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The Relationship of General Science Grades to Program Completion in an Associate Degree Nursing Program

Catherine Edlebeck
Walden University

Walden University

COLLEGE OF EDUCATION

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Catherine Edlebeck

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Review Committee
Dr. Stacy Wahl, Committee Chairperson, Education Faculty
Dr. Marianne Borja, Committee Member, Education Faculty
Dr. Ann Jablonski, University Reviewer, Education Faculty

Chief Academic Officer

Eric Riedel, Ph.D.

Walden University
2016

Abstract

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Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

High attrition of nursing students in the United States may contribute to a shortage of registered nurses and inefficient use of scarce resources. The purpose of this study was to explore the relationship between nursing student grades in 3 science prerequisites and length of time to program completion on each of the study college's 4 campuses. Ausubel's theory of subsumption, wherein a learner's ability to meaningfully learn new data depends on the existing cognitive structure within which the new material is assimilated, was used as a theoretical framework. Prerequisite science course grades for 575 nursing students attending a Midwestern technical and community college with 4 campuses were obtained along with data on program completion. Grade data from 2005-2015 were analyzed using a 1-way or Welch ANOVA and Pearson product-moment correlation. Significant differences were found among campuses in both mean science grades and time to completion. Most science course grades did not demonstrate a significant correlation with time to completion. Based on these findings, it is possible that student preparation in general science courses is not equivalent among campuses and may not provide the cognitive structure necessary for meaningful learning in nursing courses. To enable faculty from both disciplines to collaboratively document, examine, and align content in science and nursing courses, a curriculum mapping project was designed. Registered nurse graduates contribute to the economic and social well-being of their communities. By providing more insight about science and nursing courses and degree completion, this study is intended to promote positive social change.

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Dedication

I dedicate this project to my family. I thank my wonderful partner, Patrick Edlebeck, who gave loving advice throughout this process and many stern refusals to allow me to stop even when I told him I wanted to. I also thank my daughter, Claire Edlebeck, and her husband, Mitch Dreier; my son, John Edlebeck, and his wife, Chaja Hogeweg; and my granddaughter, Evelyn Theresa Dreier. These incredible people offered unconditional support and practical help as I navigated my way through a challenge that, at times, seemed insurmountable. They are now and will always remain lovingly in my thoughts every hour of every day.

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As I began to write my project study, it was difficult to know what was achievable within the timeframe available. My chairperson, Dr. Stacy Wahl, helped me to focus my energies on achieving sequential tasks that would eventually result in completion. For this, I am very grateful. Moreover, Dr. Wahl gave sound and practical advice on how to avoid common problems in the project study. As my project progressed, Dr. Wahl provided detailed and positive feedback that allowed me to complete each portion before progressing to the next. Finally, Dr. Wahl's constant assurance that I would meet this challenge and succeed provided an antidote to the inevitable times of discouragement and despair. I thank her from the bottom of my heart and will always consider her a valuable colleague.

As a novice quantitative researcher, I initially approached the second section of my project with fear. My second committee member, Dr. Marianne Borja, showed me that collecting, analyzing, and presenting data was something that I could achieve. I am so grateful for this lesson that will remain with me throughout my academic life. Dr. Borja gave an array of specific examples and detailed feedback that enabled me to confidently and concisely compose the second section of my project. I thank her for her unending support and help.

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Finally, my professional colleagues were a source of support, resources, and empathy. My supervisor and friend, Chaudette Miller, provided questions and challenged me to justify my work as I progressed. This allowed me to examine the research problem and implications in a contextualized manner. I thank her for her time and expertise. The college's Vice-President for Academic Affairs, Dr. Bonny Ball Copenhaver, also provided me with support, resources, and encouragement. Her commitment to students and faculty is remarkable. She has allowed me to explore the idea that solid decisions are based on solid data. I am grateful to her.

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Section 1: The Problem

Introduction

Nurse educators, college administrators, and other stakeholders have expressed concern about the high rates of attrition of students enrolled in U.S. nursing degree programs (Schneider & Lin, 2011). Students who are admitted to nursing programs and fail to complete the program in a timely manner are not able to realize a return on their investment of money and time. Also, nursing curricula comprise a specific sequence of courses. When a student withdraws or fails, a new student cannot fill the open position. This may contribute to a shortage of registered nurses. The Accreditation Commission for Education in Nursing (ACEN, 2013) requires measurement of student outcomes, including program completion. To address this problem, U.S. nursing programs have attempted various strategies to improve retention and to reduce attrition.

Definition of the Problem

Nursing student attrition rates at some colleges in the United States are as high as 50% (Abele, Penprase, & Ternes, 2013). Only half of the students who begin a program to become a nurse in the United States finish it, and academic problems contribute significantly to withdrawal or failure, especially in nursing students (Abele, Penprase, & Ternes, 2013). Many educators are now focusing on improving retention and reducing attrition as a way to increase the number of registered nurses (Pryjmachuk, S., Easton, K., & Littlewood, A. (2008).

To achieve lower rates of attrition, nursing programs are concentrating their efforts on admitting students who are likely to succeed and to identify risk factors that

may relate to attrition (Pryjmachuk, S., Easton, K., & Littlewood, A. 2008). Admissions committees often base admission decisions on applicants' grades in prerequisite science courses because high achievement in general science courses often correlates with success in nursing program completion (Harris, Rosenberg, & O'Rourke, 2014). If nursing students have earned high grades in the prerequisite general sciences, it would seem that this would relate to success in nursing courses and timely program completion. However, if nursing students have earned high grades in the general sciences but are unsuccessful in nursing courses and thus in timely program completion, there may be a need to reexamine admission criteria or the content of course prerequisites.

Rationale

Evidence of the Problem at the Local Level

In October 2014, a technical and community college in the U.S. Midwest underwent an accreditation review of its associate degree program in nursing. The college, which comprises four campuses, is one of 16 members of a statewide system for community and technical education. Total undergraduate yearly enrollment is approximately 6,000 students. The nursing associate degree program, which is offered at all four campuses, enrolls 144 students each year (Technical College, 2013). ACEN requires measurement of end-of-program outcomes against expected level of achievement (ELA), which is specified by nursing programs. Based on the recommendation of ACEN, formerly the National League for Nursing Accreditation Commission (NLNAC), the nursing program at the study college defined ELA in 2000 as 80% of students completing the associate degree program in nursing within six semesters

(NLNAC, 2012). Between 2006-2014, however, the percentage of students completing the nursing program within six semesters ranged between 64% and 67% (Edlebeck & Miller, 2014) and ELA was not met.

Prior to Fall 2013, applicants to the associate degree program in nursing were either admitted or placed on a waiting list. Admissions were prioritized only by date of application and did not include consideration of prerequisite science grades. In an effort to increase nursing student success and reduce attrition, an academically competitive admission process was implemented in Fall 2013. Faculty expressed a desire to admit students who were better-prepared in the general sciences by requiring a minimum grade of B- in Anatomy and Physiology 1 and 2. While the new petition process only requires a B- in Anatomy and Physiology 1 and 2, the literature is clear that academic success in several of the other general sciences correlates strongly with retention and graduation (Griffiths, Bevil, O'Connor, & Wieland, 1995; Schmidt & MacWilliams, 2011; Wolkowitz & Kelley, 2010). Furthermore, faculty members in the program have voiced concerns that high grades in Microbiology and Anatomy and Physiology 1 and 2 are not associated with success in the nursing program at the college and that there may be differences in instruction among campuses because no common course design for science is used (B. Copenhaver, personal communication, November 13, 2014).

Evidence of the Problem from the Professional Literature

In the *United States Registered Nurse Workforce Report Card and Shortage Forecast,* Juraschek, Zhang, Ranganathan, and Lin predicted a deficit of 918,232 registered nurses in the United States by 2030 and suggested that policymakers

"maximize educational potential on a national level" as part of a solution (2012, p. 248). Although many schools report very high rates of attrition, the number of applicants to nursing programs is also very high. The American Association of Colleges of Nursing (AACN) reported that nearly 80,000 applicants were turned away in 2012 due to a shortage of faculty, clinical sites, and other resources (AACN, 2014).

Researchers have examined factors related to nursing student success, retention, and attrition. Many scholars have examined the factors predictive of nursing student retention and attrition (Abele, Penprase, & Ternes, 2013; Pitt, Powis, Levett-Jones, & Shaffer, 2012; Pryjmachuk, Easton, & Littlewodd, 2008; Stickney, 2008; Wolkowitz & Kelley, 2010). Borman, Moser, and Bates (2013), Finnerty, Chauvin, Bonaminio, Andrews, Carrol, and Pangaro (2010), and Wheeler and Arena (2009) examined the rigor of course preparation in the general sciences as it affected subsequent success. Carrick (2011) and Evans (2013) observed that certain teaching and assessment strategies benefitted students who traditionally struggled to complete programs in nursing education. Carrick (2011), Pryjmachuk et al. (2008), and Simon, McGinniss, and Krauss (2013) suggested the strategy of admitting students who were more likely to succeed as a way to increase retention and reduce attrition. Eick, Williamson, and Heath (2012), Melillo, Dowling, Abdallah, Findeisen, and Knight (2013), and Wang et al. (2011) all focused on factors found to increase retention, decrease attrition, and increase graduation rates. An investigation of the relationship between prerequisites and completion may inform policy on both the admission of students who are more likely to succeed and to

improve the success of admitted students (Abele, Penprase, & Ternes, 2013; Schmidt & MacWilliams, 2011; Seago et al., 2012).

Purpose of the Study

At a Midwestern technical and community college that offers an associate degree in nursing across four campuses, faculty have voiced concerns that the prerequisite science courses are not adequately preparing students for the rigors of core nursing courses in the program. Faculty are also concerned that the prerequisite courses are not equivalent on all campuses and are not correlated with program completion. The purpose of this study is to explore the relationship between the grades that nursing students receive in three science prerequisites and the length of time that they need to complete their programs on each of the study college's four campuses. By examining the relationship between the grades that nursing students receive in general science prerequisite courses and the students' time to degree completion on each campus, I hope to gain insight about whether students are being adequately prepared for the academic rigor of core nursing courses.

Definitions

The following definitions inform this project study.

Advance organizer: An inclusive and relevant concept that is introduced to learners prior to the presentation of unfamiliar material (Ausubel, 1960).

Anatomy and Physiology 1: Course at the study college that examines basic human anatomy and physiology while emphasizing the relationship between structure

and function at microscopic and gross levels of organization; it has a prerequisite of 1 year of high school chemistry (Technical College website, 2014).

Anatomy and Physiology 2: Course at the study college that examines normal human anatomy and physiology at microscopic and gross levels of organization. It includes analysis of cellular metabolism, the nervous, neuromuscular, cardiovascular, and urinary systems as well as homeostasis, fluid and electrolyte and acid-base balance, and genetics. Anatomy and Physiology 1 is a prerequisite (Technical College website, 2014).

Campus: Individual location of a college offering the coursework needed to complete the associate degree nursing program (Technical College Nursing Curriculum website, 2013).

Cognitive Structure: The organization, stability, and clarity of a learner's knowledge in a given field (Ausubel, 1962a).

Meaningful learning: An active process in which instructional materials interact with previously learned, relevant ideas within a learner's cognitive structure, resulting in a valid and in-depth understanding of the information rather than simple memorization (Ausubel, 1963).

Microbiology: Course at the study college that examines microbial structure, metabolism, genetics, growth and the relationship between humans and microorganisms. The course also addresses disease production, epidemiology, immunology, and the medical impact of microbes. Anatomy and Physiology 1 is a prerequisite (Technical College website, 2014).

Program completion: Graduation from the associate degree nursing program (Schneider & Lin, 2011).

Subsumption: A theory of learner organization, long-term retention, and meaningful recall of large amounts of material. Theorist proposes that cognitive structure is hierarchically arranged with very inclusive concepts under which less-inclusive concepts and specific data are assimilated, or subsumed (Ausubel, 1962a).

Significance

In the United States, around 60% of registered nurses are prepared at the associate degree level, having earned a nursing degree at a community or technical college (U.S. Department of Health and Human Services Health Resources and Services Administration [HRSA], 2013). Federal, state, and local investment in community colleges in the United States is substantial, but it does not generate a return unless students are successful (Schneider & Lin, 2011). In 2008-2009, the federal government awarded $660 million in grants to students who did not complete a program of study, while state and local governments awarded $3 billion to students who did not return in their second year (Schneider & Lin, 2011). Community and technical colleges are an important component of the higher education system, and students who complete an associate degree or technical diploma generally receive a favorable return on their investment by obtaining employment. However, students who either fail or withdraw from a course are less likely to return and finish a program of study (Pitt, Powis, Levett-Jones, & Hunter, 2012).

The importance of completing a program of study and obtaining employment is particularly significant for the college in this study because three of the four counties served by the college have higher poverty rates, older residents, and lower mean household incomes than other counties in the state (State Demographics Website, 2013). As shown in Table 1, in 2013, mean unemployment rates in the counties served by the college ranged from 4.8%-10%, as compared to 6.8% for the state as a whole (Technical College, 2013). When compared to their peers from better-educated and higher income families, students who are from low income backgrounds or are first-generation college students are at a disadvantage for degree attainment (Thayer, 2000). Students who graduate from the associate degree nursing program and obtain a license to practice as a registered nurse have an average yearly salary of $51,970, and 81% remain in the state to work (Technical College Website, n.d.).

Table 1

Demographic Comparison of Counties Served by the College

	Population	Mean age	Mean income	Poverty rate	Unemployment
State	5,725,398	38.5	$51,598	11.6%	6.8%
Campus 1	15,992	40.3	$38,111	18.6%	10%
Campus 2	45,733	43.1	$42,601	11.9%	4.8%
Campus 3	43,785	39.8	$43,127	12.8%	8.02%
Campus 4	85,242	36.7	$67,446	6.4%	8.2%

Note. State Demographics Website, 2013.

Because state technical and community colleges in the state are funded by property taxes, tuition and fees, and state aid all students, property owners, and state

residents have an interest in program outcomes (Technical College Website, n.d.). When a student completes a program of education in a timely manner and obtains a license to practice professional nursing, he or she is more likely to obtain full employment and have adequate income (Pitt, Powis, Levett-Jones, & Hunter, 2012). Residents who are fully employed benefit taxpayers who support the college, because a majority of graduates will choose to remain in the community (Technical College Website, n.d.).

The nursing program determined an ELA for program completion based on recommendations from the accrediting body. In examining data for 2006-2014, the program did not meet the ELA in any year. The college admits new students each fall and spring. The cohort at each campus comprises 24 students in fall and 16 students in spring. The number of applicants is generally double the number that can be accepted. When a student either fails or withdraws from one or more courses in any semester, that slot cannot be filled with another student since the courses in each semester are completed in sequence. This problem requires a change in practice. A possible solution is to admit students with a greater chance to succeed. Although many nursing students report economic, financial, and social challenges, pre-nursing academic achievement in the general sciences seems to have the strongest relationship with program completion (Seago, Keane, Chen, Spetz, & Grumbach, 2012). Therefore, an examination of the relationship between these grades and program completion time on each campus will provide evidence for strategies to improve outcomes.

Guiding/Research Questions

I will address faculty and student concerns regarding adequate student preparation in the general sciences by examining whether there are differences in students' grades and in time to program completion. I am especially interested in whether grades and program completion differ by campus. The following research questions will guide this study:

RQ1: What is the difference among the four campuses in students' grades in microbiology?

$H_0$1: There is no difference among the four campuses in students' grades in microbiology.

H_a1: There is a difference among the four campuses in students' grades in microbiology.

RQ2: What is the difference among the four campuses in students' grades in anatomy and physiology 1?

$H_0$2: There is no difference among campuses in students' grades in anatomy and physiology 1.

H_a2: There is a difference among campuses in students' grades in anatomy and physiology 1.

RQ3: What is the difference among the four campuses in students' grades in anatomy and physiology 2?

$H_0$3: There is no difference among campuses in students' grades in anatomy and physiology 2.

H_a3: There is a difference among campuses in students' grades in anatomy and physiology 2.

In RQ1-3, the independent variable is the campus location, and the dependent variables are the students' grades in the three prerequisite courses.

RQ4: What is the difference among the four campuses in length of time it takes students to complete the nursing program?

$H_0 4$: There is no difference among campuses in length of time it takes students to complete the nursing program.

$H_a 4$: There is a difference among campuses in length of time it takes students to complete the nursing program.

In RQ4, the independent variable is the campus location, and the dependent variable is the length of time it takes students to complete the nursing program.

RQ5: What is the correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 1?

$H_0 5$: There is no correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 1.

$H_a 5$: There is a correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 1.

RQ6: What is the correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 2?

$H_0$6: There is no correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 2.

H_a6: There is a correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 2.

RQ7: What is the correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 3?

$H_0$7: There is no correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 3.

H_a7: There is a correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 3.

RQ8: What is the correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 4?

$H_0$8: There is no correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 4.

H_a8: There is a correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 4.

In RQ5-8, the independent variable is the student's grade in microbiology. The dependent variable is the number of semesters it takes for the student to complete the nursing program.

RQ9: What is the correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 1?

$H_0$9: There is no correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 1.

H_a9: There is a correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 1.

RQ10: What is the correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 2?

$H_0$10: There is no correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 2.

H_a10: There is a correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 2.

RQ11: What is the correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 3?

$H_0$11: There is no correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 3.

H_a11: There is a correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 3.

RQ12: What is the correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 4?

$H_0$12: There is no correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 4.

H_a12: There is a correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 4.

