.73 (8.8)	65.07 (12.9)	16.23 (4.2) N=53
Transfer	354	74.41 (9.8)	83.90 (10.6)	65.07 (12.9)	15.85 (3.7) N=226
Second Degree	70	78.16 (7.7)	86.66 (9.9)	68.94 (12.6)	17.82 (4.0) N=45
<b>Admission Type</b>					
Pre-Nursing	50	76.74 (8.1)	85.62 (9.2)	68.52 (11.2)	* N=1
Nursing	460	74.75 (9.6)	84.27 (10.4)	65.10 (13.1)	16.20 (3.9) N=320
<b>Enrollment Type</b>					
Full-time	372	75.98 (8.7)	84.95 (9.8)	67.07 (11.5)	16.45 (3.6) N=229
Part-time	140	72.13 (10.8)	82.90 (11.2)	60.95 (15.4)	15.54 (4.4) N=94

In summary, the results of achievement score analyses were counter to the research hypotheses that no differences would be found in achievement scores on nursing examination tests between groups. In fact, several differences were noted in achievement scores with regard to gender, race/ethnicity, and ESL status. Specifically, male students demonstrated higher mean scores on NET composite and mathematics scores than female students. White students demonstrated higher mean scores (i.e., NET composite, NET mathematics, NET reading, and CCTST) than African American and minority students; ESL students demonstrated significantly lower achievement scores on the NET composite and the NET reading than non-ESL students. With regard to TEAS and ATI-CTT scores, little variation in scores across groups occurred, perhaps because of the homogeneity of the sample of students

taking these examinations (i.e., largely full-time white female students). The most significant variation seen was in ATI-CTT mean scores between white and minority students, with white students having significantly higher ATI-CTT mean scores than minority students.

Table 23

*Test of Essential Academic Skills (TEAS) Means and Standard Deviation scores by Gender, Race/Ethnicity, and English-as-a-Second Language*

Group	N	C M (SD)	Mth M (SD)	Rd M (SD)	Vbl M (SD)	Sci M (SD)	ATI-CTT M (SD) / N
<b>Gender</b>							
Female	117	82.74 (5.4)	76.15 (10.7)	92.05 (5.4)	84.57 (6.6)	77.07 (8.8)	72.90 (9.1) N=269
Male	21	82.99 (4.8)	79.79 (12.1)	90.83 (6.1)	82.36 (5.8)	78.08 (8.1)	72.78 (9.5) N=36
<b>Race/Ethnicity</b>							
White	129	82.86 (5.3)	76.45 (10.9)	92.11 (5.0)	84.41 (6.3)	77.50 (8.7)	73.86 (8.5) N=256
African American	2	*	*	*	*	*	65.26 (9.9) N=23
Hispanic	2	*	*	*	*	*	*
Asian	4	*	*	*	*	*	*
Native American	0	*	*	*	*	*	*
Minority	8	81.18 (5.5)	79.45 (12.3)	88.13 (10.3)	81.34 (9.8)	73.34 (8.6)	67.58 (10.3) N=42
<b>English as a Second Language</b>							
Yes	10	*	*	*	*	*	67.85 (10.9) N=24

C=composite; Mth=mathematics; Rd=reading; Vbl=verbal; Sci=science; ATI-CTT=ATI critical thinking test

\*number too small to report means

Table 24

*Test of Essential Academic Skills (TEAS) Score Means and Standard Deviation by Educational Background, Enrollment Status, and Admission Status*

Group	N	C M (SD)	Mth M (SD)	Rd M (SD)	Vbl M (SD)	Sci M (SD)	ATI-CTT M (SD) / N
<b>Educational Background</b>							
FTIAC	30	80.91 (5.2)	71.26 (11.8)	90.92 (5.7)	84.41 (5.4)	75.33 (8.8)	71.77 (8.1) N=62
Transfer	30	82.90 (5.1)	77.78 (10.2)	92.15 (5.3)	83.54 (6.7)	77.24 (8.4)	72.80 (9.6)
Second Degree	15	*	*	*	*	*	75.20 (8.4) N=37
<b>Admissions Type</b>							
Pre-Nursing	9	*	*	*	*	*	73.84 (8.4) N=54
Nursing	129	82.79 (5.4)	77.00 (11.1)	91.82 (5.5)	84.09 (6.7)	77.21 (8.9)	72.67 (9.4) N=251
<b>Enrollment Type</b>							
Full-time	128	82.79 (5.2)	76.42 (10.8)	92.13 (5.1)	84.32 (6.4)	77.22 (8.9)	72.75 (9.3) N=269
Part-time	10	*	*	*	*	*	*

\*N=fewer than 30; ATI-CTT=ATI critical thinking test; C=composite; Mth=math; Rd=reading; Sci=science; Vbl=verbal

Table 25

*ATI Critical Thinking Test by Race/Ethnicity as Means, Standard Deviations, and t-test results*

Group	Number of Students	Mean	Standard Deviation	t-test	df	Significance
White	256	73.86	8.5			
Minority	42	67.58	10.3	4.28	296	.000

### **Term-One Outcome Analyses**

The outcome variable for this study was term-one success, which was defined in these two ways: a) categorically as passed/failed/withdrew passing/withdrew failing and b) as an interval/ratio variable, term-one grade-point average (GPA). To test the hypothesis that there will be no significant difference in term-one outcome by group, term-one grade-point averages were first examined across groups using descriptive statistics. Then group differences in term-one outcome between the groups and between students who passed or failed were examined utilizing inferential statistics, *t*-tests, and chi-square analyses. These data will be presented in the following section and summarized in Tables 26 through 35.

The term-one cumulative grade-point averages were examined for groups by gender, race/ethnicity, and English-as-a-second language (ESL). The computed means, medians, and standard deviations showed that female ( $M = 2.93$ ,  $SD = .692$ ) and male ( $M = 2.94$ ,  $SD = .676$ ) students' term-one cumulative grade-point averages were nearly the same. However, significantly lower term-one grade-point averages were found for ESL ( $M = 2.46$ ,  $SD = .852$ ), African American ( $M = 2.42$ ,  $SD = .888$ ), and minority ( $M = 2.48$ ,  $SD = .899$ ) students (Table 23.).

The *t*-tests performed on term-one grade-point average demonstrated significantly lower term-one GPAs for these groups: a) ESL students than non-ESL students,  $t(608) = 5.39$ ,  $p \leq .000$ , b) African American students than all other students,  $t(615) = 6.28$ ,  $p \leq .000$ , and minority students than all other students,  $t(615) = 7.45$ ,  $p \leq .000$ . Details of the *t*-test analyses are provided in Table 27.

Table 26

*Means and Standard Deviation for Term-One Grade-Point Average by Gender, Race/Ethnicity, English-as-a-Second Language Status*

Group	N	Mean	Standard Deviation
<b>Gender</b>			
Female	563	2.93	.692
Male	63	2.94	.676
<b>Race/Ethnicity</b>			
White	522	3.02	.594
African American	57	2.42	.888
Hispanic	15	2.84	.904
Asian	22	2.37	.922
Native American	2	3.10	.579
Minority	95	2.48	.899
<b>English-as-a-Second language</b>			
No	562	2.99	.639
Yes	48	2.46	.852

Table 27

*Term-One Grade-Point-Averages by Race/Ethnicity and English-as-a-Second-Language as Means, Standard Deviations, and t-test Results*

Group	Number of Students	Mean	Standard Deviation	t-test	df	Significance
<b>Race/Ethnicity</b>						
White	522	3.03	.594			
African American	57	2.42	.888	6.28	615	.000
Minority	95	2.48	.899	7.45	615	.000
<b>ESL</b>						
No	562	2.99	.639			
Yes	48	2.46	.852	5.39	608	.000

The means, medians, standard deviations, and score ranges for term-one cumulative GPA were also examined across the sub-groups by educational background, admissions type, and enrollment status. The means and standard deviations for term-one cumulative GPA by educational background, enrollment status, and admissions status are provided in Table 28.

Table 28

*Means and Standard Deviations for Term-One Grade-Point Average by Educational Background, Enrollment Type, and Admissions Status*

Group	N	Mean	Standard Deviation
Educational Background			
FTIAC	117	2.94	.645
Transfer	428	2.90	.713
Second Degree	81	3.09	.604
Admissions Type			
Pre-Nursing	59	2.98	.588
Nursing	564	2.93	.696
Enrollment Type			
Full-time	486	3.00	.637
Part-time	139	2.70	.809

The only difference identified in mean term-one cumulative GPA across these groups was by enrollment status. Part-time students had lower mean term-one GPAs ( $M = 2.70$ ,  $SD = .809$ ) than did full-time students ( $M = 3.00$ ,  $SD = .637$ ). The difference was significant on the  $t$  test,  $t(623) = 4.56$ ,  $p \leq .000$ . Details of the  $t$ -test analysis are presented in Table 29.

Analysis of term-one outcome by categorical coding demonstrated nearly equal pass rates for female (73.9%) and male students (75.8%). However, substantially lower pass rates were noted for African American (38.1%), minority (44.2%), ESL (45.1%), and part-time (57%) students (Table 30).

Table 29

*Term-One GPA by Enrollment Type as Means, Standard Deviations, and t-test Results*

Group	Number of Students	Mean	Standard Deviation	t-test	df	Significance
Full-time	486	3.00	.637			
Part-time	139	2.70	.809	4.56	623	.000

Table 30

*Term-One Outcome by Pass, Fail, Withdrew Passing, Withdrew Failing by Gender, Race/Ethnicity, and ESL Status*

Group	Passed N (%)	Failed N (%)	Withdrew Passing N (%)	Withdrew Failing
Gender				
Female	430 (73.9)	108 (18.9)	12 (2.1)	32 (5.5)
Male	50 (75.8)	11 (16.7)	0 (0)	5 (7.6)
Race/Ethnicity				
White	429 (80.5)	72 (13.5)	10 (1.9)	22 (4.1)
African American	24 (38.1)	31 (49.2)	0 (0)	8 (12.7)
Minority	46 (44.2)	43 (41.3)	10 (1.9)	14 (13.5)
English-as-a-Second language				
Yes	23 (45.1)	21 (41.2)	1 (2.0)	6 (11.8)

Additional analyses were conducted to ascertain the extent of difference between groups. Chi-square analysis revealed substantial significant differences in term-one outcome for each of these sub-groups. The results of the test were significantly different for African American students than others, indicating significantly lower proportions of African American students passing than expected,  $\chi^2(3, N=637) = 57.41, p \leq .000$ . Similarly, when compared to others,

minority students had significantly lower pass rates than expected,  $\chi^2(3, N=637) = 66.53, p \leq .000$ , as did ESL students,  $\chi^2(3, N=625) = 30.48, p \leq .000$ . The analysis of groups based on the categories of educational background, enrollment status, and admissions status showed only one group with significant differences (Table 31).

Table 31

*Term-One Outcome by Pass, Fail, Withdrew Passing, Withdrew Failing by Educational Background, Admissions Type, and Enrollment Status*

Group	Passed N (%)	Failed N (%)	Withdrew Passing N (%)	Withdrew Failing N (%)
<b>Educational Background</b>				
FTIAC	91 (76.5%)	21 (17.6%)	3 (2.5%)	4 (3.4%)
Transfer	325 (73.4%)	85 (19.2%)	6 (1.4%)	27 (6.1%)
Second Degree	64 (74.4%)	13 (15.1%)	3 (3.5%)	6 (7.0%)
<b>Admission Type</b>				
Pre-Nursing	48 (81.4%)	7 (11.9%)	1 (1.7%)	3 (5.1%)
Nursing	432 (73.4%)	109 (18.6%)	11 (1.9%)	34 (5.8%)
<b>Enrollment Type</b>				
Full-time	395 (79.3%)	76 (15.3%)	7 (1.4%)	20 (4.0%)
Part-time	85 (57%)	42 (28.2%)	5 (3.4%)	17 (11.4%)

Chi-square analysis also showed significant results for part-time versus full-time students with significantly lower proportions of part-time students passing than expected,  $\chi^2(3, N=647) = 31.49, p \leq .000$ . Details of significant results from chi-square analyses for term-one outcome by race/ethnicity, ESL, and enrollment status are presented in Table 32.

Table 32

*Chi-square Results for Term-One Outcome by Race/Ethnicity, English-as-a-Second Language, and Enrollment Type*

Group	$\chi^2$	<i>df</i>	Significance
Race/Ethnicity			
White			
African American	57.41	3	.000
Minority	66.53	3	.000
ESL			
Yes	30.48	3	.000
Enrollment Type			
Full-time			
Part-time	31.49	3	.000

In summary, the hypothesis that there will be no significant differences in groups based on term-one outcome is not supported. In fact, significant differences were seen in students' term-one outcome (i.e., pass rate) depending upon a number of background characteristics (i.e., race/ethnicity, ESL status, and enrollment status).