In RQ 9-12, the independent variable is the student's grade in anatomy and physiology 1. The dependent variable is the number of semesters it takes for the student to complete the nursing program.

RQ13: What is the correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 1?

$H_0$13: There is no correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 1.

H_a13: There is a correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 1.

RQ14: What is the correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 2?

$H_0$14: There is no correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 1.

H_a14: There is a correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 2.

RQ15: What is the correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 3?

$H_0$15: There is no correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 3.

H_a15: There is a correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 3.

RQ16: What is the correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 4?

$H_0$16: There is no correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 4.

H_a16: There is a correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 4.

In RQ 13-16, the independent variable is the student's grade in anatomy and physiology 2. The dependent variable is the number of semesters it takes for the student to complete the nursing program.

Conceptual Framework

According to David Ausubel, "the most important single factor influencing learning is what the learner already knows" (1968, p. vi). His theory of subsumption suggested that meaningful learning is facilitated by the assimilation of new information into the learner's already existing cognitive structure. Conversely, rote learning results when the learner has no relevant cognitive structure into which the new information may be assimilated (Ausubel, 1962a). The theory described a hierarchical structure within the

learner's cognitive structure consisting of highly inclusive and relevant conceptual systems. If these previously learned concepts are stable, new information presented to the learner interacts with and is subsumed, or assimilated under one of the inclusive relevant concepts. In order to place the new information within a previously established concept, the learner needs to perceive relationships between the new and the old. This results in both meaningful learning and retention of the new information (Ausubel, 1962b). To facilitate this meaningful learning and retention, Ausubel proposed that inclusive and relevant concepts be introduced prior to presentation of unfamiliar material by the utilization of "advance organizers" (Ausubel, 1960, p. 268). Ausubel attributed the facilitating influence of these organizers to (a) the learner's recognition of the relationship of the new information to his/her own relevant existing cognitive structure, which is provided by the organizer and (b) the learner's placement of the new information within this larger, more inclusive concept (Ausubel, 1960). In nursing education programs, the sheer volume of content to be taught and learned requires a certain amount of expository teaching; that is, the teacher imparts knowledge and the students receive it. Students may resort to a familiar pattern of rote learning and memorization simply because they lack confidence or are experiencing anxiety. Ausubel contended that this pattern could be replaced by relating new material to previously learned material within the learner's cognitive structure. He suggested that arranging instruction to create this cognitive structure "should be the principal factor influencing meaningful reception learning and retention in a classroom setting" (Ausubel, 1977, p. 166).

In nursing education, program courses are sequential. Students are required to apply previously-learned concepts to increasingly complex situations in response to patient condition (Griffiths, Bevil, O'Connor, & Wieland, 1995). As the student progresses, prerequisite courses provide the cognitive structure and advance organizers for meaningful learning of new and unfamiliar material. When subject matter is sequentially organized, students' mastery of earlier material becomes "a crucial factor influencing his learning of later appearing material" (Ausubel, 1962c, p. 243). The literature is in general agreement that high grades in science prerequisites seem to correlate with student success in nursing programs (Griffiths et al., 1995; Schmidt & MacWilliams, 2011; Wolkowitz & Kelley, 2010). If students are successful in general sciences, successful program completion should follow (Wong & Wong, 1999). Concerns have arisen among stakeholders that the college's prerequisite science courses are not equivalent on each campus and may not be related to success. The general science prerequisites may not be serving as advance organizers to facilitate the cognitive structure needed for meaningful learning in the nursing courses. The grade differences among campuses and the relationships, if any, between the science prerequisites and program completion may clarify this.

Review of the Literature

A literature search was conducted using the library resources at Walden University and the local community college library. The research database used was primarily Google Scholar with supplemental searches within CINAHL Plus with Full Text, ERIC, and MEDLINE with Full Text. The literature review was organized around

common themes in the literature search. Subtopics that emerged as significant were (a) the theoretical foundation comprising the two categories of subsumption theory and meaningful learning, (b) retention and attrition within both the community college and nurse education settings (c) factors related to academic and professional success in nurse education defined as program progression and licensing exam success, respectively; and (d) the course content, rigor, and design of prerequisites. The following search terms were used: *admission criteria, assimilation, Ausubel, Ausubelian theory, advance organizer, meaningful learning, scaffolding, subsumption, attrition, completion, correlation, graduation, predictor variables, prerequisite courses, program completion, progression, remediation, retention, rigor, design, science courses,* and *success.* To further refine the results, the search terms were paired with *associate degree, community college, nursing student,* and *nursing education.* Each of the subtopics is relevant to both the broad problem of nursing student retention and attrition and the local problem of uncertainty regarding preparation of students in the general sciences. Upon entering a pre-nursing curriculum, students are provided with a sequentially arranged set of prerequisite courses. These courses should provide the cognitive structure needed to succeed in the core nursing courses. Upon entering the core courses, students are required to relate and apply unfamiliar, complex, and specific information to previously learned broad and inclusive topics. If students lack sufficient knowledge to form these relationships, they are more likely to attempt to memorize unfamiliar material and may have difficulty recalling and applying it when asked to do so. Certain characteristics seem to correlate with student success in nursing education. In this study, general science

preparation is the focus since questions have arisen from stakeholders on the topic. If course design and rigor of prerequisites affects student learning, addressing this may increase student success and retention.

Subsumption Theory

The theory of subsumption was initially described by David Ausubel in 1962 (Ausubel, 1962a). Using experimental design, he examined the use of advance organizers, sequencing of learning to improve cognitive structure, and the facilitation of meaningful learning in the classroom. More recently, researchers have considered the effects of advance organizers on meaningful learning in a variety of disciplines.

Advance organizers. In his seminal research, Ausubel found that advance organizers facilitated the retention of new knowledge. He presented a group of senior undergraduate students who had no previous knowledge of the subject with a 2,500 word passage on metallurgy. The experimental group received an advance organizing passage containing information relevant to the subsequent passage. The control group received a passage containing very general metallurgical information with no relevancy to the subsequent passage. Comparison of the mean retention scores of the group showed significantly higher scores in the experimental group (Ausubel, 1960).

In addressing the importance of sequential learning, Ausubel presented undergraduate psychology students with two sequentially prepared endocrinology passages. The experimental group received an introductory passage that comprised inclusive and general information regarding endocrinology, while the control group received a passage with more specific but less relevant information. After controlling for

learning ability and background knowledge, the experimental group exhibited significantly improved learning and retention. In students who had shown relatively low verbal ability, the effect of the organizer was even more significant. When the subjects' knowledge of the first passage was considered stable and clear, learning of the second passage was enhanced (Ausubel, 1962c; Ausubel, 1970).

In medical education, Ausubel suggested sequencing and the use of advance organizers to improve retention and usable recall of medical knowledge. Much like today's nursing students, medical students are presented with large amounts of information and are expected to apply it clinically; Ausubel contended that improving the cognitive structure could improve retention and problem-solving. He suggested sequencing courses from the general anatomy and physiology in the first lectures and presenting deviations from normal in later lectures. In this case, the general anatomy and physiology are the advanced organizer (Ausubel, 1962d).

Advance organizers were found to facilitate the readiness of students for university-level science courses. Schmid, Youl, George, and Read (2012) found that an intensive bridging course taken by students beginning chemistry in the first year of college contributed to increased success in students with no prior chemistry experience. The course comprised 13 hours of lecture with two hours of application following each lecture. The authors determined that the increase in success was both qualitative and quantitative. Students reported increased confidence in the subject and performed better on first-year chemistry exams than students who did not take the course. The authors attributed this success to the bridging course serving as an advance organizer. Based on

subsumption theory, Koscianski, Ribiero, and Rutz da Silva (2012) utilized subsumption theory to determine whether a short animation could serve as an advance organizer between pre-existent knowledge and new material in a physics course. Students created a short video to explain the concept of force. The results of a pre- and post-test on the subject suggested that the short animation had a significant positive effect on meaningful learning.

The effect of advance organizers on learning was not always supported in the literature. Ausubel expanded on the effects of sequencing in a later study, again using a group of undergraduate psychology students and information on endocrinology. He presented the experimental group with a passage on normal physiology followed by a passage describing various pathologies. In this study, the experimental group repetitively studied the passage on normal physiology and the control group did not. An analysis of variance showed that knowledge of the material on normal physiology did not influence learning of the related material (Ausubel, 1966). Lane, Newman, and Hull (1988) compared control and experimental groups of undergraduate psychology students. Both the control group and the experimental group received a pre and post-test exam interest survey and a pre and post-test on chapter content. The experimental group received an advance organizer in the form of an outline of the unfamiliar material to be presented. The advance organizer did not have a significant effect on cognitive performance, but did have a significant relationship with maintaining student interest in the subject. The authors suggested that interest may be an important and overlooked component of the relationships shown in the majority of Ausubel's work.

Meaningful learning. Ausubel (1962a) differentiated both the process and result of meaningful learning from the process and result of rote learning. He maintained that meaningfully learned materials were relatable to previously learned ideas and concepts. Conversely, rote learning resulted when isolated ideas were presented without such a relationship. Information learned by rote would be less likely to be recalled in a useful manner or much more likely to be forgotten. Ivie (1998) equated meaningful learning with higher order thinking by using subsumption theory. He defined higher order thinking as (a) the ability to think abstractly, (b) the ability to organize information into relationships, analogies, and systems; and (c) the ability to apply logic. He suggested that the use of advance organizers, subsumption, and logic be utilized in the planning of instruction by (a) assessing the learner's existing cognitive structure, (b) providing appropriate advance organizer as anchors for the new material to be presented, (c) presenting new material along with the suggestion as to where the new material relates to the advance organizer, (d) providing practice to allow the cognitive structure to become stable, and (e) guiding the learner through an application of the new material. Both the quality of the organizer and the organizational ability of students were found to be significant as effects on meaningful vs. rote learning.

Weisberg (1970) presented eighth-grade students with either a diagram, a map, or a paragraph containing geographical information. Results on a post-test showed that both visual advance organizers facilitated meaningful learning, while the paragraph did not. The author concluded that a poorly designed organizer would yield the same result on meaningful learning as no organizer. Gurlitt, Dummel, Schuster, and Nuckles (2012),

applied three differently structured advance organizers to a group of undergraduate statistics students. One organizer was "less-structured", one was "well-structured", and one was "well-structured and key concept-emphasizing" (p. 358). The results provided evidence that the well-structured and enhanced concept advance organizers showed a reliable benefit to meaningful learning and recall. The well-structured organizer did outperform the less-structure organizer, but not significantly.

Graber, Means, and Johnsten (1972) determined the cognitive organizing ability of students with a pre-test, then presented an irrelevant and a relevant passage to undergraduate chemistry students. Post-test scores were significantly improved only in the students who were good organizers. This led the authors to conclude that, unless their study was a statistical rarity, the effect of advance organizers is very small, relies on learner characteristics, and is easily confounded. Atomatofa (2013), Ermayanti (2013), Koscianski et al. (2012), and Mallick and Amandeep (2014) all found meaningful learning enhanced by different types of advance organizers. Atomotafa (2013) noted students using rote memorization to learn unfamiliar science concepts and presented a series of visual and text advance organizers to an experimental group and none to a control group. Post-test scores exhibited higher means for the experimental group in concept attainment and delayed retention of the concept of gravity.

Ermayanti (2013) examined the effect of using advance organizers to increase reading comprehension. Ermanyati suggested that three phases would be most effective: (a) presenting the organizer, (b) presenting new material, and (c) strengthening the learner's cognitive organization by repeating, writing, and applying the new material.

Because this study was classroom action research, the advance organizers and exams were given to all students within a classroom. Mean scores in reading comprehension, particularly descriptive reading, increased in a series of three reading exams over the course of one semester. Qualitative themes emerging from interviews with the students included seriousness of reading, helpfulness of advance organizers, and enjoyment of the application of advance organizers. Koscianski et al. (2012) found that students who created a short animation in a physics course exhibited greater assimilation of the concept of force than those who did not. Furthermore, the qualitative portion of this study indicated that students who created the animation were more motivated and contributed more in class than the other students.

In a cohort of secondary school social science students, Mallick and Amandeep (2014) presented both expository and comparative advance organizers to an experimental group while utilizing only traditional lecture with a control group. The groups had been selected based on intelligence test results and were given an achievement test at the end of the term. Based on the mean exam score, the experimental group showed high achievement in social science, whereas the control group showed average achievement. Analysis of t-test results revealed a difference in achievement that was significant.

Retention and Attrition

Retention and attrition have long been a concern in higher education. Community college attrition rates are estimated to be between 20% and 50% (Schneider & Lin, 2011; Windham, Rehfuss, Wiliams, Pugh, & Tincher-Ladner, 2014). According to Schneider and Lin (2011), around 20% of students who begin their studies at a community college

do not return for a second year, while Windham et al. (2014) reported that nearly one-half of community college students leave prior to degree attainment. These students suffer personal consequences, since they have "paid tuition, borrowed money, and changed their lives in pursuit of a degree they will likely never earn" (Schneider & Lin, 2011, p. 4). In nurse education, attrition rates are also high. In baccalaureate and associate degree programs, attrition may be as high as 50% and 47%, respectively (Harris et al., 2014). The literature regarding community college student attrition as well as nursing student attrition was examined.

Community college retention and attrition. Community college students, in general, have greater attrition risk factors than four-year college students (Mullin, 2012). Nearly half of all minority undergraduates and more than 40% of low income undergraduates attend community colleges. Although 67% of students are age 18-24, they are different from the typical student at a four-year college; 84% of community college students work and 60% work more than 20 hours per week while enrolled (Mullin, 2012). Schneider and Lin (2011) examined the taxpayer cost of community college attrition. Between 2004 and 2009, state and local governments spent $3 billion in appropriations to community colleges for students who did not return for a second year. State governments distributed grants totaling $240 million to students who did not return for a second year, and the federal government spent $660 million on grants to students who did not return for a second year (Schneider & Yin, 2011).

It has been suggested that underprepared students are more likely to attend community colleges. Most community colleges are open access, which creates a more

diverse student body but also decreases the ability to selectively admit students who are more likely to succeed (Fike & Fike, 2008; Mullin, 2012; Teranishi, Suarez-Orozco, & Suarez-Orozco, 2011). First-generation students, defined as those students whose parents did not attain post-high school education, more commonly attend community college because of the lower cost and physical proximity to home and work (Teranishi et al, 2011). Soria and Stebleton (2012), noting that first-generation students were more likely to be students of color, working class, and low-income, controlled for these variables in a qualitative survey examining engagement. Engagement was significantly lower in first-generation students as compared to non-first generation students and regression analysis showed that retention from the first to the second year was also lower in first-generation students. First-generation Latinos, Asian and Pacific Islanders, and native-born blacks are also more likely to attend community colleges. These students work more hours, have dependents, and are more likely to be over the age of 24; these characteristics increase the risk of attrition (Teranishi et al., 2011). Many community colleges are attempting to develop models to increase retention and limit attrition both by providing early remediation of struggling students and isolating predictors of success. According to Daiek, Dixon, and Talbert (2012) and Levin and Calcnago (2008), more than 60% of students entering community college need developmental courses or remediation. Levin and Calcnago (2008) contend that true experimental research on the effectiveness of remediation is lacking; without more evidence, the cost of remediation ($1-2 billion/yearly) cannot be justified. Bahr (2008) also found a paucity of evidence to provide justification of the cost of remediation. He evaluated the relative success of math

remediation in a community college by comparing credential attainment in students who completed a remedial math sequence with students who did not require remediation. Using logistic regression, results of this quantitative study found that students who successfully completed math remediation achieved credentials similar to students who did not need math remediation, suggesting that the math remediation was effective. However, he also found that 75% of remedial math students did not remediate successfully and more than 80% of those did not attain any credential.

In attempting to determine the likelihood of community college retention, several authors suggested certain student characteristics that increase the likelihood of success. Fike and Fike (2008) quantitatively and retrospectively analyzed fall-to-spring and fall-to-fall retention in a community college. Correlating positively with retention were successful completion of developmental math, receiving financial aid, online courses, and participation in student support. The strongest correlation was the completion of developmental reading. Additionally, students who reported that their mother had some college education were more likely to be retained, affirming the advantage of having a parent who attained higher education. Mertes and Hoover (2014) attempted to predict additional retention variables by using previously identified indicators as independent variables but added residency status, program of study, educational level of parents, and completion of a technology course. Retention rates were higher for students under 18, females, students enrolled in occupational programs, and students who passed the technology course. Full-time, White, nonremedial students who received financial aid had the highest retention rates.

Psychological predictors of retention, including self-efficacy, locus of control, and an education-employment connection were quantitatively examined as they related to age, ethnicity, gender, and first-generation status in a study conducted by Luke, Redekop, and Burgin (2014). Regression analysis showed that age was not significant for self-efficacy or locus of control but was significant for education-employment connection. Ethnicity was not significant for any of the psychological predictors, but female gender was significantly higher for self-efficacy, and education-employment connection. Males were significantly higher on locus of control. Self-efficacy, locus of control, and education-employment connection were all predictive of participants' intent to return the following semester.

Nurse education retention and attrition. The problem of nursing student attrition is particularly important in the United States because students who fail to complete a program of study cannot obtain a license to practice as a registered nurse and will not enter the workforce as registered nurses. Juraschek et al. (2012) predicted regional registered nurse shortages by using a model based on personal health expenditures and state-based estimates of age and population. Each state was assigned a 2009 grade and a 2030 grade for adequacy of the number of registered nurses. The forecast is for a worsening shortage of registered nurses in all but two states, Massachusetts and South Dakota, who received "A" grades for 2030. Twelve states, all in the South and West, received "F" grades for 2030. Overall, the total national registered nurse deficit is predicted to be between 725,619 and 1,112,112 registered nurses by 2030 (Juraschek et al. (2012).

Although the number of students that can be accepted into nursing programs is limited, it will be necessary to address this deficit in the next decade. Therefore, it is important that the students who enter nurse education ultimately obtain a license as a registered nurse. Clinical placement site and support seems to affect students' decision to leave. Pryjmachuk, Easton, and Littlewood (2008) in a retrospective, four-cohort study of preregistration nursing students, found differences between the cohorts depending on where students were placed for clinical education. Overall, 25% of students left the program. Students who had training sites in pediatrics were significantly more likely to leave than those assigned to general medical and mental health sites. In a systematic review of placement-related attrition, Eick, Williamson, and Heath (2012) found that student self-confidence, support at the placement site, and stress related to placement was significant in students' decisions to leave their program.

Pryjmachuk et al. (2008) found that attrition was significantly higher in younger students, non-white students, males, and students who were admitted with only minimum qualifications. Wray et al. (2010) examined attrition by retrospectively comparing data between students who left after the first year and students who returned for year 2. Like Pryjmachuk et al., Wray et al. found that students with higher qualifications on entry were more likely to complete the program, but gender and ethnicity were not significant. Attrition was more likely in students who were living away from their home town. Students who had dependents were more likely to be retained. Wray et al. agreed that as age increased the likelihood of retention increased. Mulholland et al. (2008) also found that older students were more likely to complete the program and that males had a higher

likelihood of attrition. However, Mulholland et al. did not find any significant differences between students who were at minimum qualification and those who had higher qualifications. Also notable was that Zimbabwean students, 97% of whom were black, had higher rates of retention than native-born white students. This is in contrast to other studies in which minority students were at higher risk for attrition (Eick et al., 2012; Melillo et al., 2013).

Stickney (2008) found that students who performed well on the Test of Adult Basic Education (TABE) and had higher prerequisite grades were significantly more likely to complete their program, but found no significant relationship retention and gender or age. Other authors found academic factors related to high attrition, as well. Harris, Rosenberg, and O'Rourke (2014) suggested that students who had repeated a science course, been enrolled in remedial math, or had lower than average American College Testing (ACT) scores were at risk for attrition from the program. Raman (2013) found that a minimum pre-nursing grade point average (GPA) did not affect attrition, but students who entered with a higher GPA were more likely to complete (Raman, 2013). Along with academic performance, Shelton (2012) and Williams (2010) examined the trait of persistence as it affected attrition of nursing students. Students who exhibited persistence tended to have greater financial resources, better connections with faculty, and higher pre-nursing GPAs than those who did not.

Factors Related to Success in Nurse Education

Factors related to nursing student success in the literature are often divided into two measurements; program success and success on the National Council Licensure

Exam for Registered Nurses (NCLEX-RN). Retention, attrition, program completion, and NCLEX-RN first-time pass rates are all components in the evaluation of a program's success (ACEN: Accreditation Commission for Education in Nursing website, 2013). Therefore, the literature was reviewed from the standpoint of both program completion and NCLEX-RN first-time pass rates. A large portion of the literature related student success to academic factors; non-academic factors were examined less frequently.

NCLEX-RN success. Academic factors were found to be significant for NCLEX-RN success, which was defined as passing the exam on the first attempt. Pre-nursing grade point average (GPA) was examined as a predictor by several authors. Newton and Moore (2009) determined the pre-nursing GPA to be highly predictive of NCLEX-RN readiness, as did Shaffer (2013) and Yates and Sandiford (2013). Conversely, DeLima, London, and Manieri (2011) and Jeffreys (2007) found no relationship between students' GPA upon beginning core nursing courses and NCLEX-RN success, and Trofino (2013) found that overall high school GPA had no effect on NCLEX-RN. In their landmark study of the contributory effect of basic sciences on academic success in nurse education, Wong and Wong (1999) also noted that high school science GPA did not predict success on CNATS (Canadian Nurses Association Testing Service), the Canadian equivalent of NCLEX-RN. They did determine that final college course grades in Anatomy and Physiology, Chemistry, and Biology significantly correlated with passing CNATS on the first attempt.

This correlation between grades in various science courses and licensing exam success has been widely investigated. Shaffer (2013) indicated that as the student grade

in Anatomy and Physiology 1, Anatomy and Physiology 2, and/or Microbiology increased, so did the likelihood of passing NCLEX-RN. Furthermore, a single failure or withdrawal that necessitated repetition of any science course was predictive of NCLEX-RN failure. Other authors noted individual science courses as predictive. Penprase, Harris, and Qu (2013) found that the grade in Pathophysiology was a reliable predictor of passing, while Lockie, Van Lanen, and McGannon (2013) determined that the students' grade in Chemistry was important in predicting success. In examining Anatomy and Physiology 1 and 2 and Chemistry, Higgins (2005), found that Anatomy and Physiology 1 was significantly correlated with NCLEX-RN success, but Anatomy and Physiology 2 and Chemistry were not. Elder, Jacobs, and Fast (2014) and McGahee, Gramling, and Reid (2010) noted that students who passed NCLEX-RN had significantly higher grades in all prerequisite science courses than students who did not. This was not replicated by Jeffreys (2007), who found that Anatomy and Physiology 1 success did not correlate with performance on the NCLEX-RN.

Certain core nursing courses were examined as predictors of licensing exam success. High grades in the first nursing theory course predicted success on NCLEX-RN in several studies (Jeffreys, 2007; Newton, 2009; Trofino, 2013), but DeLima et al. (2011) found no significant correlation. Students who only achieved a minimum grade in the first nursing theory course (Jeffreys, 2007) or repeated any nursing course (Trofino, 2013) were less likely to pass NCLEX-RN. Achievement in a comprehensive medical-surgical adult nursing course was found to be significantly predictive of NCLEX-RN success by Penprase et al. (2013); each 0.1 increase in grade increased the probability of

passing NCLEX by 59%. McCarthy (2014) and Yates and Sandiford (2013) also determined that a high grade in advanced medical-surgical nursing correlated positively with NCLEX-RN success, but DeLima et al. (2011) found the grade in medical-surgical nursing not significant as a predictor.

Grade point averages at the end of first semester and at the end of the program were examined with mixed results. Jeffreys (2007) found that an end-of-program B average or higher predicted NCLEX-RN success and Wong and Wong (1999) found that overall program GPA predicted passing the CNATS on the first try. However, DeLima et al. (2011) found no significance in the GPA at graduation. Jeffreys (2007), Newton and Moore (2009), and Trofino (2013), found the GPA at the end of first semester significant. Authors investigated the relationship of standardized entrance and exit exams on NCLEX-RN success with mixed results.

Various exit and predictor exams correlated significantly with NCLEX-RN readiness (DeLima et al., 2011; Simon, et al., 2013; Yates & Sandiford, 2013). Entrance exams scores were examined and found to be predictive of NCLEX-RN success when combined with the pre-nursing GPA (Higgins et al., 2014; Hinderer, Dibartolo, & Walsh, 2014; Newton & Moore, 2009; Yates & Sandiford, 2013), while McCarthy et al. (2014) noted that high scores on standardized exams throughout the nursing curriculum resulted in a high probability of passing NCLEX-RN. However, no significant correlation between standardized entrance exam scores and NCLEX-RN success was found by Newton and Moore (2009). Non-academic factors were also studied. Older students, females, and Caucasians were more likely to pass the NCLEX-RN than younger students,

males, and minority students. African Americans had the highest risk of failure (DeLima et al., 2011; Lockie et al., 2013; Trofino, 2013; Yates & Sandiford, 2013). Lockie et al. (2013, citing Kolb, 1976) studied learning styles using Kolb's experiential learning model and found that assimilators, convergers, and divergers passed the licensing exam at significantly higher rates than did accommodators.

Program success. GPA was significant for program success. Wong and Wong (1999) found that high school grades were positively correlated with the cumulative GPA in nursing courses, and Herrera (2013) noted that a high mean GPA in nursing courses correlated with program completion. Lancia et al. (2013) found that students with a higher average in upper secondary school had a greater likelihood of graduating on time, a higher GPA at graduation, and higher average exam scores when compared to their counterparts who entered the program with lower grades.

Pre-nursing GPA was also found to correlate with program graduation (Cunningham et al., 2014; Hinderer et al., 2014; Raman, 2013; Seago et al., 2012; Timer & Clauson, 2011). Newton and Moore (2009) found that students who did not progress to the final semester were more likely to have a GPA less than 2.5/4.0, and any pre-nursing grade less than 2.5/4.0 predicted attrition. However, Higgins (2005) and Jeffreys (2007) found no such correlation. Standardized testing was found to correlate with program progression and success. Pre-admission standardized exam scores in reading, math, and English were positively correlated with program success (Herrera, 2013; Higgins, 2005; Knauss & Willson, 2013; McCarthy et al., 2014; Wolkowitz & Kelley, 2010). McCarthy et al. (2014) measured program success by using standardized testing

throughout the program; higher pre-admission exam scores predicted higher scores for program duration. Underwood et al. (2013) included entrance exam scores in an admission protocol and found that math, English, and science all were positively and significantly correlated with final course grades in the three first-semester nursing courses. Chen and Voyles (2013) also found that students who completed all three first semester nursing courses had significantly higher composite scores on entrance exams, while Wolkowitz and Kelley (2010) determined that those who had the highest scores on an entrance exam also had the highest scores on a standardized achievement test given at the end of the first semester, and Jeffreys (2007) found that students who only achieved the minimum grade in their first nursing theory course were less likely to complete the program.

Crouch (2015) combined the pre-nursing GPA, a standardized entrance exam, and the Watson-Glaser Critical Thinking Appraisal and found that the three scores together were a significant, valid predictor of success in a nursing program. Cunningham et al. (2014) showed that combining standardized entrance exam scores with the number of prerequisites completed and the pre-nursing GPA resulted in a valid predictor model of nursing student success. Harris et al. (2014) found that a lower than average American College Testing (ACT) score, repetition of Anatomy and Physiology, and participation in a remedial math course comprised a model highly predictive of program failure. However, Hinderer (2014), found no correlation between entrance exams and program progression.

In a study of students who were on academic probation, Abele et al. (2013) determined that any previous course failure reduced the likelihood of completion by half. This study also was the only one that showed a psychology course grade positively correlated with program success. Interestingly, this course was developed by nursing faculty. Non-academic factors were also noted to influence program success. Several non-academic characteristics including emotional intelligence, psychological empowerment, resilience, and spiritual well-being were examined by Beauvais et al. (2014). Psychological empowerment and resilience were weakly correlated with program success as measured by cumulative GPA, but emotional intelligence and spiritual well-being were not. Raman (2013) measured the effects of the non-academic factors of faculty support, self-efficacy, academic self-concept, goal orientation, math self-concept, commitment, and barriers to success. Faculty support, self-efficacy, commitment, and math self-concept were significantly related to success as measured by GPA at the end of the first year.

Pitt et al. (2014) measured the effect of the personal qualities of aloofness, confidence, and self-control on clinical performance and GPA. Confidence and self-control were positively correlated with both clinical performance and GPA, while aloofness correlated negatively with GPA only. Seago et al. (2012) found that students who self-reported academic confidence upon program entry were more likely to graduate. Male gender, non-white ethnicity, and lower age at entry were found to be factors that negatively influenced completion (Abele et al., 2013; Chen & Voyles, 2013; Herrera, 2013; Salamonson et al., 2014; Seago et al., 2012; & Timer & Clauson, 2011). The only

noted exception is Herrera (2013). In her study, American Indians achieved a 100% completion rate when participating in a specially designed program for that ethnic group. Salamonson et al. (2014) found a positive link between nursing as a first career choice and program completion. She also found that students who worked more than 16 hours per week were less likely to complete, whereas Seago et al. (2012) found no link between hours worked per week and program completion.

Researchers who examined program success and completion found that students who achieved high science scores both in prerequisite courses and on standardized exams were more likely to progress (Chen & Voyles, 2013; Cunningham et al., 2014; Harris et al., 2014; Higgins, 2005; Hinderer et al., 2014; Seago et al., 2012; Wolkowitz & Kelley, 2010; Wong & Wong, 1999). Cunningham et al. (2014) found the prerequisite science GPA to be the most significant predictor of progress, while Harris et al. (2014) noted that students who earned lower than a C in Anatomy and Physiology (A/P) were more likely to later withdraw from a nursing course. Jeffreys (2007) found no such correlation between the grade in A/P and program completion.

Uncertainty regarding transfer grades in the sciences due to inconsistency in grade requirements was noted by Chen and Voyles (2013), Griffiths et al. (1995), and Herrera (2013). Griffiths et al. (1995) attempted to determine proficiency in A/P by designing a two-part experiment to determine student preparation. The initial phase comprised administration of a criterion-referenced A/P exam to students entering core nursing courses. Six variables assigned to the prerequisite course were used to predict student score on the exam; (a) type of course, (b) focus of course, (c) total number of credits

awarded for the course (d) mean final grade in course, (e) type of institution in which the course was taken, and (f) number of years since the course was taken. Two of the variables reached significance: mean final grade in the prerequisite and type of college at which the course was taken. In the second phase of the study, the score on the exam was regressed on the final scores in the second core nursing course. Three variables were found to be significant: mean final grade in prerequisite, type of college in which the course was taken, and the number of credits awarded. The authors concluded that the mean final grade in A/P is important when making decisions regarding program admission, but should be considered in combination with the type of college at which it was taken.

Prerequisite Course Design and Rigor

There is a correlation of high grades in prerequisite science courses with eventual student success (Griffiths et al., 1995; McGahee et al., 2010; Schmidt & MacWilliams, 2011; Simon et al., 2013; Wolkowitz & Kelley, 2010). The rigor and content of these prerequisites was not examined in any of the aforementioned articles. Wong and Wong (1999) suggested that the content presented in science courses was uniquely relevant to the success of nursing students. Therefore, a potential challenge in nurse education is to determine whether students have mastered the prerequisite science content.

Design. Investigators addressed the need for discussion in the way nursing students are taught the general sciences (Larcombe & Dick, 2003; Logan & Angel, 2011). Logan and Angel (2011) found that working nurses perceived educational gaps in their science courses. Although most perceived that knowledge of biology, anatomy, and

physiology was essential, they emphasized the need for it to be taught contextually "alongside nursing practice" (p.413). Larcombe and Dick (2003) questioned whether science teachers or nurses were best qualified to teach bioscience subjects and suggested that a team-teaching approach offered a superior experience. By combining the expertise of a bioscience specialist and a nurse, they noted that students were more likely to perceive the bioscience portion as relevant and contributory to nurse education. However, Cruthirds et al. (2011) warned against utilizing clinicians over doctoral-prepared scientists in the teaching of biosciences.

Outside of nurse education, medical educators have examined prerequisite rigor and course design for science courses. Several authors related competence in the general sciences as important to the academic and professional success of medical students (Dienstag, 2008; Finnerty et al., 2010; Miller, Perotti, Silverthorn, Dalley, & Rarey, 2002). Several authors examined the idea of teaching concepts and reasoning rather than content and memorization in order to improve competence (Bergtrom, 2011; Hsieh & Cifuentes, 2006; Miller et al.; Richardson, Tooker, & Eshleman, 2014; Wagner, 2014). Bergtrom (2011) replaced traditional didactic teaching methods in a large undergraduate cell biology course with active learning. The methods included asking students to request written clarification on the most difficult point from the previous lecture ("the muddiest point"), audience response questions, crossword puzzles, short writing assignments, and discussion board postings. The final grades and exam averages were comparable between courses, but student feedback was more positive with the experimental course.

Hsieh and Cifuentes (2006) incorporated visualization into science teaching by either exposing students to concept visualization tools on paper or using a computer drawing program. These students were compared to a control group who received traditional didactic teaching. The students who were taught to visualize science concepts on paper and with computer tools scored significantly higher on a comprehensive exam than students who were not provided with the tools. There was no difference between the scores of students who used paper and those who used computers, leading the authors to conclude that either paper or computers for concept visualization would be superior to traditional lecture. Miller et al. (2002) proposed concept-based teaching and suggested that students need to be discouraged from viewing anatomy courses as an exercise in memorization. Instead, the courses should present anatomy as a dynamic basis for problem solving. Miller et al. presented examples of this including analytical questions, skill practice integrated with anatomical structure and function, and the integration of physiology with anatomical structure. Richardson et al. (2014) incorporated a basic chemistry course into a university learning community. A chemistry teacher and a teacher from the education faculty taught the course together. The chemistry faculty focused on content and the education faculty focused on application of the content. The authors concluded that this system allowed students to integrate chemistry with events in the larger community, fulfilling the learning community's mission.

Supplemental and preparatory courses were also suggested as a way to improve student outcomes in science courses (Beeber & Biermann, 2007; Hopper, 2011; Van Lanen, Lockie, & McGannon, 2000). Beeber and Bierman surveyed currently-enrolled

Anatomy and Physiology (A/P) students who had participated in an optional prerequisite foundational biology course. A majority of students reported feeling very prepared for the current course. Students indicated that the design of the foundational course, which included oral presentation laboratory experiments, and written reports facilitated their ability to collect, apply, and analyze data. Students who took the foundational course also passed A/P at a higher rate than those who did not.