Further analyses were conducted to examine Hypotheses 4 and 5. These hypotheses posed that there will be no significant relationship between term-one outcome and PNUR-GPA, nursing entrance examination, or critical-thinking test scores. The details of students' PNUR-GPA and term-one GPA based on term-one categorization as passed or failed are presented in Table 33 and 34. The computed means and standard deviations showed that students who failed term-one ( $M= 3.06$ ,  $SD= .305$ ) had lower entry cumulative PNUR-GPAs than those students who passed ( $M= 3.47$ ,  $SD= .348$ ). Additionally, the final term-one GPA

was significantly lower for students who failed term-one ( $M= 1.98$ ,  $SD= .642$ ) than those who passed all term-one courses, ( $M= 3.21$ ,  $SD= .397$ ).

Table 33

*Pre-Nursing Cumulative Grade-Point Averages by Pass/Fail Status as Means, Standard Deviations, and t-test Results*

Term-One Outcome	Number of Students	Mean	Standard Deviation	t-test	df	Significance
Pass	492	3.47	.348	12.94	644	.000
Fail	154	3.06	.305			

Table 34

*Term-One Grade-Point Averages by Pass/Fail Status as Means, Standard Deviations, and t-test Results*

Term-One Outcome	Number of Students	Mean	Standard Deviation	t-test	df	Significance
Pass	482	3.21	.397	27.5	621	.000
Fail	141	1.98	.642			

Details of the mean test scores and results of *t*-tests based on classification as passed or failed for term-one are included in Table 35. This analysis demonstrated that as compared to students who passed term-one, students who failed term-one had low scores on the NET composite ( $M= 70.68$  vs.  $M=76.44$ ), NET mathematics ( $M= 80.93$  vs.  $M=85.68$ ), NET reading ( $M=59.83$  vs.  $M=67.33$ , and both the CCTST ( $M=13.63$  vs.  $M=16.96$ ) and ATI-CTT ( $M=67.75$  vs.  $M= 74.28$ ) tests, respectively.

Table 35

*Nursing Entrance Test (NET) and Critical Thinking Skills Test Score Means, Standard Deviations, and t-test Results by Term-One Pass/Fail Status*

Test/Term-One Outcome	Number of Students	Mean	Standard Deviation	t-test	df	Significance
NET Composite						
Pass	371	76.44	8.71	6.37	508	.000
Fail	139	70.68	10.09			
NET Mathematics						
Pass	371	85.68	9.55	4.75	508	.000
Fail	139	80.83	11.29			
NET Reading						
Pass	371	67.33	12.30	6.00	507	.000
Fail	138	59.83	13.12			
CCTST						
Pass	244	16.96	3.68	7.08	320	.000
Fail	78	13.63	3.42			
ATI-CTT						
Pass	242	74.28	8.43	5.25	302	.000
Fail	62	67.75	9.86			

Additional analyses were conducted to ascertain if differences between students who passed or failed were significant. The results of the *t* tests were significant. Students who failed term-one had significantly lower PNUR-GPAs,  $t(644) = 12.94, p \leq .000$ ; term-one GPAs,  $t(621) = 27.5, p \leq .000$ ; NET composite,  $t(508) = 6.37, p \leq .000$ ; NET mathematics,  $t(508) = 4.75, p \leq .000$ ; NET reading,  $t(507) = 6.00, p \leq .000$ ; CCTST,  $t$

(302) = 5.25,  $p \leq .000$ ; and ATI-CTT,  $t(320) = 7.08$ ,  $p \leq .000$  test scores. Analyses were not completed on TEAS composite or TEAS sub-test mean scores due to the small group size (i.e., 15) of students who were classified as failing term-one.

These data were counter to the proposed hypotheses. Because significant differences in PNUR-GPA, mean test scores on the NET as well as CCTST, and ATI-CTT were found, Hypotheses 4 and 5 were not supported.

### **Predictor Correlations**

The importance of early academic success in the nursing major and the ability of nursing faculty to identify which variables most closely correlate as predictors of academic success for nursing students were further examined. The Pearson correlation coefficients for each of the single GPA and test-score predictors on term-one outcome were computed. Table 36 contains the details of the predictor correlation coefficients for single predictors on term-one outcome (i.e., term-one GPA). Results of this analysis demonstrated that most of the predictors selected for investigation in this study correlated positively with term-one GPA at a two-tailed significance of  $p \leq 0.05$  or  $p \leq 0.01$ . Only two predictors (i.e., critical seven GPA and TEAS mathematics score) were not significantly correlated with term-one outcome as measured by GPA. Six predictors (i.e., PNUR-GPA, NET composite, NET mathematics, NET reading, CCTST, and ATI-CTT scores) showed significant predictor correlation with term-one GPA (i.e.,  $p \leq .000$  at a two-tailed significance of 0.01).

### **Multiple Regression Analyses**

The assessment of a single predictor on an outcome variable is useful albeit limited; if a researcher looks only at the relationship between two variables, he or she ignores the

contribution other variables might add to the outcome variable, which is a cause for concern (Licht, 2008, p. 36). Multiple regression is a powerful statistical tool that can be used to

Table 36

*Pearson Correlation Coefficients for Single Predictor Variables on Term-One Outcome*

Predictor	N	Coefficient	Significance
PNUR-GPA	625	.609**	.000
Critical Seven GPA	617	.058	.152
NET- Composite	490	.354**	.000
NET Mathematics	490	.276**	.000
NET Reading	489	.320**	.000
TEAS Composite	137	.249**	.003
TEAS Mathematics	137	.064	.459
TEAS Reading	137	.277**	.001
TEAS Verbal	137	.213*	.012
TEAS Science	137	.266**	.002
CCTST	315	.408**	.000
ATI-CTT	299	.376**	.000

\*significant at 0.05 two-tailed; \*\*significant at 0.01 two-tailed

examine the incremental, combined, and independent contribution of predictors as well as the validity of a set of predictors over another set of predictors (Green & Salkind, 2005, p. 284).

Since this investigator sought to examine multiple predictors commonly used to screen students for admissions to the nursing major and their relationship to early academic success in the major as measured by term-one GPA, multiple regression analyses of data were performed.

Two unordered multiple regression analyses were conducted. First, a multiple regression analysis was conducted to create a model to represent the combination of admissions factors that would best predict term-one outcome for students completing the NET and CCTST examinations. Second, a multiple regression analysis was conducted to create a model representing the combination of admissions factors best predicting term-one outcome for students completing the TEAS and ATI-CTT examinations. Last, to test Hypothesis 6 of this study, the resulting prediction models were analyzed to evaluate if any differences existed in predictive efficiency between the two sets of entrance examinations.

Prior to performing multiple regression analyses, the underlying assumptions related to MCR were tested. First, normality was examined for the predictor and criterion variable through the assessment of histograms. Both predictor and criterion continuous data variables were found to be normally distributed. Second, correlations of predictor variables were examined for intercorrelation; no significant intercorrelations existed for predictor variables as utilized in the multiple regression analyses (Appendix D). Last, linearity criteria were met and were demonstrated in the analyses of single predictors on the outcome predictor which revealed positive Pearson correlation coefficients (Table 36). Additionally, examination of predictor variables on criterion-variable scatterplots were examined, which demonstrated a straight-line relationship between predictors and the outcome variable. The presence of homoscedasticity was also reviewed through the examination of scatterplots, which demonstrated equal spread of variance around variables.

### **Multiple Regression Analyses for the NET**

In addition to demographic and background variables, 6 predictors were entered into the multiple regression analyses for NET test-takers to determine the multiple correlations

between these predictors and term-one outcome. These six predictors included PNUR-GPA, critical seven GPA, NET composite score, NET mathematics score, NET reading score, and CCTST score. This set of predictors was constructed based on the subset of tests the student took as a NET test-taker.

The regression equation for this subset of tests indicated that only PNUR-GPA and CCTST scores were significant,  $R^2 = .434$ , adjusted  $R^2 = .430$ ,  $F = 116.48$ ,  $df 2, 306$ , significance of  $F = .000$ . These results demonstrated that 43% of the variance in term-one outcome as measured by term-one GPA can be predicted by PNUR-GPA and the CCTST score for NET test-takers. Examination of the Beta coefficients for PNUR-GPA demonstrated that PNUR GPA accounted for 30.58% of the variance, while the CCTST score accounted for 4.6% of the variance. The combined effect of these predictors shows an addition of 8.2%, accounting for the total variance explained by these predictors of 43%.

Additionally, these results indicate that critical seven GPA, NET-composite score, NET mathematics score, and NET reading score offer little incremental predictive value. The resulting predictive formula for NET test-takers was:

Using Un-standardized Test Scores:

$$\text{GPA} = 0.956 \times (\text{PNUR-GPA}) + 0.037 \times \text{CCTST score} - .871$$

Using Standardized Test Scores:

$$\text{GPA} = 0.553 \times (\text{PNUR-GPA}) + .215 \times \text{CCTST score}$$

Therefore, these findings were counter to Hypotheses 4 and 5, that there will be no significant relationship between term-one outcome and nursing entrance test scores, PNUR-GPA, or critical thinking test scores. These results showed that PNUR-GPA is significantly correlated to term-one GPA and that when combined with CCTST scores predicted 43% of

the variance in term-one GPA. However, the null hypotheses were not supported in that NET composite, mathematics, and reading scores were not significantly related to term-one outcome (Appendix E and Appendix F).

### **Multiple Regression Analyses for the TEAS**

Regression analyses for TEAS test-takers included the examination of demographic and background variables as well as eight other predictors. These eight predictors were PNUR-GPA, Critical seven GPA, TEAS composite score, TEAS mathematics score, TEAS reading score, TEAS verbal score, TEAS science score, and ATI-CTT score. This predictor set was identified based on the set of tests taken by TEAS test-takers.

Unlike the NET regression analysis, the regression analysis for TEAS test-takers initially showed these three predictors as significant: PNUR-GPA, ATI-CTT, and the TEAS mathematics score, which had a negative correlation of  $-.013$ ,  $p = .024$  to term-one outcome. To understand this unexpected result, data were re-analyzed by gender, ethnicity, pass/fail, and ESL groups,  $t$  tests for TEAS mathematics and term-one GPA. This analysis showed that Asian students with English-as-a-second language represented the only group demonstrating a TEAS mathematics score with a negative correlation to term-one GPA. Since this group represented 14 students, a new variable was coded (Asian-ESL); students in this group were excluded from the regression analysis, and the process was repeated.

The resulting regression analysis produced results similar to that of NET test-takers; the regression equation for this subset of tests indicated that only PNUR-GPA and ATI-CTT scores were significant,  $R^2 = .477$ , adjusted  $R^2 = .473$ ,  $F = 128.97$ ,  $df 2, 285$ , significance of  $F = .000$ . These results demonstrated that 48% of the variance in term-one outcome as measured by term-one GPA was predicted by PNUR-GPA and ATI-CTT scores for TEAS

test-takers. Once again, further examination of the Beta coefficients demonstrated that PNUR GPA accounted for 32.6% of the variance, while the ATI-CTT score accounted for 6.55% of the variance. The combined effect of these two predictors provided an addition of 8.55%, adding to the total variance explained by these predictors of 47.7 %.

Based on these results, critical seven GPA, TEAS-composite score, TEAS mathematics score, TEAS reading score, TEAS verbal score, and TEAS science score offered little incremental predictive value. The resulting predictive formula for TEAS test-takers was:

Using Un-standardized Test Scores:

$$\text{GPA} = 0.952 \times (\text{PNUR-GPA}) + 0.018 \times \text{ATI-CTT score} - 1.528$$

Using Standardized Test Scores:

$$\text{GPA} = 0.571 \times (\text{PNUR-GPA}) + 0.256 \times \text{ATI-CTT score}$$

Comparable to results noted in the NET regression analysis, the TEAS regression analysis demonstrated findings counter to Hypotheses 4 and 5. In fact, PNUR-GPA and the ATI-CTT scores correlated with term-one outcome, predicting 48% of the variance in term-one outcome for TEAS test-takers. The null hypotheses were not supported in that critical seven GPA, and TEAS scores (composite, mathematics, reading, verbal, and science) contributed little to the prediction of term-one GPA. Additionally, a spurious effect was seen initially in this regression analysis, in that Asian-ESL students demonstrated TEAS mathematics scores which correlated negatively with term-one GPA. This result was likely a surrogate for some other unexplained factor but was not further explored as the group size was too small and, therefore, precluded further analysis.