Hopper (2011) examined the effect of an A/P supplemental course that was offered concurrently with a traditional A/P course. The supplemental course emphasized study skills and self-assessment of learning as applied to the content presented in the traditional A/P course. Other activities included group discussion of new concepts, development of a glossary, practice in the anatomy lab, interpretation of diagrams, online games, and learning how to sequence. Student participation in the course effectively improved retention in A/P. Sixty-three percent of students enrolled in the supplement and 38% of students not enrolled in the supplement passed A/P. Van Lanen et al. (2000) determined that traditional nursing student performance in a chemistry course was better when students attended concurrent supplemental instruction courses that included group discussions, mind maps, and individual reinforcement of difficult topics. Conversely, nontraditional students or transfer students were not helped by supplemental instruction. The authors speculated that traditional students may have more of a need for the social interaction that was provided by the supplemental instruction, while the nontraditional and transfer students relied more on their own "motivation, life experiences, persistence, and a readiness to learn" (p. 770).

Classroom activities and different presentation methods were examined by several researchers (DeCiccio, Kenny, Lippacher, & Flanary, 2011; Gannon & Abdullah, 2013; Wagner, 2014). DeCiccio et al. (2011) piloted an A/P course for at-risk first-year students. At-risk students were defined as those who had scores on the Scholastic Aptitude Test (SAT) of 900 or below in verbal and math. To improve student outcomes, the pilot extended the time for A/P from one semester to two semesters, incorporated physicians to team-teach with the A/P instructors, utilized classroom response systems and case studies, and provided small group discussions. After one year of the pilot, the percentage of students passing the course rose from 35% to 78% while the average SAT score of the passers fell by more than 70 points. The authors concluded that the pilot improved learning, particularly in at-risk students, by improving engagement and increasing active learning.

Gannon and Abdullah (2013) designed an A/P course based on the use of open-note quizzes to help at-risk students improve their performance on unit exams. Quizzes were given to the experimental group at the beginning of every class period. The students were allowed to use notes from the previous week's lecture materials. The control group received only additional instructor clarification on the material during this period. Student outcomes on five unit exams were compared. The experimental group performed significantly higher on four of the five unit exams. The experimental group also had a lower rate of attrition and gave more favorable course evaluations. The authors concluded that students who received the open-note quizzes were better able to learn independently.

Wagner (2014) designed a kinesthetic learning activity to facilitate nursing students' understanding of cardiac structure, function, and pathology. Students walked through an anatomical diagram of the heart that was drawn on the classroom floor. The concepts of flow through the heart, preload, afterload and oxygen diffusion were clarified. Various pathologies and medication effects were also kinesthetically demonstrated. Following this lesson, exam scores rose, students reported greater understanding, and clinical faculty noted deeper thinking in regards to cardiac patient care.

Self-efficacy and anxiety seem to affect student learning in science. Crane and Cox (2013) noted that science anxiety in nursing students negatively affected learning and had negative consequences for success in their nursing education program. They suggested designing pre-nursing science courses to (a) provide a low-stakes introduction to how basic science works, (b) raise awareness among both students and faculty regarding the amount of anxiety pre-nursing students have when entering science courses, and (c) consider providing pre-nursing students with workshops or support groups to learn how to study science. Larson et al. (2014) examined whether math and science self-efficacy measured in the first year of college would predict graduation four to eight years later. Students completed a Likert-type scale to describe their level of confidence in math and science. When combined with the first semester GPA, the math/science self-efficacy score was predictive of graduation even after controlling for pre-admission aptitude in math and science. The authors found that the score's effect on failing to graduate was even larger than the effect on graduating.

Rigor. Several authors investigated whether the type of feeder school may influence the predictive value of prerequisite grades. Wheeler and Arena (2009) investigated whether the selectivity of applicants' feeder school improved the predictive value of the GPA. Predictor variables included a math/science prerequisite GPA, feeder school selectivity, and demographic information. The outcome variable was academic probation. Students were placed on academic probation if their cumulative GPA fell below 3.0 for one semester or longer. School selectivity was determined by using the rankings provided by the U.S. News and World Report Classification System. Regression analysis showed that both GPA and selectivity of the feeder school predicted the event of academic probation. The authors determined that a more selective undergraduate program with a higher level of rigor in undergraduate work was predictive of success in the physical therapy program. They recommended that the GPA should be considered for admission in combination with the selectivity of the feeder school.

Griffiths et al. (1995) designed a study in response to faculty concerns regarding the under preparedness of nursing students who had taken A/P at feeder schools prior to entering the nursing program. Faculty noted the great variation in the type of school (2-year public vs. all others), the type of A/P studied (human or mammalian), the number of credits awarded, and the number of years since the course was taken. Students completed a criterion-referenced A/P exam. This exam score was regressed upon the previously mentioned variables. A higher mean final grade in the A/P course and a school other than 2-year public emerged as significant positive predictors of A/P knowledge base.

Bormann, Moser, and Bates (2013) investigated the factors affecting student academic achievement to optimize advisement practices in a genetics course. Variables were collected on each student including demographics, professor, transfer status, major, class standing, biology grade, and whether the biology course had been taken in residency at the college. The correlation between the biology grade and the genetics grade was calculated. The biology grade was positively correlated with the genetics grade, but transfer students, students from a metropolitan area, preveterinary students, and seniors had higher grades in the genetics course. The authors speculated that students attending high school in metropolitan areas may have had more access to rigorous or advanced courses than those from rural areas. Students who took biology in residence at the college had higher grades in the genetics course than those who took biology elsewhere. These results led the authors to speculate that the students were better prepared based on course rigor.

Cruthirds et al. (2011) surveyed pharmacy faculty regarding preparation of Doctor of Pharmacy students in the basic sciences. A majority (2/3) of faculty surveyed reported finding students under prepared in pathophysiology and biochemistry. Student undergraduate education was obtained at a variety of institutions because the Accreditation Council for Pharmacy Education (ACPE) allows each pharmacy program to determine its own policies and requirements for admission. The author suggested that prerequisite requirements in general chemistry, organic chemistry, and the biological sciences be standardized across all preprofessional programs.

The determination and improvement of course rigor by assigning a difficulty index (DI) to the evaluation of learning outcomes was investigated by Zainudin et al. (2011). The DI is a measure of the difficulty of either an exam or an assignment. In this study, the assessment was considered objective if it was assigned to true/false, multiple-choice, matching, or fill-in-the-blank exam questions. The assessment was considered subjective if it was an essay or a structured open-ended question. Both the objective and subjective assessments were based on the learning outcomes. The DI was calculated by determining how many students completed the assessment correctly. If the DI is high, the assessment was correctly completed by more students. If the DI is low, many students competed the assessment incorrectly. The authors applied DI to a Management Information Systems course as a case study. Using the results, the instructor modified exam questions to increase the overall rigor of the course and to improve the learning outcomes. The authors recommend a) each evaluation item should link to a learning outcome, b) each evaluation item needs a DI identified, and c) evaluation items with a DI outside the agreed-upon value need to be modified.

Implications

The reviewed literature supports the efficacy of well-designed advance organizers to improve outcomes in nursing education. Many authors have attempted to create both admission and progression models that correlate with student success. There is general agreement that science courses may be uniquely related to the type of reasoning and analysis that is required for nursing students to be successful. However, there is little agreement on how to teach prerequisite science courses to encourage meaningful

learning. There is also some concern regarding the rigor of general science prerequisites, although no published research on standardizing rigor in prerequisite science courses was found. In the four campuses that comprise my college, the science prerequisites are not standardized in design, delivery or rigor. This study will examine how student prerequisite grades and length to program completion differ among campuses and how prerequisite grades are related to program progression on each campus. If the results of the data collection and analysis exhibit significant differences among campuses in student grades and program progression, a possible project may be to determine a standard and rigorous course design that would provide the cognitive structure needed by nursing students.

Summary

The literature generally supports the ability of advance organizers to improve meaningful learning in a variety of settings and disciplines. However, the advance organizers were not always shown to have a positive effect and a poorly-designed organizer may not have a positive effect on learning. A majority of authors found a positive effect, but it is important to determine the type, timing, and design of the organizer if it is to contribute to student retention and recall.

Community colleges tend to admit less prepared students who may have a greater risk of attrition. Attrition is costly both personally and economically in the United States, as is remediation of these students. Characteristics of students who are likely to succeed have been investigated with females, students who have educated parents, white ethnicity, high self-efficacy, and financial aid more likely to stay in school. These

characteristics may be used upon admission to provide more targeted remediation and support to certain students.

The nursing shortage is worsened by high rates of attrition in nursing students. Variables contributing to attrition were found to be both academic and non-academic. Several, but not all of the authors found that pre-nursing GPA was related to success both on the licensing exam and in the nursing program. Standardized exams used both before admission, throughout the program, and at exit seemed to provide information regarding potential student success. There were a variety of exams used. The timing of the exams was also quite varied. Several authors recommended using standardized exams scores as an indicator of which students to admit. Science grades, both on standardized exams and in prerequisite courses, were related to academic success in nearly all of the literature. The connection to professional success, or the licensing exam, was not as clear. Authors who investigated non-academic characteristics found that confidence and self-efficacy predicted academic progress. Older students, females, and non-minority students were more likely to have both academic and professional success. It is possible that more consistent criteria for academic and non-academic variables related to student success would be useful for admission and remediation. The non-academic variables may be used to actively assist certain students with specific learning strategies to increase their likelihood of success.

Prerequisites as advance organizers seem to be supported in the literature. The literature on prerequisite course design and rigor is sparse. Because science prerequisite courses may serve as advance organizers for core nursing courses, the way in which these

courses are taught and how students achieve grades may be quite important. Some authors suggested that a team-teaching approach using both a nurse and a scientist would be useful in helping nursing students contextualize what they learn. Others recommended less reliance on memorization and more emphasis on concepts, reasoning, and critical thinking. Active learning strategies along with supplemental instruction were suggested, along with strategies to reduce anxiety and increase self-efficacy. Although a few authors determined that certain feeder schools provided prerequisite science courses that improved student performance in nursing core courses, I could find no recommendations other than a single article on assigning difficulty index for how to determine course content or rigor. This is a gap in the literature.

In the following sections, I will describe the methods used to investigate the relationship between prerequisite science courses and number of semesters to completion in the nursing program on all four campuses. This description will include the research design, the setting and sample, and the data collection and analysis procedures.

Section 2: The Methodology

Introduction

In this project study, my focal case was a nursing program that is offered by a U.S. Midwestern technical and community college across four campuses. Between 2006 and 2014, a lower than desired number of students had completed the study college's associate degree nursing program within six semesters. The study college did not meet ELA for this outcome in thefour recent accreditation process. Failure to meet the ELA required the college to examine possible reasons for the extended time that many students required to earn an associate degree in nursing. Over the past several years, faculty and students have expressed concern regarding student preparation in the general sciences as a possible explanation for low degree completion in the nursing program. I discovered through a review of the literature that high grades in the general science prerequisites are usually correlated with academic success (Chen & Voyles, 2013; Wolkowitz & Kelley, 2010; Wong & Wong, 1999). I found very little information on course design or rigor in these courses. Therefore, I considered the possibility that prerequisite course content, rigor, and delivery may not be equivalent on all campuses.

In the college where I conducted the study, faculty at the four campuses required common textbooks but did not use a common course design for Microbiology and Anatomy and Physiology 1 and 2. Each campus had a different faculty member teaching these courses. Moreover, the same faculty member taught all science courses on his or her campus. As a first step in determining whether nursing students were equally well-prepared for the core nursing courses on each of the college's four campuses, I

investigated prerequisite grade differences among campuses, program completion time among campuses, and the relationship of prerequisite science grades to the number of semesters that it took students to complete the nursing program on each campus.

Research Design and Approach

I used a quantitative research approach, which is appropriate when the research questions attempt to explain "why something occurs" (Creswell, 2012, p.13). I considered and rejected a mixed-method design. Mixed-method designs may be explanatory or exploratory. An explanatory design would require quantitative data collection followed by qualitative data collection. The explanatory design is used if the researcher wishes to examine outlying results or extreme cases (Lodico, Spaulding, & Voegtle, 2010). An exploratory mixed-methods design would require the collection of qualitative data followed by the collection of quantitative data. This design is often used when researchers do not know enough about a topic to determine an appropriate quantitative design (Lodico et al., 2010). Mixed-method research is useful when one type of research is "not enough to…answer the research question" (Creswell, 2012, p. 535). I did not wish to address outliers or extreme cases in answering the research questions, but sought one possible explanation for the length of time it takes students to complete the nursing program. As a faculty member in the study college's nursing program, I am familiar with the topic, the program, and the specific courses addressed in the research questions.

I considered and rejected a qualitative design. In a qualitative design, the researcher explores problems to obtain a deep understanding, does not present statistics,

and analyzes words to increase understanding of phenomena (Creswell, 2012). In this project study, addressing the research questions required numerical data so that I could apply statistical analysis. The purpose and research questions were not general or broad, but specific to certain courses and campuses. My decision to reject a qualitative design was also based on the potential audience of my research, which comprises the college's stakeholders. I believe that quantitative data analysis will be more understandable to the college's stakeholders, most of whom are familiar with measurement, assessment, and statistics (Lodico et al., 2010).

In this study, I used a quantitative approach. The purpose, research questions, and hypothesis were narrow and specific and the data required a statistical analysis to determine any relationships (Creswell, 2012). This approach is nonexperimental because I did not manipulate any variable, did not randomly select participants, and did not attempt to establish any causative relationship (Lodico et al., 2010). This approach is used when the researcher wishes to test a hypothesis and generalize the findings to a population or a segment of the population (Creswell, 2012). However, my research questions are specific to nursing students. Because nursing students comprised the largest number of program students at the college during the data collection period, any results are generalizable to future nursing students. The generalizability is further enhanced by the use of a census sample, in which I collected data from every member of the population (Triola, 2012).

Because the study's purpose was to explore the relationship between the grades that nursing students receive in three science prerequisites and the length of time that they

needed to complete their programs on each of the study college's four campuses, I used a case study correlational design. The type of correlational study was an explanatory design. Data were collected at one point in time, at least one value for each variable was obtained, and a statistical test was used to draw conclusions from the results, following Creswell's (2012) recommendations. I believe that a correlational design was the logical choice for this study. By using a quantitative correlational design, I was able to make an observation about the existing situation without administering a treatment or determining cause and effect (Pyrczak, 2006). The correlational design is used when the researcher wishes to identify a direction and association between two values (Creswell, 2012).

Setting and Sample

The population from which I drew the sample comprised all students who began the study college's associate degree nursing program between Fall 2005-Spring 2013. I chose these dates because of the college's schedule of accreditation by ACEN. Between the last accreditation in 2005 and the most recent accreditation in 2014, the accrediting agency increased the national standard for measuring student outcomes (ACEN, 2013). In its 2014 accreditation visit, ACEN noted that the study college had not met its ELA at any time during the most recent accreditation period. The nursing program calculated the ELA by using data from this period, so I used this data in my study.

To be considered a target population, all members of a group need to share the same characteristic (Creswell, 2012). In this population, the participants shared the characteristic of appearing on the course roster for all first semester nursing courses. Any

student who was not registered for all four courses did not fulfill the criteria and was excluded from the study.

According to Creswell (2012), it is important to select as large a sample as possible so that the sample will best represent the population. I used a nonprobability census sample to minimize the potential that the sample would differ from the population. In a census sample, data are collected from every member of the target population (Triola, 2012). The sample was a census of all students who began and completed the associate degree nursing program between Fall 2005-Spring 2013. The sampling was exhaustive since all students who were enrolled in the core nursing courses and completed the program during the selected period were included. I excluded transfer grades in any of the three prerequisites under investigation for those courses, but I included all other grades for correlation.

I collected data for 10 fall semesters and 10 spring semesters with a sample size of 575 and performed a power analysis to determine adequate sample size. In inferential statistics, the sample size (*N*) may be determined by consideration of the effect size (ES) and significance criterion (α). In education, if a relatively inexpensive change in practice could raise academic achievement by an ES of .3, significant gains in student achievement may result.

The difference in a nursing student completing the nursing program even one semester earlier would result in saving money and resources. Therefore, ES is medium, or .3 (Cohen, 1992). The α level, which is the maximum risk the researcher will accept of a Type I error, or mistakenly rejecting the null hypothesis, is set at .05. This is a level

that is widely accepted in the social sciences (Creswell, 2012). I desired to avoid a Type II error, or failing to reject the null hypothesis if it is false. A power of .8 decreases the risk of this error (Cohen, 1992). These levels are set prior to statistical analysis. The required sample size for using ANOVA with a medium effect size, α of .05, and power of .8 is 45 per group. With four groups, the required sample size is 180 for ANOVA. The sample was larger than that, so the risk of Types I and II error was small.

Using the Pearson product-moment correlation coefficient with an ES of .3, power of .8, and α of .05 will require an *N* of 85 (Cohen, 1992, Table 1). This number is likely to reduce sampling error and to represent the population. Any data obtained from this sample may be analyzed to provide statistics (Urdan, 2010).

To answer the research questions, I investigated possible statistical differences and relationships between the independent and dependent variables in this sample. The data were archival and obtained from student academic records. The student identification number was used to track the number of semesters to graduation. Differences in and relationships between the independent and dependent variables in this sample provided the data required to answer the research questions.

Instrumentation and Materials

I used an Excel® spreadsheet to track student grades in the general sciences and the number of semesters to completion. The spreadsheets were used to collect data for the project and are available from the researcher. The data were represented in tables and graphs generated using IBM SPSS Statistics (SPSS Statistics Website, n.d.). In correlational research the purpose is to "compare participants in this single group on two

or more characteristics" (Creswell, 2012, p. 355). The student information included (a) the student identification number, (b) the campus at which the student took each prerequisite science course, (c) the grade in each prerequisite science course, and (d) the number of semesters it took the student to complete the program. In this way, I collected identical information on each student. All information was archival, so no recruitment of participants was required. The only student identifier was a number.

Data Collection and Analysis

I obtained written approval from the Divisional Dean of Nursing, the Vice President of Academic Affairs, the Office of Institutional Effectiveness, and the President's Cabinet to access student records through the college's archive of academic records. Letters of permission are in Appendix B. The data were available for all semesters under investigation. The data were entered at the end of each semester when the faculty member entered a grade. As mentioned, the student identification number was used to track the data. Each course grade was listed under a catalog number:

- Microbiology-10806197
- Anatomy and Physiology 1-10806177
- Anatomy and Physiology 2-10806179

Each student's graduation date was posted in the data within one week of faculty submission of the student's final grades. I obtained all of the student data for the cohorts admitted between Fall 2005-Spring 2013. Each student identification number and campus identifier was paired with the number of semesters required to complete the program. The total number of semesters investigated was 20. Next, the student grades in

the pertinent courses were recorded, converted to a numerical value, and associated with the student identification number. In this way, the data for each student was identical for: (a) identification, (b) campus, (c) grade in Microbiology, (d) grade in Anatomy and Physiology 1, (e) grade in Anatomy and Physiology 2, and (f) number of semesters to completion of the program. I reviewed student records individually and recorded the grades on the spreadsheet. I re-checked all data after the initial entry. Because the data were collected and recorded accurately, minimal threats to validity existed. An unanticipated group of data emerged when the student records were reviewed. These data comprised a number of students who had taken general science courses through the college in an online format. These data were not addressed as a separate research question.

I collected nominal, ordinal, and interval data as shown in Table 2. Nominal data comprises a label or category. The data may be numbered, but the numbers do not have any significance (Triola, 2012). In this study, the campus at which the student took the prerequisite courses was assigned a number 1-4. The campus number was not significant. Course grades are an ordinal variable, since "we know that A is higher than B, but we cannot subtract B from A" to determine the difference between them (Triola, 2012, p. 14). Therefore, the grades in Microbiology, Anatomy and Physiology 1, and Anatomy and Physiology 2 are ordinal. An interval level of measurement is similar to the ordinal level, but the difference between two data points is meaningful and there is no absolute zero. Since the Pearson product moment correlation coefficient requires interval data for both independent and dependent variables, the letter grade was converted to a

number using the conversion scale found in the Appendices. The number of semesters to completion is also interval data. The value is a number between four and 20, but there is no possibility of any value being zero (Triola, 2012).

Table 2

Levels of Data

	Nominal	Ordinal	Interval
Campus	x		
LG		x	
NG			x
SC			x

Note. Campus = campus location; LG = letter grade; NG = numeric grade after conversion;
SC = semesters to completion.

Descriptive and inferential statistics were used to analyze the data. The data were grouped and categorized to summarize overall trends. In quantitative research, the mean and standard deviation are reported on the interval data (Creswell, 2012). Measures of central tendency were reported. For example, the mean and standard deviation of grades in each course on each campus were described along with the mean and standard deviation of the number of semesters to program completion. The measures of central tendency were presented in tables. To test the hypotheses in research questions 1-16, inferential statistics were used. Inferential statistics are needed when researchers want to draw conclusions about the population from the sample (Lodico et al., 2010). Each research question had one independent variable and one dependent variable. The

independent variable for questions 1-4 was the campus location, which was represented by nominal data. In questions 5-16, the independent variable was a grade, which was represented by interval data. The dependent variable in questions 1-3 was also a grade and was interval data. The dependent variable in questions 4-16 was the length of time to program completion, which was interval data.

To examine any differences between the means in questions 1-4, either a one-way analysis of variance (ANOVA) or a Welch ANOVA was applied to the data. A one-way ANOVA or a Welch ANOVA may be used to analyze these data because the independent variable comprises two or more nominal, independent groups and the dependent variable is measured at the interval level. Because the independent variables were continuous in questions 5-16, the Pearson product moment correlation coefficient (Pearson *r*) was used. The Pearson *r* measures the strength of the relationship between two variables (Triola, 2012). For each research question, this coefficient was calculated. The first step in interpreting the coefficient was to set a significance value, which is the probability that the statistic will be due to chance. It was set at .05. Therefore, any correlation coefficient with a significance value of more than .05 may be due to chance (Lodico et al., 2010).

When using the one-way ANOVA to determine whether differences in group means were significant, it is assumed that variances of the dependent variable are equal for all groups of the independent variable. Type I error can be affected by unequal variances. One method of testing variance homogeneity is the Levene test of equality of variances (Laerd Statistics website, 2013). If $p < .05$, or statistically significant in the

Levene test, the variances are not equal. If $p > .05$, or statistically insignificant, the variances are equal. The Levene test was applied to the data with the "Sig." (p-value) column in Table 3 representing the results of this test. As shown in Table 3, the assumption of homogeneity of variance was violated in all courses, as assessed by the Levene test for equality of variances. Therefore, a Welch ANOVA was used to compare the means (Laerd Statistics website, 2013).

Table 3

Test of Homogeneity of Variances

	Levene Statistic	Sig.
Microbiology	3.730	.011
Anatomy and Physiology 1	7.266	.000
Anatomy and Physiology 2	7.385	.000

*$p < .05$

Data Results

Data were analyzed for research questions using both descriptive and inferential statisitcs. Each research question was addressed separately and after statistical analysis was completed, the hypothesis was accepted or rejected.

Research question 1. Descriptive statistics are shown in Table 4 and the campus means shown graphically in Figure 1. Data do not include online courses for analysis because online grades are not assigned to a specific campus.

Table 4

Microbiology Grade Descriptive Statistics by Campus

Campus	1 (*N*=40*)*	2 (*N*=311)	3 (*N*=47)	4 (*N*=125)	Total (*N*=523)
Mean	3.16	3.57	3.67	3.63	
Standard Deviation	.943	.553	.532	.612	

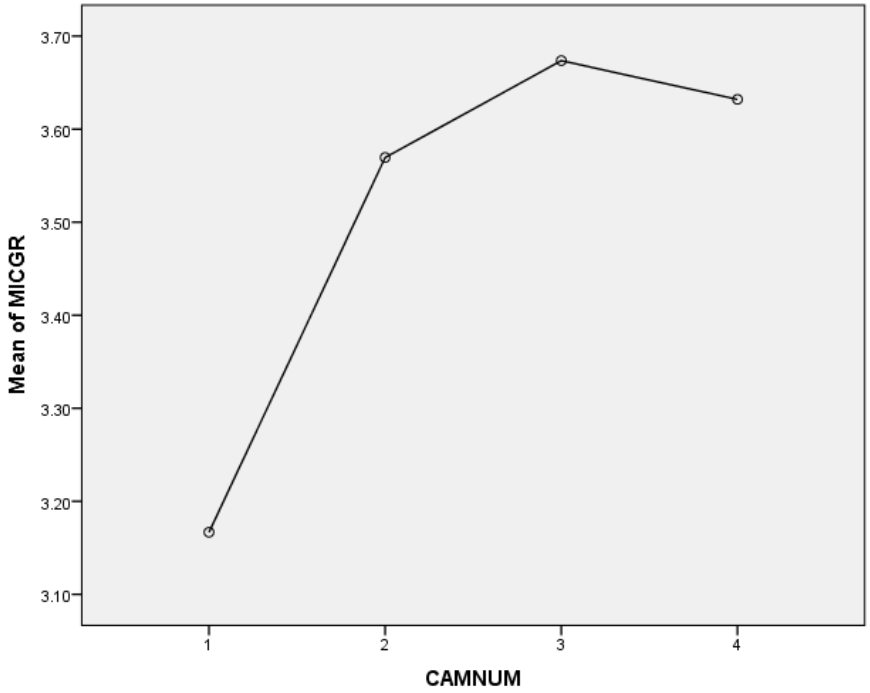

Figure 1. Mean microbiology scores by campus.
Mean of MICGR = mean microbiology grade; CAMNUM = campus identifier

In research question 1, a Welch ANOVA was applied to the data to to compare course grades of students who took a microbiology course at one of the four campuses. As shown in Table 5, there were significant differences found among campuses: [$F(3, 106.542) = 3.339$, $p = .022$].

Table 5

Welch ANOVA (Robust Tests of Equality of Means for Microbiology Scores)

	Statistic (F)	*df1*	*df2*	*Sig.*
Welch	3.339	3	106.542	.022

*$p < .05$

Because the groups were not homogeneous, a Games-Howell post hoc test was used to determine the nature of the differences among the campuses (Laerd Statistics website, 2013). Analysis revealed grades at campus 1 (M=3.16, SD=.943) were significantly lower than course grades at campus 3 (M=3.67, SD=.532) and campus 4 (M=3.63, SD=.612). As shown in Table 6, there were significant differences found among campuses.

Table 6

Levels of Significance in Microbiology Course Means by Campus (Post Hoc Test)

Campus	1	2	3	4
1	NA	NS	.019	.025
2	NS	NA	NS	NS
3	.019	NS	NA	NS
4	.025	NS	NS	NA

Note: NA = not applicable; NS = not significant;
*$p < .05$

RQ1: What is the difference among the four campuses in students' grades in microbiology?

$H_0$1: There is no difference among campuses in students' grades in microbiology.

H_a1: There is a difference among campuses in students' grades in microbiology.

The null hypothesis was rejected and the alternative hypothesis was accepted.

Research question 2. Descriptive statistics are shown in Table 7 and the campus means shown graphically in Figure 2. Data do not include online course grades for analysis.

Table 7

Anatomy and Physiology 1 Descriptive Statistics by Campus

Campus	1 (*N*=134)	2 (*N*=172)	3 (*N*=35)	4 (*N*=115)	Total (*N*=456)
Mean	2.98	3.49	3.72	3.43	
Standard Deviation	1.03	.701	.383	.716	

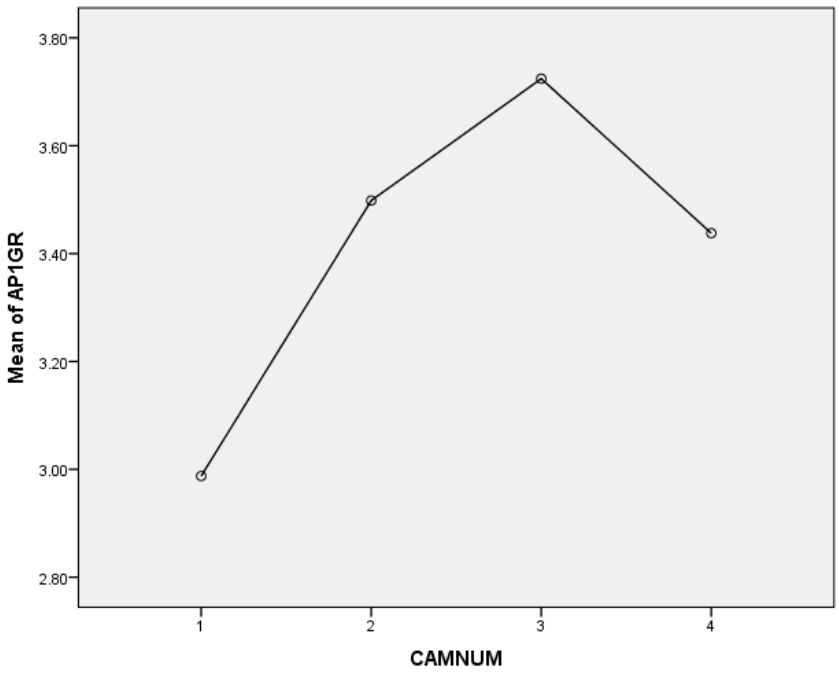

Figure 2. Mean anatomy and physiology 1 scores by campus. Mean of AP1GR = mean anatomy and physiology 1 grade; CAMNUM = campus identifier

In research question 2, a Welch ANOVA was applied to the data to to compare course grades of students who took an anatomy and physiology 1 course at one of the

four campuses. As shown in Table 8, a significant difference was found among the campuses: [F (3, 170.031) =15.193, p =.000].

Table 8

Welch Anova (Robust Tests of Equality of Means for Anatomy and Physiology 1 Scores)

	Statistic (F)	*df1*	*df2*	*Sig.*
Welch	15.193	3	170.031	.000

* $p < .05$

Because the groups were not homogenous, Games-Howell post hoc test was used to determine the nature of the differences among the campuses (Laerd Statistics website, 2013). Analysis revealed course grades at campus 1 (M=2.98, SD=1.02) were significantly (p=.000) lower than course grades at campus 2 (M=3.49, SD=.701), campus 3 (M=3.72, SD=.383), and campus 4 (M=3.43, SD=.716). Mean course grades on campus 2 (M=3.49, SD=.701) were significantly (p=.042) lower than course grades at campus 3 (M=3.72, SD=.383). Finally, mean course grades on campus 4 (M=3.43, SD=.716) were also significantly lower (p=.000) than on campus 3 (M=3.72, SD=.383). As shown in Table 9, there were significant differences found among campuses.

Table 9

Levels of Significance in Anatomy and Physiology 1 Course Means by Campus (Post Hoc Test)

Campus	1	2	3	4
1	NA	.000	.000	.000
2	.000	NA	.042	NS
3	.000	.042	NA	.014
4	.000	NS	.014	NA

Note: NA = not applicable; NS = not significant

*$p < .05$

RQ2: What is the difference among the four campuses in students' grades in anatomy and physiology 1?

$H_0$2: There is no difference among campuses in students' grades in anatomy and physiology 1.

H_a2: There is a difference among campuses in students' grades in anatomy and physiology 1.

The null hypothesis was rejected and the alternative hypothesis was accepted.

Research question 3. Descriptive statistics are shown in Table 10 and the campus means shown graphically in Figure 3. Data did not include online course grades for analysis.

Table 10
Anatomy and Physiology 2 Grade Descriptive Statistics by Campus

Campus	1 (*N*=126)	2 (*N*=247)	3 (*N*=41)	4 (*N*=111)	Total (*N*=525)
Mean	2.80	3.31	3.79	3.48	
Standard Deviation	1.03	.783	.433	.665	

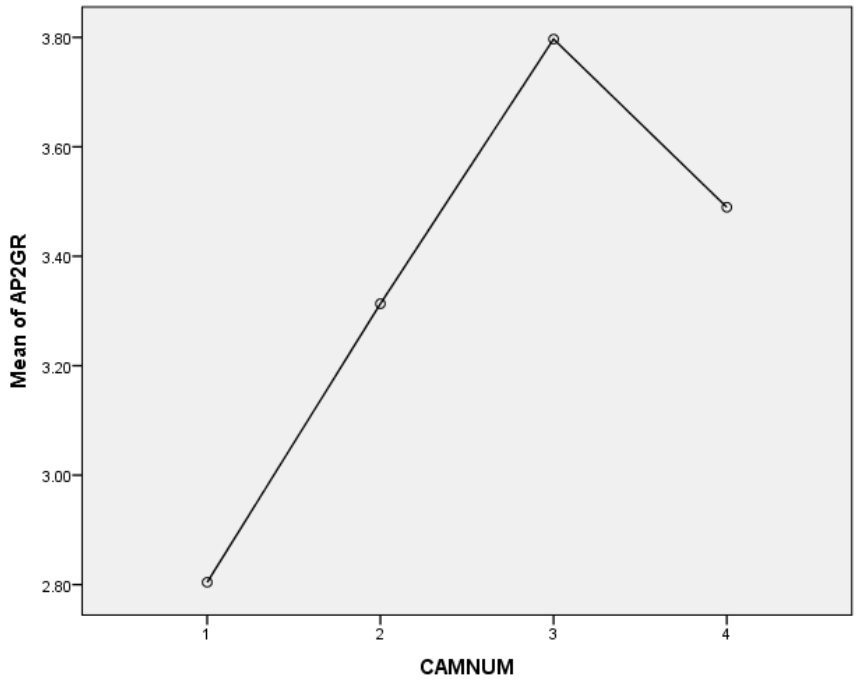

Figure 3. Mean anatomy and physiology 2 scores by campus.
Mean of AP2GR = mean anatomy and physiology 2 grade; CAMNUM = campus identifier

In research question 3, a Welch ANOVA was applied to the data to to compare course grades of students who took an anatomy and physiology 2 course at one of the four campuses. As shown in Table 11, a significant difference was found among the campuses: [F (3, 179.190) =26.805, p =.000].

Table 11

Welch ANOVA (Robust Tests of Equality of Means for Anatomy and Physiology 2 Scores)

	Statistic (F)	*df1*	*df2*	*Sig.*
Welch	26.805	3	179.190	.000

* $p < .05$

Because the groups were not homogenous, Games-Howell post hoc test was used to determine the nature of the differences among the campuses (Laerd Statistics website, 2013). Analysis revealed course grades at campus 1 (M=2.80, SD=1.03) were significantly (p=.000) lower than course grades at campus 2 (M=3.31, SD=.783), campus 3 (M=3.79, SD=.433), and campus 4 (M=3.48, SD=.665). Mean course grades on campus 2 (M=3.31, SD=.783) were also significantly (p=.000) lower than on campus 3 (M=3.79, SD=.433). Furthermore, mean course grades on campus 4 (M=3.48, SD=.665) were significantly lower (p=.007) than on campus 3 (M=3.79, SD=.433). As shown in Table 12, there were significant differences found among campuses.