**Predictive Efficiency between NET and TEAS Examinations**

To examine Hypothesis 6, the two resulting regression analyses were examined for strength of prediction. This analysis demonstrated that the TEAS test group-predictor set demonstrated greater predictive efficiency in determining term-one GPA, as the ATI-CTT had a stronger Beta coefficient than the CCTST. The standardized Beta coefficient for the ATI-CTT was .256, while the standardized Beta coefficient for the CCTST was .215.

**Summary**

In this single-site study, the researcher investigated variables that may predict term-one academic success in baccalaureate nursing students. The results of data analysis demonstrated that of the variables investigated, 43% to 48% of the variance in term-one outcome was predicted by these two main variables: pre-nursing GPA and critical thinking test score. Although significant differences in nursing entrance test scores (i.e., NET and TEAS) existed between students who failed term-one versus students who passed term-one, these scores did not add to prediction of term-one outcome when examined by multiple regression. Additionally, through multiple regression analyses, the researcher found that predictive efficiency was stronger with the model utilizing pre-nursing GPA and ATI Critical Thinking Test scores.

Another important finding through this analysis of data was that significant differences in term-one success surfaced between groups based on enrollment status (i.e., part-time vs. full-time), race/ethnicity, and ESL status. Chapter 5 provides a summary of the study, discussion of results, conclusions, recommendations for further research, and recommendations for practice.

## CHAPTER 5: SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS FOR FURTHER RESEARCH AND ACTION

The current and predicted shortage of nurses in the United States has placed unprecedented demands on academic program faculty to increase nursing student enrollment. The past eight years have shown a steady increase in the numbers of students applying to nursing programs and a continued decline in the acceptance rate as nursing programs have reached capacity (AACN, 2009). As a result, selective admissions policies and the use of nursing entrance examinations have become commonplace in nursing programs, as faculty members try to identify the students who will be the most likely to succeed in the nursing major (Newton, Smith, Moore, & Magnan, 2007; Spurlock, 2006).

An abundance of research exists about studying predictors of student success on end-of-program outcomes, such as first-time pass rate on the RN licensure examination (NCLEX-RN). However, little research has been conducted on admissions criteria or nursing entrance examinations and their correlation with early academic success in baccalaureate nursing programs.

Therefore, the focus of this study was to address two primary areas of investigation. First, the validity and usefulness of nursing entrance examinations as part of criteria for admission to the nursing major were explored. Second, the predictive efficiency of two specific nursing entrance examinations used for admissions to the nursing major was compared.

The purpose of this chapter is to provide a summary of this research endeavor and to situate the examination of nursing admissions criteria, specifically nurse entrance examination practices, in the context of higher education admissions test research.

Additionally, in this chapter the author will provide research conclusions as well as recommendations for further research and nursing educational practice as derived from the results of this study.

### **Overview**

Historically, increasing the academic success of students admitted to college has been a priority aim of faculty and staff associated with higher education institutions (Zwick, 2002). Higher education institutions have a long history of using grade-point averages and admissions test scores in decision-making processes to select applicants deemed most likely to succeed (Achieve, 2007; Alexander, 2000; Rigol, 2003). As the number of students seeking admissions into college has increased, college entrance examinations have come under increased scrutiny. The facts that college entrance examinations have become high-stakes tests and that college entrance examination scores should play a limited role in college admissions decisions have been addressed by members of higher education organizations as well as advocacy groups and sponsors of admissions tests alike (AERA, 1999; Joint Committee on Testing Practices, 2004; National Association for College Admission Counseling, 1995; The College Board, 2002b).

Testing professionals have continued to proclaim that admissions test scores should never be used as the sole criterion for admissions decisions or as the single reason for disqualifying a student for admissions. Testing experts have also continued to assert that admissions tests are valid predictors of future academic performance and that, when combined with GPA, the scores can aid in the selection of students who are the most academically able to succeed (Linn, 1990; Nobel, 2003; Sawyer, 2007; Zwick, 2002). Proponents of college admissions tests have asserted that high scores on admissions tests can compensate for lower previous

GPA, when students are being evaluated for college admissions (Linn, 2001). Additionally, test supporters have cited advantages that will accrue to higher education institutions, in that test scores provide consistent objective data for decision-making (Bejar & Blew, 1981; The College Board, 2002a). Other institutional benefits cited by examination proponents include being able to process large numbers of applications by using test-score data versus more intensive methods such as interviews or portfolio reviews (Rigol, 2003).

In sharp contrast to these assertions, critics of college admissions tests have pointed out that a test measures only a small sub-set of criteria and relies heavily on verbal and quantitative ability (FairTest.com, 2007; Koretz, 2008). Admissions tests have been shown to be biased against women, minorities, and English-as-a-second-language students (Linn, 1984, 1990; Micceri, 2009; Nobel, 2003; Ramist, Lewis, McCamley-Jenkins, 2001; Shepard, 1993; Zwick, 2002). Also, researchers have confirmed that admissions test scores contribute only a small amount, an additional 6 to 8% of the variance, over the variance predicted by GPA alone, in correlation to college grades (Linn, 1990; Sawyer, 2007; Shepard, 1993).

Criteria for admission to nursing programs have been studied by several researchers who examined end-of-program outcomes such as graduation, cumulative grade-point average (GPA), and first-time pass rate on the nursing licensure examination. Several authors have found pre-nursing cumulative GPA or cumulative GPA in selected pre-requisite coursework to correlate with graduation, cumulative GPA at the end-of-program, and NCLEX-RN success (Beeson & Kissling, 2001; Bolan & Grainger, 2003; Campbell & Dickson, 1996; Hass, Nugent, Rule, 2003; Horton, 2006; Schafer, 2002; Selmonridge & DiBartolo, 2004; Uyehara, Magnussen, Itano, & Zhang, 2007; Vandenhouten, 2008; Wescott, 1997).

A few researchers have examined nursing entrance test scores and their correlation to end-of-program outcomes with differing results. Roat (2008) found NET sub-test scores on reading and mathematics to be significantly correlated with cumulative nursing GPA, and the NET mathematics sub-test score to be significantly correlated with NCLEX-RN success. However, the number of test-takers in the study group was only 26 students. In a study of 401 baccalaureate nursing students, Schafer (2002) found a low predictive value for the NET composite scores in terms of their correlation to NCLEX-RN success.

Regarding early academic success, very little literature is available regarding the impact of nursing entrance examination scores on early academic success in the nursing major. Only two studies have been conducted about early academic success in the nursing major with the focus of the research on baccalaureate programming. In a study of 164 baccalaureate students, Newton et al. (2007) found that the nursing entrance examination, TEAS, accounted for 4.8% of the variance in early academic success (defined as the cumulative GPA in four first-term nursing courses). In a second study of early academic success for baccalaureate program nursing majors, Norman (2006) found the HESI A2 examination, a pre-nursing entrance test, to correlate positively with first-year nursing cumulative grade-point average and then recommended the use of examination scores for admissions criteria.

With the current controversy about admissions testing in higher education in mind and the gap in the literature on the topic of early academic success in baccalaureate nursing programs, this study was undertaken. Data were collected from a retrospective review of student records of 651 first-term nursing students enrolled in an upper-division nursing program at a private Catholic university located in the Midwest from Fall 2003 through Fall

2008. The criterion variable for this study was term-one outcome (success). Term-one outcome was defined in these two ways: first, by cumulative GPA in four term-one nursing courses and, second, by categories of pass, fail, withdrew passing, and withdrew failing.

Several predictor variables were examined; the variables included the following: a) grade-point average, b) NET mathematics score, c) NET reading score, d) NET comprehensive score, e) critical thinking entry test score, f) TEAS reading score, g) TEAS verbal score, h) TEAS mathematics score, i) TEAS science score, and j) TEAS composite score. These specific group comparisons were also examined as predictors: a) gender; b) race/ethnicity (i.e., White, African American, Hispanic, Asian, Native American); c) English as-a-second-language (i.e., native versus non-native speakers); d) educational background (i.e., FTIAC, transfer, second-degree; e) admission types (i.e., pre-nursing, nursing); and f) enrollment status (i.e., full-time, part-time).

Six hypotheses were posed for this research study; these were

- There will be no significant difference in grade-point average by educational background, enrollment status, or admissions status.
- There will be no significant difference in achievement scores on nursing examinations by educational background, enrollment status, or admissions status.
- There will be no significant relationship in term-one outcome by educational background, enrollment status, or admissions status.
- There will be no significant relationship between term-one outcome and critical-thinking test score.
- There will be no significant relationship between term-one outcome and pre-nursing grade-point averages or nursing entrance test scores.

- There will be no significant difference between the predictive efficiency of the NET and TEAS examinations or critical-thinking tests.

### **Research Hypotheses Discussion**

A quantitative methodology was used for this study, and the theoretical framework of validity was applied to situate this study in the context of informed assessment research practices. Descriptive statistics were utilized to examine the population by a) background characteristics (age, gender, race/ethnicity, English-as-a-second language); b) educational background (FTIAC, transfer, second-degree); c) admission type (NUR vs. PNUR); and d) enrollment status (full-time, part-time). Inferential statistics were applied (i.e., *t* test, chi-square) to examine relationships between GPA, nurse entrance examination scores for each group and term-one outcome (Pass/Fail, cumulative term-one GPA). Last, multiple regression analysis was applied to determine a) which variables best predicted term-one outcome and b) if the two nurse entrance examinations differed in their predictive efficiency.

This investigation was conducted in response to a current critical issue in higher education and to a gap in nursing research (i.e., the validity of criteria used for nursing admissions). Nursing admissions is an important topic today given the high demand for nurses because of the current and predicted severe shortage of nurses. Two key factors in nursing education that contribute to the nursing shortage are the extant constraints on educational programs to increase their enrollments and nursing program attrition rates, which are estimated to be as high as 50% in some institutions (Roberts, 2002).

In this research, early academic success was posed as an immediate short-term solution to the nursing shortage. Increasing retention and persistence of students in nursing programs

can first be addressed by admitting students who are most likely to succeed and limiting the rejection of qualified students.

Significant findings related to each of the 6 hypotheses posed in this study and the related conclusions for each will be presented next.

**Hypothesis 1: There will be no significant difference in grade-point average by educational background, enrollment status, or admissions status.**

In investigating grade-point averages for biases among groups, no differences were demonstrated in cumulative pre-nursing GPA by gender, ESL status, educational background, or admissions type. However, differences were found in a) cumulative pre-nursing GPA by race/ethnicity, and enrollment type and b) critical-seven GPA by gender, race/ethnicity, enrollment status, and educational background. Therefore, Hypothesis 1 was not supported based on the following findings:

- Students displayed significantly different pre-nursing and critical-seven grade-point averages by race/ethnic group.

Cumulative pre-nursing grade-point averages were significantly lower for African-American ( $p = \leq .000$ ) and minority ( $p = \leq .000$ ) students. These differences were also seen with critical seven GPA being significantly lower for African American ( $p = \leq .000$ ) and minority students ( $p = .004$ ) than white students. This finding is consistent with Endres' (1997) research. Specifically, Endres (1997) found that mean cumulative pre-nursing GPA was lower in African American students than white students, resulting in lower admission rates for African American students even though their grade-point averages met acceptable admissions standards.

Similar to other validity studies in higher education that have examined students' mean college GPA, this researcher found lower mean cumulative grade-point averages for African-American and minority students (Nobel, 2002; Pennock-Roman, 1994). Possible explanations for this difference are that group variations may arise from conditions such as differences in pre-nursing preparation, unequal educational opportunity, biased grading practices, and/or institutional factors that have a different impact on minority students than white students.

Conclusions drawn from the differences seen in this study among racial groups must be interpreted cautiously since all minority students were grouped into one category to maximize sample size for analysis, and the sub-group of African American students composed the largest number (N= 63 or 61%) of students in the minority category. Therefore, this category primarily represents African American students and underrepresents Latino, Asian, and Native American students; consequently, generalization of these findings to any sub-group other than African American is inappropriate.

Persistent differences were demonstrated among African American and minority groups across several predictors as well as the outcome variable in this study. These differences will be discussed throughout this chapter.

- Differences were seen in critical seven grade-point averages for minority, female transfer, and part-time students.

Of the 651 subjects in this study, 617 had a critical seven GPA available for analysis. Critical seven grade-point average had some correlation with pre-nursing grade-point average ( $r=.107, p = <.01$ ) in this study. Similar to other validity studies, this researcher found lower grade-point averages (both PNUR-GPA and critical seven GPA) for African-American and

minority students. As a single predictor, critical-seven GPA was not significantly correlated with term-one GPA ( $r = .058$ ,  $p = .152$ ). When multiple regression analyses were performed, critical-seven did not contribute to the prediction of term-one outcome.

Gender differences were also seen in critical seven GPA; males showed somewhat higher critical seven GPAs than females. This situation may be a reflection of males having higher grades in science courses, which constituted five of the seven course grades examined for the critical seven GPA.