Table 12

Levels of Significance in Anatomy and Physiology 2 Course Means by Campus (Post Hoc Test)

Campus	1	2	3	4
1	NA	.000	.000	.000
2	.000	NA	.000	NS
3	.000	.000	NA	.007
4	.000	NS	.007	NA

Note: NA=not applicable; NS=not significant

*$p < .05$

RQ3: What is the difference among the four campuses in students' grades in anatomy and physiology 2?

$H_0$3: There is no difference among campuses in students' grades in anatomy and physiology 2.

H_a3: There is a difference among campuses in students' grades in anatomy and physiology 2.

The null hypothesis was rejected and the alternative hypothesis was accepted.

Research question 4. Descriptive statistics are shown in Table 13 and the campus means shown graphically in Figure 4.

Table 13

Descriptive Statistics on Semesters to Completion by Campus

	Campus 1 (*N*=77)	Campus 2 (*N*=186)	Campus 3 (*N*=148)	Campus 4 (*N*=164)	Total (*N*=575)
Mean	6.25	7.49	7.06	6.51	
Standard Deviation	3.91	2.76	2.31	2.39	

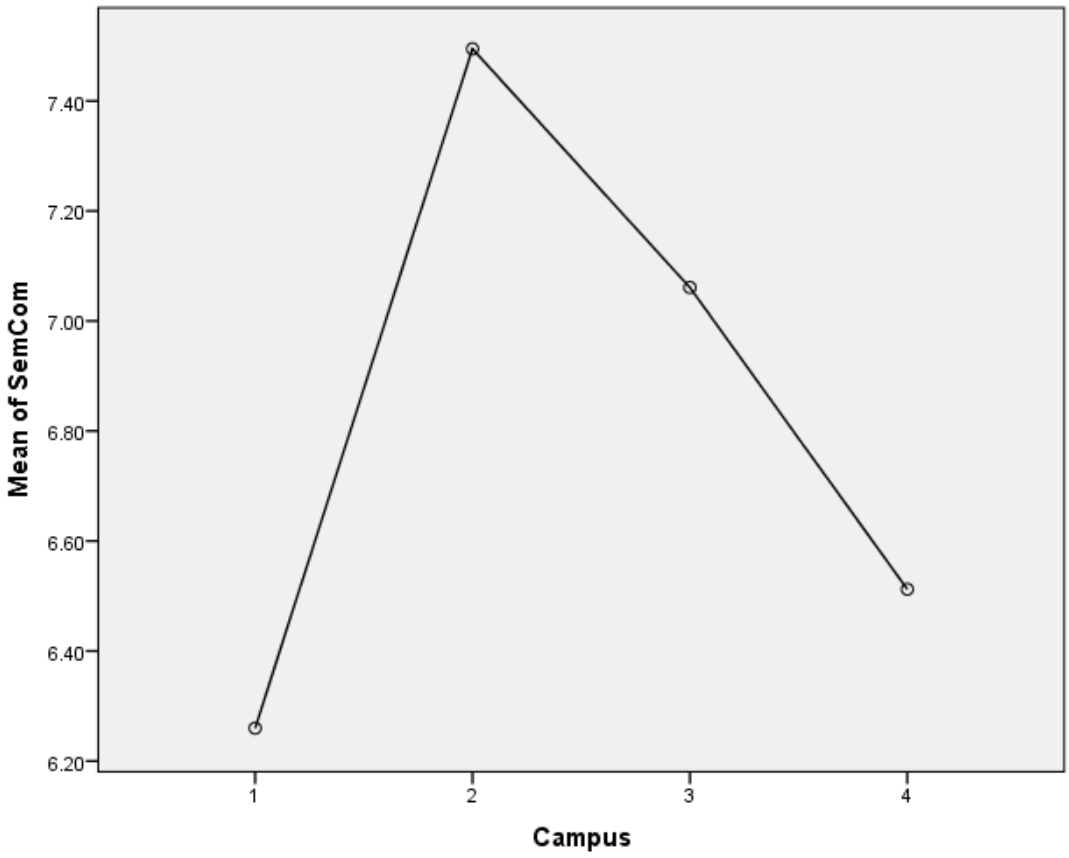

Figure 4. Mean semesters to completion by campus.
Mean of SemCom = mean semesters to completion; Campus = campus identifier

The Levene test was employed to determine if the one-way ANOVA could be used to determine differences among the groups. As shown in Table 14, there was homogeneity of variances as assessed by the Leven test for Equality of variances (p=.239). Therefore, the means can be compared by using a one-way ANOVA for analysis (Laerd Statistics website, 2013).

Table 14

Test of Homogeneity of Variances

Levene Statistic	df1	df2	Sig.
1.409	3	571	.239

* $p < .05$

In research question 4, a one-way ANOVA was applied to the data to to compare the number of semester to completion of the nursing program among the four campuses. As shown in Table 15, a significant difference was found among the campuses: [F (3, 572) =5.535, $p < .001$].

Table 15

One-way Analysis of Variance of Semesters to Completion by Campus

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	125.108	3	41.673	5.535	.001
Within Groups	4298.728	572	7.528		
Total	4423.746	575			

* $p < .05$

Because the assumption of homogeneity was not violated, a Tukey-Kramer post hoc test was used to determine the nature of the differences between campuses (Laerd Statistics website, 2013). Analysis revealed that there was a significant (p=.005) difference in semesters to completion at campus 1 (M=6.25, SD=3.91) and campus 2 (M=7.49, SD=2.76). There was also a significant difference (p=.005) between semesters to completion at campus 4 (M=6.51, SD=2.39) and semesters to completion at campus 2 (M=7.49, SD=2.76). This is shown in Table 16.

Table 16

Levels of Significance in Semesters to Completion by Campus (Post Hoc Test)

Campus	1	2	3	4
1	NA	.005	NS	NS
2	.005	NA	NS	.005
3	NA	NS	NA	NS
4	NS	.005	NS	NA

Note: NA = not applicable; NS = not significant
* $p < .05$

RQ4: What is the difference among the four campuses in length of time it takes students to complete the nursing program?

$H_0$4: There is no difference among campuses in length of time it takes students to complete the nursing program.

H_a4: There is a difference among campuses in length of time it takes students to complete the nursing program.

The null hypothesis is rejected and the alternative hypothesis is accepted.

Research question 5. In research question 5, the relationship between the grade in microbiology taken on campus 1 and the number of semesters to completion was examined.

For campus 1, the Pearson correlation coefficient was -.166, which indicated a negative correlation between the grade in microbiology and the number of semesters to completion. The coefficient of determination, which is the proportion of variance in one variable that is explained by the other variable, was .027. The grade in microbiology statistically explained 2.7% of the variability in semesters to completion. There was a negative correlation between microbiology grade and semesters to completion r (38)=-.166, p=.306, which was not statistically significant. This is shown in Table 17.

Table 17

Correlation Between Microbiology Grade and Semesters to Completion on Campus 1

Pearson *r*	Sig.(2-tailed)	N	r^2
-.166	.306	40	.027

*$p < .05$

RQ5: What is the correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 1?

$H_0$5: There is no correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 1.

H_a5: There is a correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 1.

The null hypothesis in research question 5 was not rejected, since there was no statistically significant correlation between the microbiology grade and the number of semesters to completion on campus 1. Therefore, the alternative hypothesis was rejected.

Research question 6. In research question 6, the relationship between the grade in microbiology taken on campus 2 and the number of semesters to completion was examined.

For campus 2, the Pearson correlation coefficient was .031, which indicated a positive correlation between the grade in microbiology and the number of semesters to completion. The grade in microbiology statistically explained .09% of the variability in semesters to completion. There was a positive correlation between microbiology grade and semesters to completion r (309)=.031, p=.582, which was not statistically significant. This is shown in Table 18.

Table 18

Correlation Between Microbiology Grade and Semesters to Completion on Campus 2

Pearson *r*	Sig.(2-tailed)	N	r^2
.031	.582	311	.09

*$p < .05$

RQ6: What is the correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 2?

$H_0$6: There is no correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 2.

H_a6: There is a correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 2.

The null hypothesis in research question 6 was not rejected, since there was no statistically significant correlation between the microbiology grade and the number of semesters to completion on campus 2. Therefore, the positive hypothesis was rejected.

Research question 7. In research question 7, the relationship between the grade in microbiology taken on campus 3 and the number of semesters to completion was examined.

For campus 3, the Pearson correlation coefficient was -.021, which indicated a very small negative correlation between the grade in microbiology and the number of semesters to completion. The grade in microbiology statistically explained .04 % of the variability in semesters to completion. There was a very small negative correlation between microbiology grade and semesters to completion r (43)=-.021, p=.890, which was not statistically significant. This is shown in Table 19.

Table 19

Correlation Between Microbiology Grade and Semesters to Completion on Campus 3

Pearson *r*	Sig.(2-tailed)	N	r^2
-.021	.890	47	.0004

* $p < .05$

RQ7**:** What is the correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 3?

$H_0$7: There is no correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 3.

H_a7: There is a correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 3.

The null hypothesis in research question 6 was not rejected, since there was no statistically significant correlation between the microbiology grade and the number of semesters to completion on campus 3. Therefore, the alternative hypothesis was rejected.

Research question 8. In research question 8, the relationship between the grade in microbiology taken on campus 4 and the number of semesters to completion was examined.

For campus 4, the Pearson correlation coefficient was .116, which indicated a positive correlation between the grade in microbiology and the number of semesters to completion. The grade in microbiology statistically explained 1.3% of the variability in semesters to completion. There was a negative correlation between microbiology grade and semesters to completion r (123)=.116, p=.197, which was not statistically significant. This is shown in Table 20.

Table 20

Correlation Between Microbiology Grade and Semesters to Completion on Campus 4

Pearson *r*	Sig.(2-tailed)	N	r^2
.116	.197	125	.013

*$p < .05$

RQ8: What is the correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 4?

$H_0$8: There is no correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 4.

H_a8: There is a correlation between the student's grade in microbiology and the number of semesters it takes for the student to complete the nursing program at campus 4.

The null hypothesis in research question 8 was not rejected, since there was no statistically significant correlation between the microbiology grade and the number of semesters to completion on campus 4. Therefore, the alternative hypothesis was rejected.

Research question 9. In research question 9, the relationship between the grade in anatomy and physiology 1 taken on campus 1 and the number of semesters to completion was examined.

For campus 1 , the Pearson correlation coefficient was -.112, which indicated a negative correlation between the grade in anatomy and physiology 1 and the number of semesters to completion. The grade in anatomy and physiology 1 statistically explained 1.2% of the variability in semesters to completion. There was a negative correlation

between anatomy and physiology 1 grade and semesters to completion r (132)=-.112, p=.198, which was not statistically significant. This is shown in Table 21.

Table 21

Correlation Between Anatomy and Physiology 1 Grade and Semesters to Completion Campus 1

Pearson r	Sig.(2-tailed)	N	r^2
-.112	.198	134	.112

* $p < .05$

RQ9: What is the correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 1?

$H_0$9: There is no correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 1.

H_a9: There is a correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 1.

The null hypothesis in research question 9 was not rejected, since there was no statistically significant correlation between the anatomy and physiology 1 grade and the number of semesters to completion on campus 1. Therefore, the alternative hypothesis was rejected.

Research question 10. In research question 10, the relationship between the grade in anatomy and physiology 1 taken on campus 2 and the number of semesters to completion was examined.

For campus 2, the Pearson correlation coefficient was -.366, which indicated a negative correlation between the grade in anatomy and physiology 1 and the number of semesters to completion. The grade in anatomy and physiology 1 statistically explained 13.3% of the variability in semesters to completion. There was a negative correlation between anatomy and physiology 1 grade and semesters to completion r (170)=-.366, p=.000, which was statistically significant. This is shown in Table 22.

Table 22

Correlation Between Anatomy and Physiology 1 Grade and Semesters to Completion Campus 2

Pearson *r*	Sig.(2-tailed)	N	r^2
-.366	.000	172	.133

* $p < .05$

RQ10: What is the correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 2?

$H_0$10: There is no correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 2.

H_a10: There is a correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 2.

The null hypothesis in research question 10 was rejected and the alternative hypothesis accepted. There was a statistically significant negative correlation between the anatomy and physiology 1 grade and the number of semesters to completion on campus 2.

Research question 11. In research question 11, the relationship between the grade in anatomy and physiology 1 taken on campus 3 and the number of semesters to completion was examined.

For campus 2, the Pearson coefficient was .173, which indicated a positive correlation between the grade in anatomy and physiology 1 and the number of semesters to completion. The grade in anatomy and physiology 1 statistically explained 2.9% of the variability in semesters to completion. There was a positive correlation between anatomy and physiology 1 grade and semesters to completion r (33)=.173, p=.321, which was not statistically significant. This is shown in Table 23.

Table 23

Correlation Between Anatomy and Physiology 1 Grade and Semesters to Completion Campus 3

Pearson *r*	Sig.(2-tailed)	N	r^2
.173	.321	35	.029

*$p < .05$

RQ11: What is the correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 3?

$H_0$11: There is no correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 3.

H_a11: There is a correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 3.

The null hypothesis in research question 11 was not rejected, since there was no statistically significant negative correlation between the anatomy and physiology 1 grade and the number of semesters to completion on campus 3. Therefore, the alternative hypothesis was rejected.

Research question 12. In research question 12, the relationship between the grade in anatomy and physiology 1 taken on campus 4 and the number of semesters to completion was examined.

For campus 4, the Pearson correlation coefficient was -.161, which indicated a negative correlation between the grade in anatomy and physiology 1 and the number of semesters to completion. The grade in anatomy and physiology 1 statistically explained 2.5% of the variability in semesters to completion. There was a negative correlation between anatomy and physiology 1 grade and semesters to completion r (113)=-.161, p=.085, which was not statistically significant. This is shown in Table 24.

Table 24

Correlation Between Anatomy and Physiology 1 Grade and Semesters to Completion Campus 4

Pearson *r*	Sig.(2-tailed)	N	r^2
-.161	.085	115	.025

* $p < .05$

RQ12: What is the correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 4?

$H_0$12: There is no correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 4.

H_a12: There is a correlation between the student's grade in anatomy and physiology 1 and the number of semesters it takes for the student to complete the nursing program at campus 4.

The null hypothesis in research question 12 was not rejected, since there was no statistically significant negative correlation between the anatomy and physiology 1 grade and the number of semesters to completion on campus 4. Therefore, the alternative hypothesis was rejected.

Research question 13. In research question 13, the relationship between the grade in anatomy and physiology 2 taken on campus 1 and the number of semesters to completion was examined.

For campus 1, the Pearson correlation coefficient was -.213, which indicated a negative correlation between the grade in anatomy and physiology 1 and the number of semesters to completion. The grade in anatomy and physiology 2 statistically explained 4.5% of the variability in semesters to completion. There was a negative correlation between anatomy and physiology 2 grade and semesters to completion r (124=-.213, p=.017), which was statistically significant. This is shown in Table 25.

Table 25

Correlation Between Anatomy and Physiology 2 Grade and Semesters to Completion Campus 1

Pearson r	Sig.(2-tailed)	N	r^2
-.213	.017	126	.045

* $p < .05$

RQ13: What is the correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 1?

$H_0$13: There is no correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 1.

H_a13: There is a correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 1.

The null hypothesis in research question 13 was rejected and the alternative hypothesis accepted. There was a statistically significant negative correlation between

the anatomy and physiology 2 grade and the number of semesters to completion on campus 1.

Research question 14. In research question 14, the relationship between the grade in anatomy and physiology 2 taken on campus 2 and the number of semesters to completion was examined.

For campus 2, the Pearson correlation coefficient was -.166, which indicated a negative correlation between the grade in anatomy and physiology 2 and the number of semesters to completion. The grade in anatomy and physiology 2 statistically explained 2.7% of the variability in semesters to completion. There was a negative correlation between anatomy and physiology 1 grade and semesters to completion r (245)=-.166, p=.009), which was statistically significant. This is shown in Table 26.

Table 26

Correlation Between Anatomy and Physiology 2 Grade and Semesters to Completion Campus 2

Pearson *r*	Sig.(2-tailed)	N	r^2
-.166	.009	247	.027

* $p < .05$

RQ14: What is the correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 2?

$H_0$14: There is no correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 2.

H_a14: There is a correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 2.

The null hypothesis in research question 14 was rejected and the alternative hypothesis accepted. There was a statistically significant negative correlation between the anatomy and physiology 2 grade and the number of semesters to completion on campus 2.

Research question 15. In research question 15, the relationship between the grade in anatomy and physiology 2 taken on campus 3 and the number of semesters to completion was examined.

For campus 3, the Pearson correlation coefficient was .009, which indicated a very small positive correlation between the grade in anatomy and physiology 2 and the number of semesters to completion. The grade in anatomy and physiology 2 statistically explained 0% of the variability in semesters to completion. There was a very small positive correlation between anatomy and physiology 2 grade and semesters to completion r (39)=.009, p=.956), which was not statistically significant. This is shown in Table 27.

Table 27

Correlation Between Anatomy and Physiology 2 Grade and Semesters to Completion Campus 3

Pearson *r*	Sig.(2-tailed)	N	r^2
.009	.956	41	.000

*$p < .05$

RQ15: What is the correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 3?

$H_0$15: There is no correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 3.

H_a15: There is a correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 3.

The null hypothesis in research question 15 was not rejected, since there was no statistically significant negative correlation between the anatomy and physiology 2 grade and the number of semesters to completion on campus 3. Therefore, the alternative hypothesis was rejected.

Research question 16. In research question 16, the relationship between the grade in anatomy and physiology 2 taken on campus 4 and the number of semesters to completion was examined.