A tendency for males to score higher in science courses has been well documented in the higher education assessment literature (Pennock-Roman, 1994; Young, 2001; Zwick, 2002). Due to the small number of males (10.1%) represented in this study, caution should be exercised in interpreting the significance of this finding. Although these differences were noted, critical seven GPA was not useful as a single predictor for term-one outcome or as a contributor to incremental predictive effectiveness in multivariate analyses.

Cumulative pre-nursing grade-point averages were significantly lower for part-time ( $p \leq .000$ ) students than full-time students. This finding about part-time students may represent a population sampling bias in this study. Self-selection to enroll on a part-time basis or faculty advising into part-time study of academically weaker students or individuals with more factors that may potentially have a negative impact on academic pursuits may explain why part-time students earned significantly lower PNUR-GPAs than full-time students.

Another factor that should be considered is whether part-time status is a surrogate for socioeconomic status. Researchers have suggested that differences in GPA for part-time versus full-time students may be more reflective of students' socioeconomic status than enrollment. For instance, more affluent students have greater resources to support full-time

study and academic achievement than do less affluent students who end up attending college on a part-time basis (Mattern, Shaw, & Williams, 2008; Micceri, 2009).

Part-time students composed a significant group in this study, accounting for 151 (23.2%) of the 651 students. Differences in the performance of the part-time student group persisted across other predictors in this study and are discussed further in this chapter.

In examining for group differences by educational background, differences were found between critical seven GPA for FTIAC students versus transfer students. Transfer students had significantly higher critical seven grade-point averages than FTIAC students ( $p = .040$ ). One plausible explanation for this difference may be that FTIAC students' grades represent greater consistency in grading practices since they were attained at the same educational institution versus those of transfer students. Transfer students may have taken the courses in the critical seven at a variety of institutions versus a single institution as seen in FTIAC students. Course grading variability is a source of bias widely discussed in assessment and validity research (Burton & Ramist, 2001; Ramist, Lewis, McCamley-Jenkins, 1994; Ramist, Lewis, & McCamley-Jenkins, 2001).

These findings support those of Horton (2006), who said educational background (transfer student status) was not a positive or negative predictor of success in the nursing major (i.e., graduation from the nursing major or NCLEX-RN success). Additionally, findings of this study did not support those of Lewis and Lewis (2000), who suggested that transfer students are less likely to be successful in the nursing major, with those transferring from two-year institutions less likely to succeed than FTIAC and four-year transfer students.

**Hypothesis 2: There will be no significant difference in achievement scores on nursing examinations by educational background, enrollment status, or admissions status.**

Two nursing entrance examinations used for admissions to the nursing major were analyzed in this study; these were the Nurse Entrance Examination (NET) and the Test of Essential Academic Skills (TEAS). Additionally, two critical thinking tests given to students in their first-term nursing courses were analyzed for their potential value in predicating early academic success in the nursing major. The analyses of hypothesis testing found significant group differences in test score achievement. Therefore Hypothesis 2 was not supported based on the following:

- Students displayed significantly different scores on the NET, CCTST and ATI-CTT by race/ethnicity, gender, ESL status and enrollment status.

Of the 651 students in this study, most of the students, 513 (78.8%), took the NET as their nursing entrance examination. Analysis of the Nurse Entrance Test for bias among groups yielded several group differences. Gender differences in mean scores were seen between male and female students. Male students had significantly higher NET composite ( $p = .001$ ) and NET mathematics ( $p = .001$ ) scores than female students. However, no differences were noted in NET reading or CCTST scores between males and females. These findings are consistent with other admissions test research which has demonstrated higher scores for males on standardized admissions tests, particularly standardized mathematics tests (Ramist, Lewis, & McCamley-Jenkins, 2001; Zwick, 2002). This gender difference did not surface in the student population who took the TEAS examination for entry into the nursing major.

In examining mean NET and CCTST test scores by race/ethnicity and ESL status, several differences were found. White students demonstrated significantly higher NET composite ( $p = \leq .000$ ), NET reading ( $p = .003$ ), NET mathematics ( $p = \leq .000$ ) and CCTST scores ( $p = \leq .000$ ) than African American students or minority students. Additionally, students with

English-as-a-second-language demonstrated significantly lower NET composite ( $p = .005$ ) and NET reading ( $p = \leq .000$ ) scores than native English speakers. Few nursing scholars have examined predictor differences by race/ethnicity or ESL status; however, several researchers have noted this gap and recommended further research in this area (DiBartolo & Seldomridge, 2005; Sayles, Shelton & Powell, 2003; Schafer, 2002; Symes, 2005; Wescott, 1997). These findings are consistent with broader college entrance test research. Differences in mean scores on college entrance examinations for African American, Hispanic, Native American, and ESL students have been widely documented in higher education admission test research (Nobel, 2003; Young 2001). Many explanations have been identified in the literature for why this bias exists; however, consensus regarding the causes of group differences in college entrance examination test scores has not yet been reached.

Additionally, group differences were found in nurse entrance examination scores between part-time and full-time students. Part-time students had significantly lower NET composite and NET reading scores than full-time students ( $p = \leq .000$ ). Sub-group analyses for the TEAS group of test-takers were not conducted due to the numbers of part-time, minority, and ESL students being fewer than 10 in each category.

The implications of this finding are gripping; in this study population, if a single predictor model were applied using NET test scores solely in admissions, decisions would be biased against female, African American, minority, ESL, and part-time students. Additionally, no validity evidence would exist to support this decision. This research study documents the fact that when multivariate analysis was applied, test scores did not contribute to the prediction of term-one success. In fact, cumulative pre-nursing grade-point average was found to account for most of the variance seen. In terms of CCTST scores, no differences

were found between English-as-a second language speakers and native English-speaking students.

**Hypothesis 3: There will be no significant relationship in term-one outcome by educational background, enrollment status, or admissions status.**

Data analyses revealed significant differences in term-one success by group. Hypothesis 3 was not supported as evidenced by the following findings:

- African American, minority, ESL, and part-time students had a much higher likelihood of term-one failure than white full-time students.

While term-one pass rates were nearly equal for female (73.9%) and male students (75.8%), significantly lower term-one pass rates were documented for African American (38.1%), minority (44.2%), ESL (45.1%), and part-time (57%) students. These differences were statistically significant ( $p = \leq .000$ ) for all of the groups. A comparison of these findings to those from similar studies is not possible since few researchers in nursing have examined student program success rate by race/ethnicity or ESL status; if studies were conducted, the researchers often reported group sizes too small for statistical analyses (Daley, Kirkpatrick, Frazier, Chung, & Moser, 2003; DiBartolo & Seldomridge, 2005; Wescott,, 1997). However, some researchers have reported findings by race/ethnicity classification in studies of NCLEX-RN pass rates and have found statistically higher failure rates for minority students (Byrd, Garza, & Nieswiadomy, 1999; Hass, Nugent, & Rule, 2003; Sayles, Shelton, & Powell, 2003).

**Hypothesis 4: There will be no significant relationship between term-one outcome and critical-thinking test score.**

Counter to the posed hypothesis, scores on critical thinking tests were significantly different for students who passed term-one courses than for students who failed term-one courses; therefore, Hypothesis 4 was not supported.

- Critical Thinking test scores positively correlated with term-one outcome.

In the NET test group, CCTST examination scores proved to be positively correlated ( $r = .408, p = \leq .000$ ) with term-one success. This examination was not taken prior to admissions but after admissions and during the first-term of nursing academic coursework. In single predictor findings, the CCTST was significantly correlated with term-one success; students who passed term-one courses had significantly higher CCTST scores ( $p = \leq .000$ ) than those who failed term-one courses. Additionally, in multivariate analyses, for NET test-takers, the CCTST added incremental value to predicting early academic success, accounting for 4.6% of the variance.

In the TEAS test group, students completed the ATI-CTT during their first semester in the nursing major. Similarly, ATI-CTT test scores were positively correlated with term-one outcome ( $r = .376, p = \leq .000$ ). Again, in single predictor findings the ATI-CTT was significantly correlated with term-one success; students who passed term-one classes had significantly higher ATI-CTT scores than those who failed term-one ( $p = \leq .000$ ). Also, as noted in multivariate analyses, the ATI-CTT added incremental predictive value over cumulative pre-nursing GPA and accounted for 6.55% of the variance.

Since no studies were found examining critical thinking test scores as predictors of early academic success, comparisons with previous research cannot be made. However, one study examined the predictive value of the CCTST for passing NCLEX-RN. In this study

researchers examined pre- and post-program CCTST scores and found that CCTST scores were not predictive of students who passed the NCLEX-RN (Giddens & Gloeckner, 2005).

**Hypothesis 5: There will be no significant relationship between term-one outcome and cumulative pre-nursing GPA or Nursing Entrance Test scores.**

Data analysis revealed two essential findings regarding term-one outcome and cumulative pre-nursing GPA and NET scores as predictors of early academic success in which Hypothesis 5 was not supported.

- Students who failed term-one courses across groups had significantly lower cumulative PNUR-GPAs than students who passed.

A central finding in this study was that cumulative pre-nursing grade-point average was a strong predictor of early academic success. In single predictor analyses, cumulative pre-nursing GPA was positively correlated with term-one outcome ( $r = .609, p = \leq .000$ ). In multivariate analyses cumulative pre-nursing grade-point average was able to account for 30-39% of the variance in term-one achievement for first-term nursing students; and prediction of term-one outcome was only modestly increased with the addition of one other predictor.

Students who failed term-one courses across groups had significantly lower cumulative PNUR-GPAs than students who passed. When entered into multivariate analyses to create a best predictor model, grade-point average predictive strength was somewhat increased when one other predictor was added. These findings were consistent with those of Norman (2006), who said that cumulative pre-nursing GPA significantly correlated with first-year grades of nursing students.

Counter to the findings described by Newton, Smith, Moore and Magnan (2007), who found pre-requisite course GPA to correlate significantly with first-term nursing GPA, this

researcher found that critical seven grade-point average did not correlate significantly with term-one outcome as a single predictor or improve predictive accuracy in multivariate analyses.

These studies differed in that Newton et al. (2007) utilized only one type of GPA for correlation (i.e., critical seven GPA) while this study utilized two different grade-point averages as predictor variables (i.e., cumulative pre-nursing GPA and critical seven GPA). Had only the critical seven GPA been selected for this study, a positive correlation with term-one GPA would have been expected.

- Nursing Entrance Test scores did not correlate positively or negatively with term-one outcome.

Of the 651 students in this study, the majority of students, 513 (78.8%), took the NET as their nursing entrance examination. In single predictor analyses, positive correlations with term-one outcome were found for NET composite ( $r = .354, p = \leq .000$ ), NET mathematics ( $r = .276, p = \leq .000$ ), and NET reading ( $r = .320, p = \leq .000$ ). Additionally,  $t$  tests demonstrated that NET composite, NET mathematics, and NET reading scores were significantly lower ( $p = \leq .000$ ) for students who failed term-one courses. However, when regression analyses were performed, findings negated the value of significant correlations found with  $t$ -test analyses; NET examination scores did not contribute to the prediction of students who passed term-one courses. Almost all of the variance seen between passing and failing students was accounted for by cumulative pre-nursing grade-point average.

With regard to nursing entrance test scores, this study partially supported the findings of other researchers who found that nursing entrance examination scores correlated with first-term or first-year GPA (Newton, Smith, Moore, & Magnan 2007; Norman, 2006) as seen on

*t*-tests in single predictor analyses. However, counter to Newton's finding that nursing entrance scores were able to account for 4.8% of the variance in first-term GPA when the TEAS examination was used, this study did not find predictive value for the NET test or the TEAS examination. Almost all of the variance seen between passing and failing in term-one was accounted for by the cumulative pre-nursing grade-point average.

When multivariate analysis was applied, nursing entrance test scores did not contribute to the prediction of term-one success; in fact, cumulative pre-nursing grade-point average was shown to account for most of the variance found. These findings suggest that in-program activities or instruction during students' term-one courses at the study institution may be compensating or remediating essential academic skill weaknesses identified by the NET.

Therefore, the results of this study do not support the use of the NET for admissions decision-making. However, using NET scores may be helpful in identifying at-risk students with essential academic-skill weaknesses that may be improved with selected skill-building activities. Additionally, further study is needed regarding the relationship between TEAS scores and term-one outcome for sub-groups of students, as the population of TEAS test-takers was nearly homogenous and contained few students who failed. Also minority, ESL, and part-time student groups were underrepresented; therefore, group sizes were too small for analysis in this study.