For campus 4, the Pearson correlation coefficient was -.076, which indicated a very small negative correlation between the grade in anatomy and physiology 2 and the number of semesters to completion. The grade in anatomy and physiology 2 statistically explained .6% of the variability in semesters to completion. There was a very small negative correlation between anatomy and physiology 2 grade and semesters to completion r (109)=-.076, p=.431), which was not statistically significant. This is shown in Table 28.

Table 28

Correlation Between Anatomy and Physiology 2 Grade and Semesters to Completion Campus 4

Pearson *r*	Sig.(2-tailed)	N	r^2
-.076	.431	111	.006

* $p < .05$

RQ16: What is the correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 4?

$H_0$16: There is no correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 4.

H_a16: There is a correlation between the student's grade in anatomy and physiology 2 and the number of semesters it takes for the student to complete the nursing program at campus 4.

The null hypothesis in research question 16 was not rejected, since there was no statistically significant negative correlation between the anatomy and physiology 2 grade and the number of semesters to completion on campus 4. Therefore, the alternative hypothesis was rejected.

Assumptions, Limitations, and Delimitations

Assumptions

Certain assumptions were made upon the undertaking of this investigation. Faced with an unsatisfactory accreditation report, the college was investigating nursing student academic and professional progress on several fronts. Since I have taught the two medical-surgical courses that rely on general science proficiency, I was acutely aware of what I perceived to be a student deficiency in this area. Once I started networking with my colleagues, I found a majority of them had the same concerns. I made a preliminary assumption that our students were not progressing well because of this perceived deficit and that the research questions would provide a starting point for further investigation. It was possible that no relationship existed.

I also assumed that this investigation would lead to a positive resolution in the college, that our students would begin to graduate at higher rates, and that this would contribute to solving the shortage of registered nurses in the state. Although community college students do have higher attrition rates than students at four-year institutions, the attrition rates in associate and baccalaureate degree nursing programs are quite similar (Fike & Fike, 2008; Newton et al., 2007; Sandiford & Jackson, 2003). It was possible

that our students were not very different from students who seek baccalaureate degrees in nursing.

Another assumption was that the results of this investigation might lead to changes in the manner in which nursing students learn science at the college. I assumed that this would help the community college system and the community. I have found that there is little agreement on how to best provide understanding to nursing students when teaching general sciences. However, the general science instructors are not part of the Division of Nursing and are not under the jurisdiction of the Dean for Nursing. It is uncertain whether or not they will be interested in changing course design or rigor.

Limitations

This study has limitations. This study investigated only one community college in the Midwest. The data were archival and the design was not experimental. The impetus for the investigation was the unfavorable result of an accreditation process. The research results may be helpful to this college but may not necessarily benefit all community colleges or the greater educational community. Although some generalization may be appropriate because of the large number of nursing students at the college, the non-experimental design limited the generalizability.

Delimitations

The scope of the study was quite narrow. Throughout the literature review, many variables were noted by multiple authors to have an effect on academic progress. However, the variables studied in this project were an attempt to address a local problem.

The sample size and the inclusion of multiple semesters enhanced the strength of the results. I was the sole collector of data for this study. I was familiar with the program, the problem, the study, and the research questions. This contributed positively to the accuracy of the data collection and recording.

An unforeseen circumstance was the number of students who took science courses online. This had not been mentioned in my prior conversations with nursing and general science faculty. Although the number was small, it may be interesting in future investigations to examine relationships between online courses and student success.

Protection of Participants' Rights

Archival data of student grades and graduation status were available for the entire census sample. The college's Research and Data coordinator created a query for the specific data required, which she forwarded to me. No names appeared on the data collection instruments. I had the only access to the data. Electronic data were stored on my computer, which is password-protected and kept in a locked office. Paper data was stored in a personal, locked file cabinet in a locked office. Permission was obtained from the college to collect, analyze, and report data. No students were contacted or interviewed.

Summary

The research conducted in this study was a quantitative analysis. All of the data were pre-existing and accessible through the college's archives. The census sample included students who were enrolled in all four core nursing courses between the fall semester of 2005 and the spring semester of 2015, inclusive.

Independent variables investigated were the students' campus location in questions 1-4 and grades in microbiology, anatomy and physiology 1, and anatomy and physiology 2 in questions 5-16. The course grades were also investigated as dependent variables in questions 1-3. The number of semesters the student required to complete the nursing program was the dependent variable in questions 4-16. Data were analyzed to determine whether differences existed in student grades and length to program completion between campuses and whether there was a significant relationship between the students' grades in the aforementioned courses and number of semesters to program completion on all four campuses.

Both descriptive and inferential statistics were applied to the interval data. To answer the research questions, a one-way ANOVA, a Welch ANOVA, or a Pearson correlation coefficient was calculated for each null hypothesis. Permission was obtained from the Divisional Dean for Nursing, the Vice-President for Academic Affairs, the Office of Institutional Effectiveness, and the College Board of Directors. No students were contacted or interviewed and only numbers were used to identify the participants.

The results of the data analysis suggested that differences may exist among campuses in course design, content, rigor, or delivery. Significant differences were found among campuses in all three general science mean grades as well as total semesters to completion. Since the literature suggests that high grades in general science courses are related to positive progress in nurse education, a negative correlation was expected in this data; in other words, a higher grade in science would be expected to correlate with a lower number of semesters to program completion. This was true on campus 2 in

anatomy and physiology 1 and on campuses 1 and 2 in anatomy and physiology 2, but on most campuses and for most courses, no significant correlation was found.

The assumption that all courses and campuses provide students with the same information is challenged by these study results. General science preparation may not be adequately and equitably preparing students for the rigor of the core nursing courses. If students lack adequate cognitive structure into which they may assimilate the new information presented in the nursing courses, a lack of academic progress may delay or prevent program completion and may prevent the student from obtaining a license to practice as a registered nurse. Although the data analysis raised many questions, a first step in analyzing and describing each course's design, content, rigor, and delivery is needed. A literature review revealed that curriculum mapping may encourage collaboration between divisions to examine alignment of the curriculum. Curriculum mapping may also help faculty to determine if differences exist between what is intended to be taught, what is taught, and what is learned. Finally, curriculum mapping may assist students to understand their accountability for previously learned concepts. Therefore, I propose a project in which general science and nursing faculty from all campuses collaborate to create a curriculum map comprising the three science courses and the three nursing courses that rely most heavily on the science prerequisites for student success. The project will: (a) provide faculty with evidence-based information regarding the benefits of curriculum mapping, (b) gather specific curricular data from faculty, (c) provide a model and a template for creating a curriculum map, 4) bring faculty together

for a collaborative session based on the survey results, and (d) result in the creation of a dynamic curriculum map.

Section 3: The Project

Introduction

Failure to meet ELA for nursing student completion during the program's latest accreditation visit led faculty and administration at the research site to explore ways to improve this measurement. The lower than desired number of students completing the nursing program was concerning to stakeholders; a delay or failure in program completion means that students are unable to obtain a license to practice as registered nurses, which may contribute to the ongoing shortage of registered nurses.

Because academic problems are the main reason for student academic failure (Abele et al., 2013), the program of study was examined. Anecdotal evidence was collected from students and faculty on all campuses, which revealed that most nursing faculty and many nursing students at the study college reported being unprepared for the rigor of the nursing core courses. A common theme was the lack of preparedness in the general sciences. Findings in this study suggest that general science course design, content, rigor, and delivery were not equivalent on all campuses.

Based on my study findings, I proposed a project in which faculty will collaborate to determine these course components as a first step in addressing concerns regarding preparedness for the core nursing courses. In 1980, English described curriculum mapping as "a reconstruction of the real curriculum teachers have taught" (p. 558). According to English, faculty working together to determine how and what is being taught may begin to "permit an estimate of the amount of variance from teacher to teacher" (p. 558). By using curriculum mapping, faculty can obtain an overview of the

entire curriculum, encourage alignment between general science and nursing program curricula, and better understand what has been taught in previous courses (Walker, 2006). A curriculum map may help faculty to understand how different courses in the curriculum relate to one another, to learning outcomes, and to assessment (Harden, 2001).

Description and Goals

I have three goals for the curriculum mapping project: (a) to educate the study college's science and nursing program faculty on the benefits of creating a curriculum map for the three science prerequisites and the three nursing courses that rely most heavily on the prerequisites, (b) to accurately document intended learning outcomes, content, teaching and learning activities, assessment criteria, and assessment methods for Microbiology, Anatomy and Physiology 1, Anatomy and Physiology 2, Nursing Health Alterations, Nursing Complex Health Alterations 1, and Nursing Complex Health Alterations 2 and (c) to empower science and nursing faculty to collaborate in the creation of a curriculum map.

The college's administrators have agreed to ask science and nursing faculty on all four campuses to participate. The course competencies for each of the six courses will be provided via email in advance of an in-person meeting. After this initial exposure, a group comprising science instructors and nursing instructors will meet during a breakout session on a faculty work day; I will serve as moderator. At this time, the group will receive information via a short, evidence-based PowerPoint presentation on the benefits and challenges of curriculum mapping. Next, all of the participating instructors will be

asked to fill out an online survey asking whether they introduced, practiced, reinforced, or assessed each competency in their own course (Spencer, Riddle, & Knewstubb, 2012).

As the project manager, I will collect, analyze, and trend the survey data. Once all of the surveys are completed, the faculty will again meet on a scheduled faculty workday. At this time, the survey results will be shared and the results used to encourage collegial discussions. The moderator will use guided reflection to elicit descriptions of how each instructor addresses the course competencies. Another area of discussion will be to identify potential areas of the disciplines that may be integrated, which Jacobs (2000) has found to be a powerful learning experience for students.

Then, the template for the actual curriculum map will be introduced. The final meeting of this work group, again using a faculty work day, will consist of the actual map creation. Each faculty member will be provided with a printed template with all course names and competencies pre-printed. The faculty member will make notes in the proper courses regarding intended learning outcomes, content, teaching and learning activities, assessment criteria, and assessment methods for each course. The last portion of the day will again be a collegial discussion addressing gaps and duplication (see Appendix A for complete lesson plan).

Rationale

To address the problem of low completion rates at the study college, quantitative data were collected. According to my data, students may not be adequately and equivalently prepared for the core nursing courses on all campuses. To increase completion rates, students need to make satisfactory academic progress (Chen & Voyles,

2013; Wolkowitz & Kelley, 2010; Wong & Wong, 1999). According to subsumption theory, the conceptual framework upon which this study was based, learners are able to assimilate complex or unfamiliar material when it is related to previously mastered material in a stable cognitive framework (Ausubel, 1960). Based on my experience, it is possible that students may need better science preparation, but it is also possible that upon entering core nursing courses, students need a review of previously learned material. By examining in detail exactly what is taught in each of the aforementioned courses, content gaps and duplication may be discovered, highlighted, and corrected (Archambault & Masunaga, 2015). This examination may allow nonessential material to be eliminated and may result in a more intense focus on the concepts that are essential for student progress.

Review of the Literature

I conducted a literature search using Walden University and my local community college library resources. I used the following terms and combinations of terms: *curriculum maps, curriculum mapping, curriculum mapping* and *nurse education, curriculum mapping* and *nursing education, curriculum mapping* and *alignment, curriculum mapping* and *collaboration, curriculum mapping* and *academic progress,* and *curriculum mapping* and *student success.* Databases used included CINAHL Plus with Full Text, ERIC, and Google Scholar.

Prevalent themes that emerged included improved student achievement, curriculum alignment, and faculty collaboration. The proposed project is appropriate for each of these.

The impetus for the study was concern over student progress and success. Anecdotal data collected showed that faculty and students were concerned with science preparation in the existing curriculum. Science faculty and nursing faculty are in two different academic divisions and, therefore, have little opportunity to collaborate. In order to address all of these concerns, I have developed a project that is intended to bring nursing and science faculty together in order to examine the nursing curriculum with a goal of promoting student success and improving the nursing program's ELA.

Nursing faculty at the study college assume that students who have successfully completed science prerequisites have a a certain level of knowledge, or stable cognitive structure. This assumption may not be based in reality. General studies faculty may assume that sciences are reinforced in the nursing curriculum, which also may not be true in every course.

Bringing both general science and nursing curricula into alignment with what is actually being taught, assessed, and learned in the classroom will require collaboration between science faculty and nursing faculty. In my review of the literature, a connection was suggested between science achievement and both professional and academic success. Based upon my research, I believe that curriculum mapping may help nursing students to succeed because it will, hopefully, help faculty to align the science curriculum and the nursing curriculum and better encourage faculty collaboration.

Improved Student Achievement

Several authors suggested that curriculum mapping can increase both academic and professional student success. Narayanasamy, Jurgens, Narayanasamy, and Guo

(2013) addressed a perceived curricular deficiency regarding diversity education by mapping the diversity components of each course in a school of nursing and midwifery. They found that the maps provided accurate course comparisons and were used to direct curricular development, leading to increased student attainment of the outcomes relating to diversity (Narayanasamy, Jurgens, Narayanasamy, & Guo, 2013). Using a Delphi method to obtain input on credit requirements and learning achievements between institutions offering a diploma and those offering a baccalaureate degree, the authors constructed a curriculum map. The map established links between the education requirements at each level and the national required competencies for registered nurses in Australia. This resulted in a more seamless transition between programs and higher student achievement (Birks, Smithson, Wickett, & Homes, 2015).

Similarly, Landry et al. (2011) created a consortium of educators from community colleges, universities, and hospitals to map the curriculum in each of their programs in response to a California mandate requiring seamless associate-to-baccalaureate progression. The maps led to increased student progression by eliminating redundancies and nonessential material, focusing attention to gaps in topic areas, and reducing in the practice-education gap (Landry et al., 2011). Similar outcomes were noted by Fowler, Lazo, Turner, and Hohenstein (2015) when they used curriculum mapping during a curriculum redesign project at a large research university. Curriculum mapping was one of nine steps in the redesign process and resulted in the identification of gaps and redundancies. Eventually, the process resulted in the addition of leveling courses for

transfer students to provide necessary foundational knowledge and improve student outcomes (Fowler, Lazo, & Hohenstein, 2015).

Starting with a review of syllabi, Archambault and Masunaga (2015) recorded learning outcomes, assignments, and assessments into a curriculum map to "flag" courses that were not fitting into an information literacy curriculum as a whole. This encouraged several departments to embed certain critical information literacy concepts within courses, leading to better student attainment of learning outcomes (Archambault & Masunaga, 2015). A four-year Hong Kong teacher education program superimposed student learning outcomes upon the actual curriculum documents to provide a graphic illustration of what was actually taught versus what the curriculum described. The resulting discrepancies were used to determine whether the student learning outcomes were reflected in the curriculum. This helped students to clearly relate their coursework to the student learning outcomes (Lam & Tsui, 2013).

Progress in student skill acquisition after curriculum mapping led to changes in student assessment in an Australian social work program. All student assessments were mapped and compared with five agreed-upon criteria for rigor. Relatively small changes to the existing curriculum were noted to yield a sizable impact in student problem solving abilities and critical thinking (Watts & Hodgson, 2015). A medical school in Toronto used curriculum mapping based on external accreditation standards to develop a multi-level resident training approach, while at the same time ensuring student competence prior to progression. The curriculum maps identified areas of need for remediation and areas of competency. When these were individualized by learner, certain students were

allowed to progress to higher levels and experience different clinical settings. However, students who did not meet the essential competencies were remediated. In this way, all students progressed to residency with a minimum level of achievement (Iglar, Whitehead, & Takahashi, 2013).

To improve student engagement, Veltri, Webb, Matveev, and Zapatero (2011) suggested inclusion of a completed curriculum map in course syllabi and class discussions. They speculated that the proof of alignment between the designed, intended, and enacted curriculum would give students insight on the reasoning behind the course assignments and assessments (Veltri, Webb, Matveev, & Zapatero, 2011). One author disagreed with the usefulness of curriculum mapping. The expressed concern was that by utilizing such specific outcome criteria to drive instruction and assessment, faculty may be restricted. This author suggested that more flexibility was needed to address social problems and to encourage creativity by keeping instruction dynamic (Wang, 2015).

Curriculum Alignment

As educational institutions have been increasingly scrutinized for measurable outcomes, the effort to align curricula with student learning outcomes has increased. A simple definition of alignment is "an agreement or match between two categories" (Squires, 2012, p. 129). Curriculum mapping is useful in the evaluation of the links between curriculum content and course, program, or college target learning outcomes. Therefore, curriculum mapping was examined as an alignment tool by a number of investigators.

To determine the extent to which specified learning outcomes were reflected in the planned curriculum, Lam and Tsui (2013) completed a pilot curriculum mapping study using four faculty members as a research team. A survey was sent to all faculty members in a teacher education program in Hong Kong. The survey resulted in five overarching student learning outcomes. The research team coded all objectives, assessments, and content as they related to the five student learning outcomes. The mapping results found gaps and redundancies between the taught curriculum and the student learning outcomes. The authors suggested that the redundancies may have actually helped students by progressively reinforcing the student learning outcomes. The curriculum maps were slated to be utilized during the next curriculum re-design (Lam & Tsui, 2013). In the second phase of their investigation, Lam and Tsui (2014) used professional development time to map objectives, assessment, and content of 14 courses and to code each with the number(s) of the student learning outcome(s) addressed. The results were noted to be helpful in the program development process by creating more space for progressive reinforcement and achievement of the student learning outcomes (Lam & Tsui, 2014).