**Hypothesis 6: There will be no significant difference between the predictive efficiency of the Nurse Entrance Test and the Test of Essential Academic Skills examinations or critical thinking tests.**

While the results of this study did not indicate predictive effectiveness for either the NET or TEAS examinations in predicting early academic success, usefulness was demonstrated

for the critical thinking tests. Therefore, data analysis regarding the predictive efficiency between the two critical thinking tests was carried out, and differences in predictive efficiency were demonstrated. These results did not support the null hypothesis as evidenced by the following findings:

- Critical thinking test scores were positively correlated with early academic success in the baccalaureate nursing major.

Since two populations of test-takers were represented in this study (i.e., NET and TEAS), predictor sets were developed for each, with the NET test-takers model including the CCTST score and the TEAS model including the ATI-CTT score. Subsequent multiple regression analyses demonstrated only two predictors that significantly correlated with term-one success; these predictors were cumulative pre-nursing GPA and critical thinking test scores. While the NET and TEAS nursing entrance examinations demonstrated no predictive effectiveness in this study, critical thinking tests showed positive predictive value. In fact, the critical thinking test scores aided prediction and demonstrated predictive formulas for each group of test-takers. When the standardized Beta coefficients were examined for the CCTST (.215) and ATI-CTT (.256), the formula utilizing the ATI-CTT showed stronger predictive efficiency.

In summary, this research is unique in that the investigation included a comparison of predictive efficiency of nursing entrance as well as critical thinking tests and their ability to predict early academic success; unfortunately, no literature is available to provide data for comparison with this aspect of the study. These findings are important and add to the body of knowledge in the search for fair as well as accurate admissions criteria for data-based decision-making in baccalaureate nursing program admissions.

This research validated the use of cumulative pre-nursing GPA as a valid predictor of early academic success. Other important findings were as follows:

- Two variables, cumulative pre-nursing GPA and critical thinking test score, were effective for predicting early academic success.
- Critical seven GPA was not a useful variable for predicting early academic success when cumulative pre-nursing GPA is available.
- Low entry GPA placed a student at risk for early academic failure in the nursing major.
- Nursing entrance examinations did not contribute to the prediction of early academic success.
- Low nursing entrance examination scores can be used to identify students at risk for early academic failure.
- Differences in achievement exist for African American, minority, and English-as-a second-language students.
- When compared to full-time students, part-time students consistently underperformed in GPA, test scores, and term-one outcome.
- Critical thinking test scores were valid predictors that added to the overall predictive efficiency of PNUR-GPA.
- Type of admission category was not an important/useful variable.

### **Conclusions**

The results of this five-year study demonstrated that pre-admissions data currently collected on students applying to the nursing major can effectively be used to predict early academic success. However, nursing faculty must continue to review which elements

selected for admissions criteria prove to be most valid for the population of students entering their particular nursing program. As a result of this validity study, the following conclusions were drawn:

- Using ranked selective pre-nursing cumulative GPA will result in fewer minority, ESL, and part-time students being admitted to baccalaureate nursing programs.

Although all students met the qualifying entry GPA standard, GPA was statistically significantly lower for minority, ESL, and part-time students. If faculty members adopt admissions policies of accepting only those students with the highest entry GPAs, this action will result in fewer students from these groups being admitted to the nursing program; and consequently, higher education's goal of increasing educational access for minorities and the nursing profession's goal of increasing diversity will be thwarted.

- Using both pre-nursing grade-point average and critical seven grade-point average can increase the bias in academic factors weighted for admissions decision-making.

As demonstrated in this study, having two types of GPA weighted in admissions decisions compounds the importance of entry GPA in admissions decisions. Additionally, since critical seven GPA was not shown to correlate positively with early academic success, it does not demonstrate validity as a predictor.

- Critical seven grade-point averages when used in academic decision-making favors male over female students.

Findings of this study showed that critical seven GPAs were higher for male students than for female students. Using critical-seven GPA would, therefore, favor males over females if used in admissions decisions even though data from this study refutes the validity of critical seven GPA as a predictor of early academic success.

- Critical seven grade-point averages show bias and may favor transfer students over FTIAC students if used in admission decision-making.

Students at the study institution who were enrolled as first-time-in-any-college demonstrated lower critical-seven GPAs than transfer students. If critical-seven GPA were weighted in admissions decisions, transfer students would be favored over FTIAC students for admissions to the nursing program. It is counter-productive for the university/college where the nursing program resides to turn away home institution students in favor of transfer students.

- Higher rates of term-one failure were seen for African American, minority, ESL, and part-time students than for white full-time students.

This researcher found that African American, minority, ESL, and part-time students are at risk for early academic failure in the nursing major. This result should encourage nursing faculty members to put in place academic support services early in the program to assist at-risk students to achieve at the outset.

- Critical thinking test scores incrementally add to the prediction of term-one success when combined with cumulative pre-nursing grade-point average.

Based on the results of this study, critical thinking test scores were useful predictors of early academic success in the baccalaureate nursing major. Therefore, critical thinking should be considered as an important element of success in the nursing program.

- Cumulative pre-nursing GPA demonstrates a positive correlation with term-one GPA and is a valid predictor of term-one outcome across groups.

When all predictors were analyzed, pre-nursing GPA was shown consistently and across groups to predict early academic success. The use of pre-nursing cumulative GPA as part

of admissions criteria was supported by this study. In fact, the only criteria significant for predicting early academic success were pre-nursing GPA and CTT scores.

- Nursing Entrance Test scores may indicate academic skill weaknesses but do not aid with the prediction of early academic success.

Although nursing program faculty members may wish to use scores on entrance examinations as valid predictors for academic success in the nursing program, the use of these tests to identify the students most likely to achieve early academic success was not supported by the findings of this study. In fact, at the study institution, students with lower Nursing Entrance Test scores appeared to have had their academic skill deficits remediated while in the first-term courses, as multiple regression analyses showed that these scores were not predictive of early academic success.

### **Limitations**

In this study, the researcher examined a select set of academic and non-academic factors for correlation with early academic success. Factors unexamined in this study, such as study skills, study time, stress and coping behaviors, role strain, and motivation, are additional factors likely to have an impact on academic success. Additionally the small group size of non-passers in the TEAS test group posed methodological problems, in that analyses for differences among sub-groups (i.e., part-time, minority, English-as-a second language students) could not be completed.

### **Recommendations for Further Research**

While this research addressed a gap in the literature on predictors of early academic success in the nursing major, more study is needed to further address as well as define

student characteristics that are predictive of early academic success. Therefore, the following recommendations are made for further research:

1. Local validation studies should be conducted by faculty members in baccalaureate programs to ensure that valid, fair, and consistent measures are used as criteria for admissions decisions for the nursing major. Research on end-of-program success has been unable to identify one set of predictors that has been generalizable throughout nursing programs. Program faculty members should seek ecological validity by studying their own populations without seeking generalizability of their findings. Identifying criteria that can best predict success in the local program will benefit colleges in that nursing faculty and staff members will have access to actionable data, can use resources more effectively, can potentially improve retention, and will graduate increased numbers of diverse students.
2. Studies should be conducted over time to maximize the student population for analyses. Studies that are conducted periodically and include data collected over time allow for trending of data (as student constituencies change) and provide the opportunity for program administrators as well as faculty to adjust admissions criteria as needed according to data reviewed. Clearly, studying small populations can lead to skewed data and erroneous conclusions.
3. More research studies should be conducted on nursing entrance examinations and their ability to predict success in baccalaureate nursing programs. Although this study did not find correlations between scores on Nursing Entrance Examinations and early academic success, programs using these examinations should investigate and document the usefulness of these tests in their own programs. To continue making

- admissions decisions based on assumptions about the effectiveness of test scores in predicting early academic success in baccalaureate nursing programs is debatable as well as problematic.
4. The relationship between critical thinking and early academic success in the nursing major should be explored. While a few studies have examined NCLEX-RN success and critical-thinking test scores, little empirical research exists on critical thinking abilities and their relationship to early academic success in the nursing major. This void must be filled.
  5. Nursing admissions predictive validity studies should collect and analyze gender, race/ethnicity, English-as-a second-language, educational background, and enrollment status. Few studies were found that reported data by these important subgroup types. Without these analyses, nursing faculties are likely to remain unenlightened on the complex factors that may affect early academic success in specific student populations.
  6. Researchers should explore other variables such as non-cognitive factors that may influence early academic success in the nursing major. In this study, predictors examined were able to account for 43-48% of the variance in predicting early academic success. With 52-57% of the variance left unexplained, ample space exists for inquiry into other factors that may account for early academic success. These factors might include study skills, learning styles, motivation, stress and coping behaviors, social support, finances, and role strain, among others.

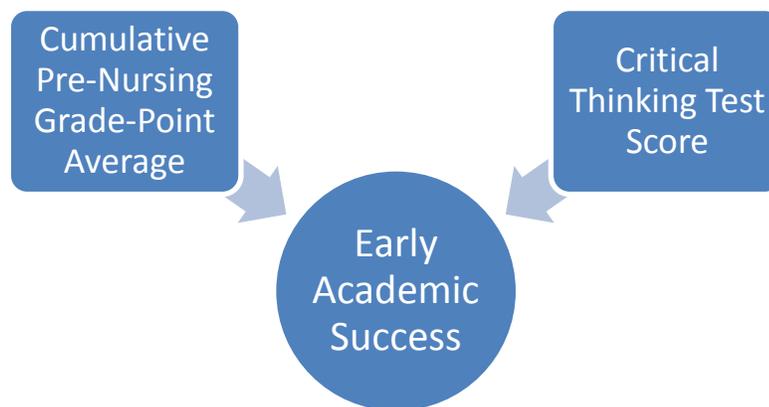
### Recommendations for Practice

This study has illustrated that a significant gap exists in the research on identifying valid predictors for admissions decision-making in baccalaureate nursing programs, and the researcher pointed out that data utilized for admissions decisions may not be supported when scrutinized through empirical study and analyses. In addition to these compelling areas for research, the following recommendations for practice are included.

1. Nursing admissions committees should use the Early Academic Success (EAS) prediction model validated in this research (see Figure 1).

Both cumulative pre-nursing grade-point-average and critical thinking test scores demonstrated predictive effectiveness of early academic success in this study.

Nursing faculty electing to use test scores as part of the admissions requirements to the nursing major should choose tests with demonstrated validity to early academic success. This research validated the usefulness of two critical thinking tests, CCTST and the ATI-CTT.



*Figure 1.* Early Academic Success Prediction Model

2. Nursing admissions committees should examine the admissions criteria of the nursing program for validity evidence. A shift to early academic success is suggested for the criterion variable in admissions criteria studies since many of the current predictors have been based on end-of-program variables (i.e., NCLEX-RN first-time pass-rate or program graduation). End-of-program criterion variables are likely influenced heavily by many in-program factors and less influenced by pre-program factors. Admissions criteria that do not have validity evidence should be reconsidered and substituted with factors that have established validity.
3. Nursing admissions committees should consider adopting admissions criteria that allow applicants to express their academic and performance strengths by means other than cognitive tests. When nursing programs rely heavily on prior grade-point average and test scores, students who traditionally have lower achievement scores (but scores that meet qualifying admissions criteria) may be disadvantaged in a meritocratic system of admissions. Students should not be rejected from admissions to the nursing major based on a single test score. Adopting criteria that nursing faculty feel may reflect or capture the essence of dispositions needed to succeed in the nursing major and become a compassionate nursing professional may allow students to express these “softer” qualities, thereby winning admissions to the program.
4. Nursing faculty should acknowledge that some students enter the program with lower pre-nursing GPAs and that this status may place them at risk for early academic failure. Development of an at-risk student profile will enable faculty to identify at-risk students early in the program and to develop academic support activities tailored to meet individual student needs. Additionally, students identified as at-risk should

- have a retention plan implemented with strategies that begin upon admissions to enhance their chances of success in the program.
5. Nursing faculty should work with their on-campus resources, such as the offices of multicultural affairs, diversity, and student services, to monitor the academic experience of minority, ESL, and part-time students in the nursing major. Based on the results of this study, minority, ESL, and part-time students were all more likely to experience failure in the first-term of the nursing major than were white, full-time, male, or female students. The nursing profession cannot reach its goal of having a more diversified nursing workforce if students of diverse backgrounds are unable to succeed in baccalaureate nursing programs. Nursing faculty must address this social and professional imperative. The complexity of factors leading to restricted academic achievement among these groups of students will be best served through a team approach. Establishing a committee to study and develop strategic interventions for the support and retention of minority students is an essential intervention to enhance the academic success of students.
  6. Administrators in nursing programs utilizing nursing entrance examinations should complete a cost analysis of the financial burden of testing for students as well as the nursing program. As tuition costs rise for students, any expenditure that is not directly essential for the student's academic studies should be scrutinized. Many students suffer financial hardship to achieve their educational goal; if this strain can be eased by any means within the control of the nursing program, faculty should address the issue. Elimination of nursing entrance examinations may be one way that nursing faculty can ease the financial burden for students. Additionally, conducting

nurse entrance examinations is an expensive venture for colleges of nursing; after review, eliminating such testing practices may result in a cost savings to the nursing program.

### **Summary**

This researcher has examined the validity of admissions criteria for predicting early academic success in the baccalaureate nursing program at one college of nursing. Additionally, the predictive efficiency of and between selected tests used in nursing admissions was examined. Cumulative pre-nursing grade-point average was identified as a valid predictor for early academic success in the nursing major; additionally, critical thinking test scores added to the predictive accuracy of cumulative pre-nursing grade-point average.

An area of concern identified during this research study was the lack of predictive effectiveness of commonly used nursing entrance examinations to predict early academic success when multivariate analysis was utilized. A second area of concern was the finding that minority, part-time, and ESL students experienced a higher rate of failure in early academic course work in the nursing major as compared to white, full-time, native English-speaking students. Clearly, the use of valid non-biased admissions criteria is essential to fairness in nursing admissions decision-making and should remain a focus for continued investigation in baccalaureate nursing education.

## References

- Abedi, J., Hofstetter, C. H., & Lord, C. (2004). Assessment accommodations for English language learners: Implications for policy-based empirical research. *Review of Educational Research, 74*(1), 1-28.
- Achieve, Inc. (2007). *Aligned expectations? A closer look at college admissions and placement tests*. Washington, DC: Achieve, Inc.
- ACT, Inc. (2008a). *College readiness*. News release August 13, 2008. ACT. [www.act.org](http://www.act.org)
- ACT, Inc. (2008b). *High school profile report: The graduating class of 2007: National*. Retrieved from <http://www.act.org>
- ACT, Inc. (2009). *History of ACT: The first 50 years, 1959-2009*. Iowa City: IA: ACT, Inc.
- Aiken, L. H., Clarke, S. P., Sloane, D. M., Sochalski, J., & Silber, J. H. (2002). Hospital nurse staffing and patient mortality, nurse burnout and job dissatisfaction. *Journal of the American Medical Association, 288*(16), 1987-1993.
- Alexander, F. K. (2000). The changing face of accountability: Monitoring and assessing institutional performance in higher education. *The Journal of Higher Education, 71*(4), 411-431.
- American Association of Colleges of Nursing. (2002). *Though enrollments rise at U.S. nursing colleges and universities, increase is insufficient to meet the demand for new nurses*. Retrieved from <http://www.aacn.nche.edu/Media/NewsReleases/enr102.htm>
- American Association of Colleges of Nursing. (2004). *Annual report July 2003-June 2004: Annual state of the schools*. Washington, DC: American Association of Colleges of Nursing.

American Association of Colleges of Nursing. (2007). *Annual state of the schools 2007*.

Washington, DC: American Association of Colleges of Nursing.

American Association of Colleges of Nursing. (2009). *Annual report July 2008-June 2009*:

*Annual state of the schools*. Washington, DC: American Association of Colleges of Nursing.

American Educational Research Association. (AERA; 1999). *Standards for educational and*

*psychological testing*. Washington, DC: American Educational Research Association.

Assessment Technologies Institute, LLC. (2000). *Interpretation of the Critical Thinking*

*Assessment: Nurse educator's guide*. Overland Park, KS: Assessment Technologies Institute, LLC.

Assessment Technologies Institute, LLC. (2001a). *Critical Thinking Assessment:*

*Developmental and statistical report*. Overland Park, KS: Assessment Technologies Institute, LLC.

Assessment Technologies Institute, LLC. (2001b). *Technical manual for the Test of Essential*

*Academic Skills 1.0 (TEAS) reading, mathematics, science, English and language usage*. Overland Park, KS: Assessment Technologies Institute, LLC.

Assessment Technologies Institute, LLC. (2009). *Group Performance Profile: Test of*

*Essential Academic Skills*. Overland Park, KS: Assessment Technologies Institute, LLC.

Beeman, P. B., & Waterhouse, J. K. (2001). NCLEX-RN performance: Predicting success on

the computerized examination. *Journal of Professional Nursing*, 4(July-August), 158-165.

Beeson, S. A., & Kissling, G. (2001). Predicting success for baccalaureate graduates on the

NCLEX-RN. *Journal of Professional Nursing*, 17(3), 121-127.

- Bejar, I. I., & Blew, E. O. (1981). *Grade inflation and the validity of the Scholastic Aptitude Test* (No. 81-3). New York, NY: College Entrance Examination Board.
- Bolan, C. M., & Grainger, P. (2003). Predicting success: High school to nursing. *Canadian Nurse, 99*(3), 19-22.
- Bondmass, M. D., Moonie, S., & Kowalski, S. (2008). Comparing NET and ERI standardized exam scores between baccalaureate graduates who pass or fail the NCLEX-RN. *International Journal of Nursing Education Scholarship, 5*(1), 1-15.
- Breland, H., Maxey, J., Gernand, R., Cumming, T., & Trapani, C. (2000). *Trends in college admissions 2000: A report of a survey of undergraduate admissions policies, practices, and procedures*. New York, NY: The College Board.
- Brualdi, A. (1999). *Traditional and modern concepts of validity*. Retrieved from <http://eric.ed.gov>
- Buerhaus, P. I., Auerbach, D. I., & Staiger, D. O. (2007). Recent trends in the registered nurse labor market in the US: Short-run swings on top of long-term trends. *Nursing Economics, 25*(2), 59-66.
- Buerhaus, P. I., Staiger, D. O., & Auerbach, D. I. (2000). Policy responses to an aging registered nurse workforce. *Nursing Economics, 18*(6), 278-303.
- Burton, N., & Ramist, L. (2001). *Predicting success in college: SAT studies of classes graduating since 1980* (No. 2001-2). New York, NY: The College Board.
- Byrd, G., Garza, C., & Nieswiadomy, R. (1999). Predictors of successful completion of a baccalaureate nursing program. *Nurse Educator, 24*(6), 33-37.
- Campbell, A. R., & Dickson, C. J. (1996). Predicting student success: A 10 year review using integrative review and meta-analysis. *Journal of Professional Nursing, 12*(1), 47-59.

- Center for Health Workforce Studies. (2007). *Toward a method for identifying facilities and communities with shortages of nurses*. Washington, DC: Center for Health Workforce Studies.
- Coalition of Michigan Organizations of Nursing. (COMON; 2006). *The nursing agenda for Michigan: 2005-2010, Actions to avert a crisis*. Retrieved from [www.michigan.gov/mdch/ocne](http://www.michigan.gov/mdch/ocne)
- Collins, P. M. (2003). *Predicting a passing outcome on the National Council Licensure Examination for Registered Nurses by associate degree graduates*. (Doctoral dissertation). (UMI No. 3077374).
- Crow, C. S., Handley, M., Morrison, R., & Shelton, M. (2004). Requirements and interventions used by BSN programs to promote and predict NCLEX-RN success: A national study. *Journal of Professional Nursing, 20*(3), 174-186.
- Daley, L. K., Kirkpatrick, B., Frazier, S. K., Chung, M. L., & Moser, D. K. (2003). Predictors of NCLEX-RN success in a baccalaureate nursing program as a foundation for remediation. *Journal of Nursing Education, 42*(9), 390-398.
- Davenport, N. C. (2007). A comprehensive approach to NCLEX-RN success. *Nursing Education Perspectives, 28*(1), 30-33.
- DiBartolo, M. C., & Seldomridge, L. (2005). A review of intervention studies to promote NCLEX-RN success of baccalaureate students. *Nurse Educator, 30*(4), 166-171.
- Dickeson, R. C. (2006). *Frequently asked questions about college costs*. (Issue paper from The Secretary of Education's Commission on the Future of Higher Education. Retrieved from <http://www.ed.gov/about/bdscomm/list/hiedfuture/reports/dickeson2.pdf>

- Educational Resources, Inc. (2009). *Testing catalog*. Shawnee Mission, KS: Educational Resources, Inc.
- Endres, D. (1997). A comparison of predictors of success on NCLEX-RN for African American, foreign-born and white baccalaureate graduates. *Journal of Nursing Education, 36*(8), 365-371.
- Facione, P. (1990). Critical Thinking: A statement of expert consensus for purposes of educational assessment and instruction. *The Delphi Report*. Millbrae, CA: The California Academic Press.
- Facione, P. (1991). The California Critical Thinking Skills Test: College level technical report #2: Factors predictive of critical thinking skills. Millbrae, CA: California Academic Press.
- Facione, P., & Facione, N. (1994). *The California Critical Thinking Skills Test, test manual*. Millbrae, CA: The California Academic Press.
- Fairtest. (2007, August 20). Different tests, same flaws: A comparison of the SAT, SAT II and ACT. [Fact sheet]. Retrieved from <http://www.fairtest.org/facts/univtestcomparison.html>.
- Frost, M. D. (2004). Nurse Entrance Test. *Mental measures yearbook*. The Buros Institute of Mental Measures and Board of Regents of the University of Nebraska.
- Gall, J. P., Gall, M. D., & Borg, W. R. (2005). *Applying educational research: A practical guide* (5<sup>th</sup> ed.). Boston, MA: Pearson.
- Gallagher, P. A., Bomba, C., & Crane, L. R. (2001). Using an admissions exam to predict student success in an ADN program. *Nurse Educator, 26*(3), 132-135.

- Giddens, J., & Gloeckner, G. W. (2005). The relationship of critical thinking to performance on the NCLEX-RN. *Journal of Nursing Education, 44*(2), 85-89.
- Gierl, M. J. (2005). Using dimensionality-based DIF analyses to identify and interpret constructs that elicit group differences. *Educational Measurement: Issues and Practice, Spring*, 3-14.
- Gladieux, L. E., Kings, J. E., & Corrigan, M. E. (1999). The federal government and higher education. In P. G. Altbach, R. O. Berdahl, & P. J. Gumport, P.J. (Eds.), *Twenty-first century social, political and economic challenges* (pp. 163-198). Baltimore, MD: The John Hopkins University Press.
- Green, S. B., & Salkind, N. J. (2005). *Using SPSS for Windows and Macintosh: Analyzing and understanding data* (4<sup>th</sup> ed.). Upper Saddle River, NJ: Pearson Prentice Hall.
- Grimm, L. G., & Yarnold, P. R. (1995). *Reading and understanding multivariate statistics*. Washington, DC: American Psychological Association.
- Haas, R., Nugent, K., E., & Rule, R. (2003). The use of discriminant function analysis to predict student success on the NCLEX-RN. *Journal of Nursing Education, 43*(10), 440-445.
- Hanks, C. (1999). How well does a test predict an outcome? *Computers in Nursing, 17*(6), 241-243.
- Higgins, B. (2005). Strategies for lowering attrition rates and raising NCLEX-RN pass rates. *Journal of Nursing Education, 44*(12), 541.
- Horton, C. D. (2006). *Predictors of academic success for undergraduate nursing students and graduates*. (Doctoral dissertation). Retrieved from <http://proquest.com>. (UMI No. 3245275).

- Hussar, W. J., & Bailey, T. M. (2008). *Projections of education statistics to 2017* (No. NCES 2008-078). Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.
- Jacobs, P., & Koehn, M. (2006). Implementing a standardized testing program: Preparing students for the NCLEX-RN. *Journal of Professional Nursing*, 22(6), 373-379.
- Joint Commission on Accreditation of Healthcare Organizations. (2002). *Health care at the crossroads: Strategies for addressing the evolving nursing crisis*. Washington, DC: Joint Commission on Accreditation of Healthcare Organizations.
- Joint Committee on Testing Practices. (2004). *Code of fair testing practices in education*. The Joint Committee on Testing Practices. Retrieved from <http://www.apa.org/science/programs/testing/fairtesting.pdf>
- Joynt, J., & Kimball, B. (2008). *Blowing open the bottleneck: Designing new approaches to increase nurse education capacity* No. May 2008) Robert Wood Johnson Foundation.
- Kelley, K., Secnik, K., & Boye, M. (2001). An evaluation of the Pharmacy College Admissions Test as a tool for pharmacy college admission committees. *American Journal of Pharmaceutical Education*, 65, 225-230.
- Klestzick, K. (December 9, 2005). *Despite encouraging trends suggested by the NLN's comprehensive survey of all nursing programs, large number of qualified applications continue to be turned down*. Retrieved from <http://www.nln.org>.
- Knapp, L. G., Kelly-Reid, J. E., Ginder, S. A., & Miller, E. (2008). *Enrollment in postsecondary institution, fall 2006; graduation rates, 2000 & 2003 cohorts; and financial statistics, fiscal year 2006* (No. NCES 2008-173). Washington, DC: National

Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

Kobrin, J. (2007). *Determining SAT benchmarks for college readiness* (No. RN-30). New York, NY: The College Board.

Koretz, D. (2008). *Measuring up: What educational testing really tells us*. Cambridge, MA: Harvard University Press.

Kuncel, M., Crede, M., & Thomas, L. (2007). A meta-analysis of the predictive validity of the Graduate Management Admission Test (GMAT) and undergraduate grade point average (UGPA) for graduate student academic performance. *Academy of Management Learning & Education*, 6(1), 51-68.

Kuncel, N., Crede, M., Thomas, L., Klieger, D., Seiler, S., & Woo, S. (2005). A meta-analysis of the validity of the Pharmacy College Admission Test (PCAT) and grade predictors of pharmacy student performance. *American Journal of Pharmaceutical Education*, 69(3), 339-347.

Kuncel, N. R., & Hezlett, S. A. (2007). Standardized tests predict graduate students' success. *Science*, 315, 1080-1081.

Kuncel, N. R., Hezlett, S. A., & Ones, D. S. (2001). A comprehensive meta-analysis of the predictive validity of the Graduate Record Examinations: Implications for graduate student selection and performance. *Psychological Bulletin*, 127(1), 162-181.  
doi:10.1037//Q033-2909.127.1.162

Kuncel, N. R., Hezlett, S. A., & Ones, D. S. (2004). Academic performance, career potential, creativity, and job performance: Can one construct predict them all? *Journal of Personality and Social Psychology*, 86(1), 148-161.

- Kurpius, S. E., & Stafford, M. E. (2006). *Testing and measurement: A user-friendly guide*. Thousand Oaks, CA: Sage.
- Kyei-Blankson, L. S. (2005). *Predictive validity, differential validity, and differential prediction of the subtests of the Medical College Admission Test*. (Unpublished doctoral dissertation). Ohio University, OH.
- Lewis, C., & Lewis, J. (2000). Predicting academic success of transfer nursing students. *Journal of Nursing Education, 39*(5), 234-236.
- Licht, M. (2008). Multiple regression and correlation. In L. G. Grimm, & P. R. Yarnold (Eds.), *Reading and understanding multivariate statistics* (pp. 19-64). Washington, DC: American Psychological Association.
- Linn, R. (1984). Selection bias: Multiple meanings. *Journal of Educational Measurement, 21*(1), 33-47.
- Linn, R., L. (1990). Admissions testing: Recommended uses, validity, differential prediction, and coaching. *Applied Measurement in Education, 3*(4), 297-318.
- Linn, R. L. (2000). Assessments and accountability. *Educational Researcher, 29*(2), 4-16.
- Linn, R. L. (2001). A century of standardized testing: Controversies and pendulum swings. *Educational Assessment, 7*(1), 29-38.
- Mattern, K. D., Shaw, E. J., & Williams, F. E. (2008). *Examining the relationship between the SAT, high school measure of academic performance, and socioeconomic status: Turning our attention to the unit of analysis* (RN-36), The College Board.
- McDonald, M. (2007). *The nurse educator's guide to assessing learning outcomes* (2<sup>nd</sup> ed.). Boston, MA: Jones and Bartlett.

- Meagher, D. (2006). *Introduction to the Miller Analogies Test*. San Antonio, TX: Harcourt Assessment, Inc.
- Meagher, D. (2008). *Miller Analogies Test: Predictive validity study general report*. San Antonio, TX: NCS Pearson, Inc.
- Meagher, D., Lin, A., & Stellato, C. (2006). A predictive validity study of the pharmacy college admission test. *American Journal of Pharmaceutical Education*, 70(3), 1-11.
- Messick, S. (1995). Validity of psychological assessment: Validation of inferences from persons' responses and performances as scientific inquiry into score meaning. *American Psychologist*, 50(9), 741-749.
- Micceri, T. (2009, February). How we justify and perpetuate the wealthy white, male academic status quo through the use of biased admissions requirements. Paper presented at the Florida Association for Institutional Research Annual Conference, Cocoa Beach, Florida.
- Michigan Board of Nursing (2003). *Administrative rules of the Michigan board of nursing*, R 338.10310.
- Michigan Center for Nursing. (2006). *Survey of nursing education programs: 2005-2006 school year*. Lansing, Michigan: Michigan Center for Nursing.
- Michigan Center for Nursing. (2007). *Michigan Center for Nursing survey of nurses 2007*. Lansing, MI: Michigan Center for Nurses.
- Miller, C., & Oldham, C. (2006). *Setting the context*. Washington: DC: U.S. Department of Education. The Secretary of Education's Commission on the Future of Higher Education. Retrieved from [www2.ed.gov/about/bdscomm/list/hiefuture/reports/miller-oldham.pdf](http://www2.ed.gov/about/bdscomm/list/hiefuture/reports/miller-oldham.pdf).

Minium, E. W., Clarke, R. C., & Coladarci, T. (1999). *Elements of statistical reasoning* (2<sup>nd</sup> ed.). Hoboken, NJ: Wiley.

Mosser, N., Williams, J., & Wood, C. (2006). Use of progression testing throughout nursing programs: How two colleges promote success on the NCLEX-RN. In M. H. Oermann, & K. T. Heinrich (Eds.), *Annual review of nursing education*. 4, 305-319.

National Association for College Admission Counseling. (1995). *Recommendations of the commission on the role of standardized testing in college admission*. National Association for College Admission Counseling. Retrieved from <http://www.nacanet.org>

National Association for College Admission Counseling. (2008). *Report of the commission on use of standardized tests in undergraduate admission*. Arlington, VA: National Association for College Admission Counseling. Retrieved from <http://www.nacanet.org>.

National Council of State Boards of Nursing. (2009). NCLEX Examination Pass Rates. Chicago, IL: National Council of State Boards of Nursing. Retrieved from [http://www.ncsbn.org/Table\\_of\\_Pass\\_Rates\\_2009.pdf](http://www.ncsbn.org/Table_of_Pass_Rates_2009.pdf)

National League for Nursing, Board of Governors. (2002, May). *The preparation of nurse educators*. New York, NY: National League for Nursing.

National League for Nursing, Board of Governors. (2005, December). *Despite encouraging trends suggested by NLN's comprehensive survey of all nursing programs, large numbers of qualified applications continue to be turned down*. Retrieved from <http://www.nln.org>

Nelson, R. (2002). US nursing shortage a "national security concern". *The Lancet*, (360), 855.

- Newton, S., Smith, L., & Moore, G. (2007). Baccalaureate nursing program admission policies: Promoting success or facilitating failure? *Journal of Nursing Education*, 46(10), 439-444.
- Newton, S., Smith, L., Moore, G., & Magnan, M. (2007). Predicting early academic achievement in a baccalaureate nursing program. *Journal of Professional Nursing*, 23(3), 144-149.
- Nibert, A., Adamson, C., Young, A., Lauchner, K., Britt, R., & Hinds, M. N. (2006). Choosing a theoretical framework to guide HESI exit examination research. *Journal of Nursing Education*, 45(8), 303-307.
- Nobel, J. (2003). *The effects of using ACT composite score and high school average on college admission decisions for racial/ethnic groups*. Iowa City, IA: ACT.
- Nobel, J., & Sawyer, R. (2002). *Predicting different levels of academic success in college using high school GPA and ACT composite score* No. 2002-4. Iowa City, IA: ACT.
- Norman, L.P. (2006). *Prediction of nursing student performance in first year coursework*. Unpublished dissertation. UMI 3225278.
- Norton, C., Relf, M., Cox, C., Farley, J., Lachat, M., Tucker, M., & Murray, J. (2006). Ensuring NCLEX-RN success for first-time test-takers. *Journal of Professional Nursing*, 22(5), 322-326.
- Oermann, M. H., & Gaberson, K. B. (2006). *Evaluation and testing in nursing education* (2<sup>nd</sup> ed.). New York, NY: Springer Publishing Company, Inc.
- Pennock-Roman, M. (1994). *College major and gender differences in the prediction of college grades* (No. 94-2 ETS RR No. 94-24). New York, NY: College Entrance Examination Board.

Potolsky, A., Cohen, J., & Saylor, C. (2003). Do prerequisite grades and tutoring make a difference? *Nursing Education Perspectives*, 24(5), 246-250.

Public Sector Consultants, Inc. (July 2001). *Study of the current and future needs of the professional nursing workforce in Michigan*. Lansing, MI: Michigan Department of Consumer and Industry Services. Retrieved from [http://www.michigan.gov/documents/cis\\_fhs\\_nursrpt\\_34456\\_7.pdf](http://www.michigan.gov/documents/cis_fhs_nursrpt_34456_7.pdf).

Ramist, L., Lewis, C., & McCamley-Jenkins, L. (1994). *Student group differences in predicting college grades: Sex, language, and ethnic groups*. (No. 93-1, 1994). New York, NY: The College Board.

Ramist, L., Lewis, C., & McCamley-Jenkins, L. (2001). *Using achievement tests SATII: Subject tests to demonstrate achievement and predict college grades: Sex, language, ethnic and parental education groups*. (No. 2001-5). New York, NY: The College Board.

Rigol, G. (1997). *Common sense about SAT score differences and test validity* (Research No. RN-01, June 1997). New York, NY: The College Board.

Rigol, G. W. (2003). *Admissions decision-making models: How US institutions of higher education select undergraduate students*. New York, NY: College Entrance Examination Board.

Roat, C. (2008). *Admission academic predictors of student outcomes in two baccalaureate nursing programs*. Unpublished dissertation. Lincoln: NE.

Roberts, D.A. (2002). *The effects of ranked and non-ranked selection criteria on the success of California Community College I students*. Unpublished dissertation. UMI 3037009.

Santa Ana College. (2003). *NCLEX success factors Santa Ana College I graduates spring and fall 2003* Research Department Rancho Santiago.

Sawyer, R. (1996). Decision theory models for validating course placement tests. *Journal of Educational Measurement*, 33(3), 271-290.

Sawyer, R. (2007). Indicators of usefulness of test scores. *Applied Measurement in Education*, 20(3), 255-271.

Sayles, S., Shelton, D., & Powell, H. (2003). Predictors of success in nursing education. *The Association of Black Nursing Faculty Journal*. 14 (6), 116-120.

Schafer, V. (2002). Determining the predictors of success for nursing students and graduates of Midamerica Nazarene University. Doctoral dissertation. UMI 3082673.

Sedlacek, W. E. (2003). Alternative admissions and scholarship selection measures in higher education. *Measurement and Evaluation in Counseling and Development*, 35, 263-272.

Seldomridge, L., & DiBartolo, M. (2004). Can success and failure be predicted for baccalaureate graduates on the computerized NCLEX-RN. *Journal of Professional Nursing*, 20(6), 361-368.

Shaw, E. J., & Milewski, G. B. (2004). *Consistency and reliability in the individualized review of college applicants* No. RN-20). New York, New York: The College Board.

Shepard, L. A. (1993). Evaluating test validity. In L. Darling-Hammon (Ed.), *Review of research in education*. 19, pp. 405 Washington, DC:

Simmons, L. E., Haupt, G., & Davis, L. (2004). *The usefulness of the Nurse Entrance Test (NET) for prediction of successful completion in a nursing program*. Educational Resources, Inc.

- Spurlock, D. (2006). Do no harm: Progression policies and high-stakes testing in nursing education. *Journal of Nursing Education, 45*(8), 297-302.
- Stagier, D. O., Auerbach, D. I., & Buerhaus, P. I. (2000). Expanding career opportunities for women and the declining interest in nursing as a career. *Nursing Economics, 18*(5), 230-236.
- Symes, L., Tart, K., & Travis, L. (2005). An evaluation of the Nursing Success Program: Reading comprehension, graduation rates, and diversity. *Nursing Educator, 30*, 217-220.
- Tanner, C. (2004). Nursing education research: Investing in our future. *Journal of Nursing Education, 43*(3), 99-100.
- The College Board. (2002a). *Best practices in admissions decisions* (No. 993603). New York, NY: College Board Publications.
- The College Board. (2002b). *Guidelines on the uses of College Board test scores and related data*. New York, NY: College Entrance Examination Board.
- The College Board. (2008). *2008 College-bound seniors: Total group profile report* No. 002\_0\_NP\_01 204). New York, NY: College Board Publications.
- U.S. Department of Education. (1983). *A Nation at Risk: The Imperative for Educational Reform*. National Commission on Excellence in Education. Washington, DC: U.S. Department of Education.
- U.S. Department of Education. (2006). *A test of leadership charting the future of U.S. higher education*. Washington, DC: Retrieved from <http://www2.ed.gov/about/bdscomm/list/hiedfuture/reports/pre-pub-report.pdf>

- U.S. Department of Education. (2008). *A nation accountable: Twenty-five years after a nation at risk*. Washington, DC: Retrieved from <http://www.ed.gov/rschstat/research/pubs/accountable>
- U.S. Department of Education, Office for Civil Rights. (2000). *The use of tests as part of high-stakes decision-making for students: A resource guide for educators and policy-makers* (No. ED 456 173). Washington, DC: US Department of Education.
- U.S. Department of Labor. (2008). Registered nurses. In Bureau of Labor Statistics (Ed.), *Occupational outlook handbook, 2008-09* (pp. 1-6)
- Uyehara, J., Magnussen, L., Itano, J., & Zhang, S. (2007). Facilitating program and NCLEX-RN success in a generic BSN program. *Nursing Forum*, 42(1), 31-38.
- Vandenhouten, C. (2008). *Predictors of success and failure on the NCLEX-RN for baccalaureate graduates*. (Doctoral dissertation). (No. UMI 3302563).
- Wellman, J. V. (2006). *Costs, prices, and affordability: A background paper for the secretary's commission on the future of higher education* Retrieved from <http://www.ed.gov/about/bdscomm/list/hiedfuture/reports/wellman.pdf>
- Wescott, C.V. (1997). *The effectiveness of admission criteria in predicting academic success for baccalaureate nursing students*. (Doctoral dissertation). (No. UMI 9805076).
- Wissman, J. (2006). *Using the ATI test of essential academic skills (TEAS) in admission decisions*. Olathe, KS: Mid-America Nazarene College.
- Yoho, M., Young, A., Adamson, C., & Britt, R. (2007). The predictive accuracy of Health Education Systems, inc., examinations for associate degree nursing students. *Teaching and Learning in Nursing*, 2, 80-84.

Young, J. W. (2001). *Differential validity, differential prediction, and college admission testing: A comprehensive review and analysis* (No. 2001-6). New York, NY: College Entrance Examination Board.

Zwick, R. (2007). *College admission testing* (No. February 2007). National Association for College Admission Counseling.

Zwick, R. (2002). *Fair game? The use of standardized admissions tests in higher education*. New York, NY: RoutledgeFalmer.

APPENDICES

## Appendix A: Predicting Success – Data Collection Form

**Identification No.** \_\_\_\_\_**Part A.****Student Characteristics:**

1. Nursing Term One Cohort:
  - a. \_\_\_\_\_ Fall (01)      code: \_\_\_\_\_ (yr/term i.e.,302, winter 2003)
  - b. \_\_\_\_\_ Winter (02)
  - c. \_\_\_\_\_ Year (3-8)
  
2. Background:
  - a. Gender: \_\_\_\_\_ Female (1)      \_\_\_\_\_ Male (2)
  - b. Age: \_\_\_\_\_ (at time of term one enrollment)
  - c. Race/Ethnicity:
    - i. \_\_\_\_\_ White, non-hispanic (1)
    - ii. \_\_\_\_\_ African American/Black (2)
    - iii. \_\_\_\_\_ Hispanic (3)
    - iv. \_\_\_\_\_ Asian (4)
    - v. \_\_\_\_\_ Native American (5)
  - d. English-As-a second language
    - i. \_\_\_\_\_ No (1)
    - ii. \_\_\_\_\_ Yes (2)

**Part B.****Educational Background:**

1. Admission Type:
  - a. \_\_\_\_\_ Pre-NUR (1)
  - b. \_\_\_\_\_ NUR (2)
  
2. Educational Background:
  - a. \_\_\_\_\_ FTIAC (1)
  - b. \_\_\_\_\_ Transfer student (2)
  - c. \_\_\_\_\_ Second Degree Student (3)
  
3. Enrollment Status:
  - a. \_\_\_\_\_ Full Time (1)
  - b. \_\_\_\_\_ Part Time (2)

**Part C.****Scholastic Data:**

1. Academic Record:
  - a. \_\_\_\_\_ Pre-Nur cumulative GPA
  - b. \_\_\_\_\_ Critical 7 Pre-Nur GPA
  
2. NET Scores:
  - a. \_\_\_\_\_ Composite score
  - b. \_\_\_\_\_ Math
  - c. \_\_\_\_\_ Reading
  
3. TEAS Scores:
  - a. \_\_\_\_\_ Composite
  - b. \_\_\_\_\_ Math
  - c. \_\_\_\_\_ Reading
  - d. \_\_\_\_\_ Verbal
  - e. \_\_\_\_\_ Science
  - f. \_\_\_\_\_ Critical thinking test
  
- 4. Term One Outcome**
  - a. \_\_\_\_\_ Passed (1)
  - b. \_\_\_\_\_ Failed (2)
  - c. \_\_\_\_\_ Withdrew failing (3)
  - d. \_\_\_\_\_ Withdrew passing (4)
  - e. \_\_\_\_\_ Term one cumulative nursing GPA

## Appendix B: Letter of Permission to Access Data



36600 SCHOOLCRAFT ROAD  
LIVONIA, MICHIGAN 48150-1176  
(734) 432-5300/FAX 432-5393

January 22, 2009

Deborah Dunn  
6380 Napier Rd.  
Plymouth Mi, 48170

Re: Permission letter for the research project, "Academic and Non-academic Factors as Predictors of In-Program Baccalaureate Nursing Student Success."

Dear Deborah,

Thank you for your interest and request to conduct your research study, at Madonna University, College of Nursing and Health. I understand that you will be conducting a retrospective review of student records for this study and need access to the following:

1. Nursing student academic files located in the College of Nursing, in the Diponio building as well as electronic records in the jenzabar database.
2. Records of students who enrolled in term one courses fall and winter semesters, beginning with winter 2003 through fall 2008.

I have read your letter and understand the research project, data collection methods, and methods for the protection of data and subject confidentiality and thereby give my permission for you to access the records you have requested once approved by the required Institutional Review Board(s).

Your research will add to the body of knowledge needed for better understanding of the factors that impact student success.

Sincerely,

[ Signature Removed ]

Teresa Thompson PhD RN CRRN-A  
Dean  
College of Nursing and Health  
Madonna University  
36600 Schoolcraft Rd.  
Livonia, MI 48154

## Appendix C: Human Subjects Approval EMU

**E**ASTERN MICHIGAN UNIVERSITY  
Education First

March 20, 2009

Debbie Dunn  
Madonna University  
36600 Schoolcraft Rd.

Dr. Debbie Dunn:

The Human Subjects Institutional Review Board (IRB) of Eastern Michigan University has granted approval to your proposal, "Academic and Non-Academic Factors as Predictors of In-Program Baccalaureate Nursing Student Success."

After careful review of your completion application, the IRB determined that the rights and welfare of the individual subjects involved in this research are carefully guarded. Additionally, the methods used to obtain informed consent are appropriate, and the individuals participating in your study are not at risk.

You are reminded of your obligation to advise the IRB of any change in the protocol that might alter your research in any manner that differs from that upon which this approval is based. Approval of this project applies for one year from the date of this letter. If your data collection continues beyond the one-year period, you must apply for a renewal. On behalf of the Human Subjects Committee, I wish you success in conducting your research.

Sincerely,

Deb de Laski-Smith, Ph.D.  
Interim Dean  
Graduate School  
Administrative Co-Chair  
University Human Subjects Review Committee

Note: If project continues beyond the length of **one** year, please submit a continuation request form by **03/20/10**.

**Reference #** 090217

University Human Subjects Review Committee · Eastern Michigan University · 200  
Boone Hall  
Ypsilanti, Michigan 48197  
Phone: 734.487.0042 Fax: 734.487.0050  
E-mail: [human.subjects@emich.edu](mailto:human.subjects@emich.edu)  
[www.ord.emich.edu](http://www.ord.emich.edu)

Appendix D: Predictor Correlations

	PNUR-GPA	Critical Seven	NET-Comp	NET Math	NET Read	TEAS Comp	TEAS Math	TEAS Read	TEAS Vbl	TEAS Sci	CCTST	ATI CTT
PNUR-GPA	1	<b>.107</b>	<b>.375</b>	<b>.333</b>	<b>.270</b>	<b>.336</b>	<b>.239</b>	.167	.208	<b>.311</b>	<b>.333</b>	<b>.274</b>
Critical Seven	<b>.107</b>	1	.082	-.041	<b>.233</b>	<b>.304</b>	<b>.294</b>	.085	.084	<b>.314</b>	-.072	<b>.243</b>
NET-Comp	<b>.375</b>	.082	1	<b>.653</b>	.782	<b>-1.0</b>	<b>-1.0</b>	<b>-1.0</b>	<b>-1.0</b>	<b>-1.0</b>	<b>.473</b>	<b>.480</b>
NET Math	<b>.333</b>	-.041	<b>.653</b>	1	<b>.213</b>	<b>-1.0</b>	<b>-1.0</b>	<b>-1.0</b>	<b>-1.0</b>	<b>-1.0</b>	<b>.324</b>	<b>.343</b>
NET Read	<b>.270</b>	<b>.223</b>	<b>.782</b>	<b>.213</b>	1	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>.416</b>	<b>.351</b>
TEAS Comp	<b>.336</b>	<b>.304</b>	<b>-1.0</b>	<b>-1.0</b>	<b>1.0</b>	1	<b>.082</b>	<b>.483</b>	<b>.713</b>	<b>.599</b>	a	<b>.511</b>
TEAS Math	<b>.239</b>	<b>.294</b>	<b>-1.0</b>	<b>-1.0</b>	<b>1.0</b>	<b>.802</b>	1	.091	<b>.322</b>	<b>.366</b>	a	.425
TEAS Read	.167	.085	<b>-1.0</b>	<b>-1.0</b>	<b>1.0</b>	<b>.493</b>	.091	1	<b>.428</b>	.128	a	<u>.185</u>
TEAS Vbl	<u>.208</u>	.084	<b>-1.0</b>	<b>-1.0</b>	<b>1.0</b>	<b>.713</b>	<b>.322</b>	<b>.428</b>	1	<u>.210</u>	a	<b>.314</b>
TEAS Sci	.311	.314	-1.0	-1.0	1.0	.599	.366	.128	<u>.210</u>	1	a	.411
CCTST	<b>.333</b>	-.072	<b>.473</b>	<b>.324</b>	<b>.416</b>	a	a	a	a	a	1	<b>.546</b>
ATI CTT	<b>.274</b>	<b>.243</b>	<b>.420</b>	<b>.343</b>	<b>.351</b>	<b>.511</b>	<b>.425</b>	<u>.185</u>	<b>.314</b>	<b>.411</b>	-.945	1

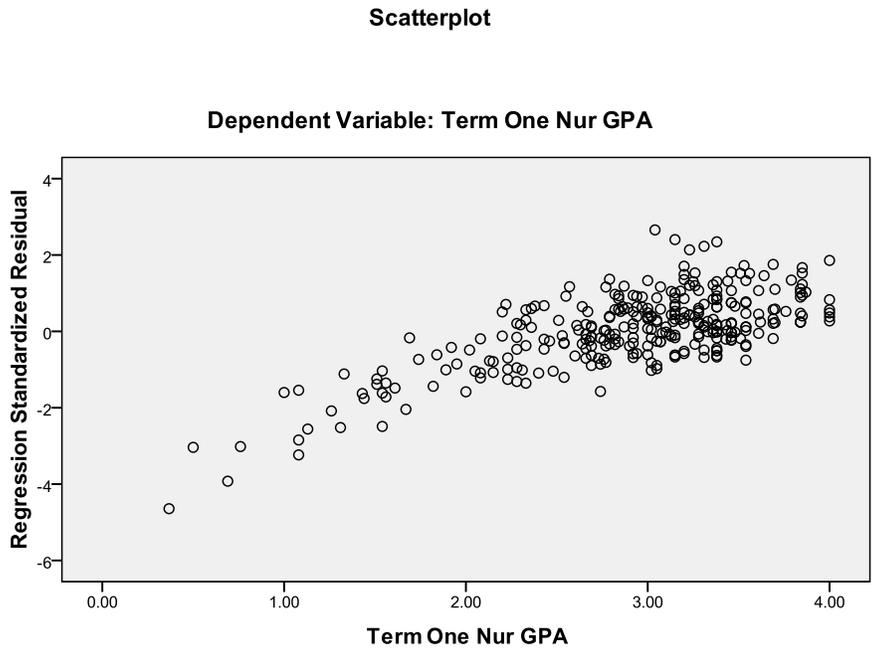
Bold:  $p = 0.01$  level (2-tailed)

Underlined:  $p = 0.05$  level (2-tailed)

a= cannot be computed due to at least one of the variables being constant

Appendix E: NET Residual Analysis Scatterplot

Figure 2. NET Residual Analysis Scatterplot



Appendix F: TEAS Residual Analysis Scatterplot

Figure 1. TEAS Residual Analysis Scatterplot