At times, an external accreditation provides motivation for an examination of alignment. A medical school in Ontario developed a curriculum map to meet the criteria for alignment in accreditation reporting. The authors worked with a technology company to develop an electronic tool that would: 1) list the program's competencies, outcomes, and curricular model; 2) list program organizational units, course sequencing, and teaching, learning, and assessment methods; and 3) compare all of the alignment of the

aforementioned components with external accrediting standards. The resulting model, called the Curriculum Inventory Standard, provides the opportunity for curriculum development, audit, and quality improvement by comparing what was actually taught to the stated student learning outcomes (Ellaway, Albright, Smothers, Cameron, & Willett, 2014).

In a very similar undertaking, investigators in a medical school in Australia developed an electronic curriculum mapping system in response to an accreditation problem (Steketee, 2015). When required to demonstrate how student learning outcomes were addressed in each course, the school was not able to do so. The reason for curriculum mapping was stated as "in bringing together the different elements of a course's curriculum, the relationships and connections between these elements can be examined to discern how and if broad educational requirements are being fulfilled" (Steketee, 2015, p. 2). A software program known as Prudentia was developed in response to the accreditation requirements. The software used curriculum maps as input to link the learning outcomes to the design of course activities and assessments, thus bringing the curricular elements into alignment.

Responding to accreditation requirements also led to a six-year alignment initiative in an Australian school of social work, which "created a methodology used to understand and conceptualise the alignment of learning outcomes, professional and discipline knowledge or content, assessment, and practicum learning" (Watts & Hodgson, 2015, p. 683). Using the analogy of cartography, the project mapped the curriculum both horizontally and vertically. The framework for the project was developed by utilizing

industry standards for practice as well as Bloom's revised taxonomy for depth of learning. Seven constructs, similar to student learning outcomes, were developed. Seventy pieces of assessment were examined, coded, and mapped for relevance to the constructs. This provided a visual representation of presence or absence of the constructs within each assessment. The authors concluded that this focused map would target small changes at certain points in the curriculum that would have a significant impact on student achievement of the constructs. Furthermore, the map provided a concise summary for accreditation purposes (Watts & Hodgson, 2015).

Alignment between theory and practice in an Australian school of nursing and midwifery was investigated by Hall (2014). A process with the acronym BEKA (benchmarking, evidencing, knowing and applying, and conceptual framework) was proposed. Benchmarking comprised an analysis of national competencies, state and national board standards, and programming at several universities to document similarities and differences among the recommended, written, and implemented curricula. The second component, evidencing, comprised the mapping of the actual objectives, content, and assessment of individual programs or course documents. The curriculum map also included all resources, texts, and assigned readings and their frequency of use. The third component, knowing, deepened the analysis by collecting qualitative data by interviewing personnel from each of the benchmarked institutions. Of particular interest to the authors was the staff's perceptions of differences in: (a) the ideal curriculum, (b) the curriculum to which students are entitled, (c) the written curriculum, or syllabus; and (d) the attained curriculum, which is a measurement of student learning. In this

component, perceived gaps between theory courses and practice courses were identified. The final process, applying, comprised a questionnaire delivered to students and new graduates requesting information about students' perceptions of their own knowledge, the application of their knowledge, and their tested knowledge. The author concluded that graduates had deeper understanding of the link between theory and practice than current students. To improve the link between education and practice, they proposed using BEKA to provide an in-depth analysis of how curriculum is taught and assessed, how it relates to industry and professional benchmarks, and how it provides a method by which objectives and assessments may be aligned (Hall, 2014).

Faculty Collaboration

Several of the aforementioned investigators included collaboration as a positive outcome of curriculum mapping, even though collaboration may not have been a motivating force for the study. Watts and Hodgson (2015) described the consequence of this collaboration between faculty members, programs, and departments as "a clearer sense of coherence" (p. 692). In their study, they found that this coherence led to a discovery of the interdisciplinary components needed to socialize students into a professional identity. Furthermore, the collaboration between program courses in the curriculum exhibited how gains in one area of student development led to gains in abilities in other areas. For example, teaching the learning outcome of critical thinking in one level and reinforcing it in the next level helped students to achieve another of the learning outcomes, informed and considered judgement (Watts & Hodgson, 2015).

A similar benefit to collaboration was found by Steketee (2015), who determined that, during the development of Prudentia, collaboration between various groups and levels was "possibly the most important step in the development of Prudentia" (p. 5). Faculty members and administration presented their personal perceptions of what comprised the curriculum and what they thought a curriculum map could accomplish. These discussions have since become part of professional development (Steketee, 2015). Lam and Tsui (2013) requested team members to work independently to code course objectives, assessment, and content for each course and compare them to five student learning outcomes. When the coding was finished, the researchers came together to collaborate on what they had found. At this time, the team members discussed their ratings and could adjust them based on input from other members. The collaborative process was considered essential; if a consensus could not be reached within the group, the course rating was not considered in the study. The authors concluded that the meaningful dialogue was successful "in managing diverse opinions into agreement in a professional manner" (p. 116).

The same investigators utilized "deliberative dialogue" (Lam & Tsui, 2014, p. 6) in the second phase of their investigation. They noted that several of the team members revised their own ratings after the other members clarified, elaborated, or explained the reasoning behind the rating they gave. The process of making meaning from in-depth discussion between curriculum developers was challenging, because the members came from different academic and cultural backgrounds. Nevertheless, the authors found it so important that they listed this portion of the study as a best practice (Lam & Tsui, 2014).

Iglar, Whitehead, and Takahashi (2013) also required a faculty consensus exercise during their medical school curriculum revision. Once curriculum maps had been individually completed, a survey of 50 faculty members was electronically conducted. The questions centered on whether all of the mapped learning outcomes were essential. The surveyed faculty agreed that 637 of 771 were essential and continued the discussion to reorganize the competencies into "essential" and "supporting". Although this was done completely via electronic communication, the authors determined that a significant amount of faculty development resulted from the collaboration (Iglar et al., 2013).

Spencer, Riddle, and Knewstubb (2012) described the fourth stage of their curriculum mapping project as "coffee chats" (p. 6). These were informal meetings during which faculty for each course met with the research team. The faculty member described the student learning outcomes that were assumed, taught, or assessed in each course. This description was compared with information that had been gathered in previous stages of the investigation. The faculty member was then able to confirm, amend, or elaborate on the information. The researcher concluded that the coffee chats were "extremely beneficial" (p. 13). Some of the benefits that were realized were the opportunity for faculty to reflect upon teaching, to share best practices, identify areas for change, and regain accountability for what they teach (Spencer et al., 2012). While undergoing a state-mandated curriculum revision in California, Landry et al. (2011) noted the collaboration between community college faculty, university faculty, and industry as one of the most beneficial outcomes of the project. The baccalaureate and associate degree requirements have been changed based on collegial dialogue, while industry

representatives have offered input on the education-practice gap. The author noted that "for the first time in these academic institutions' history, AD-level and BSN-level faculty are working together to improve each other's curriculum to directly benefit AD students and to eventually improve patient care outcomes" (p.590).

Several other investigators reported collaboration as a primary motivator of curriculum mapping. Rehrey, Siering, and Hostetter (2014) described a large-scale curricular review at a research university. The process comprised two semesters of curriculum mapping for 45 undergraduate programs in the College of Arts and Sciences. The authors reported that the faculty was initially skeptical and believed that the results of the curriculum mapping would be used to evaluate their teaching. When the project was framed as an exercise in the Scholarship of Teaching and Learning (SOTL), faculty became more receptive. The SOTL principles included: (a) a focus on student learning, (b) an emphasis on inquiry, (c) reliance on evidence, (d) respect for diverse methodologies, (e) public sharing of results, and (f) closing the loop. The authors determined that the most important lessons to emerge from the collaboration included using consistent language to avoid misunderstandings, establishing trust and respect between programs and people by recognizing that each program has value that can be used for the common good, and the need to be responsive to institutional needs.

SOTL was also the focus in a curriculum mapping collaboration between faculty and librarians at a community college in the United States (Moser, Heisel, Jacob, & McNeill, 2011). The problem was an increased need for information literacy instruction, since there was a student learning outcome that suggested mastery. However, the

librarians noted that information literacy had not been built into a majority of courses. Although the librarians were willing to give instruction, they found that many students needed more than a single session to become adept at developing sufficient research practices. Librarians met on-on-one with faculty to match the student learning outcomes to what was taught in each course. This was done to identify gaps and redundancies, but also to begin to hold students accountable for what had already been presented. The librarians hosted focus groups of faculty and administration to gather qualitative data, which led to many suggested collaborative partnerships. The curriculum maps were created on worksheets that were compatible with the college's learning management system. This has become part of the ongoing assessment process at the college. The authors noted that faculty was uneasy in the first one-on-one meetings, feeling that the quality of their instruction was being evaluated. This was remedied by a more clear explanation of the study's purpose. The collaboration, not the actual finished product, was noted by the authors as the most significant outcome of the project. They described the meetings as a way to "enter into an assessment of our library instruction program and identify opportunities for approaching and collaborating with faculty over a sequence of courses, to try to address a frustrating problem together" (Moser et al., 2011, p. 334).

Harden (2001) noted that communication about the curriculum is relatively neglected compared to the amount of time and effort placed on educational strategies. He argued that both students and teachers need to know what the curriculum comprises and exactly where in the curriculum the different competencies are addressed. A model is provided that describes the map as a collection of ten windows. The mapping includes

links between and within windows, which guides collaboration between stakeholders. For example, window two is curriculum content and window nine is curriculum management. To address each of these components, collaboration is required between the teachers who are the experts in the content of each course in the curriculum and the staff who develop the curriculum and create the assessments for the courses. If the links are used correctly, the result is collaboration between all stakeholders (Harden, 2001).

An analysis of the curriculum in a pharmacy program in Canada resulted in increased faculty engagement. Faculty members developed a curriculum map to determine whether the intended curriculum aligned with stated student learning outcomes. The school's four-year degree program comprised 36 courses. The project began with faculty discussions on the reasons for the project and information on how curriculum maps are created. Instruction was provided in the process of linking courses to the student learning outcomes. Faculty members then submitted information on their individual courses via a data-collection template. A quantitative analysis was done on the data to determine the weight of course objectives to each student learning outcome. Although the mapping process brought the curriculum into alignment, the faculty felt that the inclusive approach was the most valuable outcome. The information collected was found valuable to the teaching faculty and helped them to become more engaged in the delivery of the entire curriculum (Zelenitsky et al., 2014).

In a qualitative study of the effects of curriculum mapping on faculty collaboration, Uchiyama and Radin (2009) discussed the usual expectation of autonomy and independence as a reason for faculty leaving an institution, feeling lonely, or

complaining of isolation. In this investigation, a group of 11 faculty members collaborated to create a curriculum map to align and integrate a sequence of courses at a university. The project's original intent was the alignment of courses, but the collaboration and collegiality that emerged became the most beneficial outcome. In a two-year time period, the faculty group first authored a document outlining the group's timeline and objectives. Data from student satisfaction surveys was used to demonstrate that students perceived gaps and redundancies in their programs. Meetings were held to provide detailed information about the upcoming process of curriculum revision and mapping. Faculty initially felt threatened and expressed concern about this perceived evaluation of teaching and additional workload, but became more enthusiastic after the informational meetings. A data collection template was created and placed online and faculty independently mapped their courses in real time throughout the semester. The next semester, the instructors met every other week and aggregated the map, which highlighted strengths, gaps, redundancies, and misalignments. The group reached consensus on content, sequence, additions, and eliminations. The faculty members described increased energy and engagement, decreased isolation, an improvement in curriculum content and alignment, and more meaningful professional collaboration (Uchiyama & Radin, 2009).

Implementation

The literature review provided a wealth of information on the utilization of curriculum mapping to enhance student achievement, to align the curriculum, and to promote collaboration between faculty members. The examples and practices listed in

the various articles will be used to address the goals of the proposed project. First, information on the benefits of curriculum mapping were clearly outlined in each of the three themes of the literature review. These benefits will be shared with both science and nursing faculty members upon commencement of the project. Furthermore, several authors validated the use of an electronic survey to gather data from faculty members, which I also plan to do. A number of map models, ranging from simple to complex, were described in the literature. I plan to draw from these models to create a simple curriculum map template. Finally, the benefits of collaboration in the creation of a curriculum map were noted by a majority of the authors. My proposed project will incorporate several of these examples and practices.

In addition, subsumption theory will provide the theoretical framework for project development. If faculty are to find meaning in the curriculum mapping project, it will be necessary to present the project as a relationship between new and old information (Ausubel, 1963b). This increases the likelihood that the new information will be successfully integrated into the participant's existing cognitive structure.

As new information is introduced throughout the project, this stable cognitive structure will enable the participants to learn, retain, and meaningfully recall it when necessary (Ausubel, 1962c). For example, the first meeting comprises a discussion of course competencies. These are familiar to all faculty, but will be reinforced as an advance organizer for later competency integration. The template will be introduced as new information, but also as an advance organizer for the later task of actually

completing it. In this way, the participant will already have some of the cognitive structure needed to succeed at the more unfamiliar portions of the project.

Potential Resources and Existing Supports

The Vice President for Academic Affairs and the Divisional Deans for both Nursing and General Studies have committed to faculty use of paid work days for this project. Since all faculty travel to the central campus for paid workdays, all will be in the same place on the same days. The rooms on the centrally-located campus are equipped with technology that will support a learning presentation and projection of survey results.

The project coordinator is a nursing instructor with access to email, Skype, distance learning, and other means to communicate with both science and nursing faculty. The project coordinator will be available via these communications strategies to answer questions, offer reassurance, or provide clarification to the members. Administrative staff in the Division of Nursing will be authorized and available to keep notes of the meetings and distribute the notes to members. The print shop technician is available and has received authorization to print the maps throughout the project's duration. Network technicians are available for the eventual placing of the completed map on the college's shared drive and training faculty on the process of commenting.

Potential Barriers

With the challenges of physical proximity and paid time addressed, the most daunting potential barrier will be faculty acceptance of the collaboration. As noted by several authors, faculty members may feel threatened or skeptical regarding documentation of what is actually taught, reinforced, and assessed in the courses they

teach (Lam & Tsui, 2014; Uchiyama & Radin, 2009; Zelenitsky et al., 2014). Since the faculty was not involved in the decision-making process, it will be important to include them before the project begins. A possible method to signify the importance of collaboration would be a letter, an email, or an in-person meeting with the involved faculty. This meeting should include the reason that the project was undertaken, the possible impact on the college, and the importance of faculty buy-in. The project coordinator should be involved in the communication, but it may be more effective to have the administrators initiate this communication. The faculty members also need reassurance that they will receive the support and resources required to complete the project. The administrators should also provide reassurance that the project is not meant as an evaluation, but as a way to improve student learning (Schilling, 2013).

Besides the usual faculty fear of increased time requirement and additional workload, Brownell and Tanner (2012) speculated that science faculty may be particularly likely to resist any change in pedagogy. This may result in resistance, which often contributes to project failure. These investigators suggested that the professional identity of science instructors may be threatened by a change in either the material that is taught or the teaching strategies (Brownell & Tanner, 2012). Nursing instructors, who normally have strong science backgrounds as well as well-defined professional identities, may also be reluctant to embrace innovative teaching strategies and may perceive the creation of a curriculum map as an indicator that change is coming.

A way to address this barrier is to describe participation in the curriculum mapping project in terms of gathering evidence. Most scientists consider themselves

researchers first and teachers second, so this may be a better fit with their professional identity. Similarly, nurses are committed to evidence-based practice, so obtaining evidence to solve a problem may reduce resistance among nursing faculty. As stakeholders with a vested interest in program improvement, science and nursing faculty may find the completed curriculum map a useful resource based on accurate data (Iglar et al., 2013).

A curriculum mapping project that includes collaboration will represent a significant change in the traditional relationship between the Division of General Studies and the Division of Nursing. Borders between divisions often exist and may prevent different faculty groups from working together (Rehrey, Siering, & Hostetter, 2014). Although both Divisional Deans have agreed to this project, the faculty may remain resistant to something that is perceived as either a criticism of their practices or as something that will require additional work. One way to gain support for this change would be to combine the annual Advisory Board meetings for the two disciplines. These meetings comprise community members, former and current students, faculty, representatives of industry, and college administrators. A combined meeting during which the data results and implications are presented may encourage the two divisions to work together to solve a frustrating problem. Since this meeting is held each fall semester, the meeting could be combined in fall 2016.

It is possible that some faculty may believe that improvement in the alignment between science courses and nursing courses is unnecessary. In fact, research suggests that most teachers "do not view their teaching as requiring changing and instead believe

that their teaching is quite good" (McCrickerd, 2012, p. 58). The detailed description of content and delivery that will result from creation of a curriculum map may show that improvement is necessary in both science and nursing instruction, which faculty members may find disconcerting. This barrier may be addressed by suggesting that faculty in both divisions may be inadvertently assuming that their students have certain skills, when, in reality, they do not. By focusing the discussion on student needs, faculty may be able to see that the reason their students are not successful may be gaps in the curriculum, not in their teaching (Spencer, Riddle, & Knewstubb, 2012).

Besides the aforementioned barriers, the biggest challenges to faculty acceptance of change are time, training, and incentive (Brownell & Tanner, 2012). Many faculty members believe that it will be impossible to participate in something as time- and labor-intensive as a curricular change. Furthermore, faculty may perceive that the amount of training that will be necessary to complete this project may not be realistic or supported by the college. And finally, no financial incentive is offered by the college for participation in the project, which will likely be a barrier to acceptance. In presenting the project to faculty members, an emphasis will be placed on the elimination of redundant and nonessential material. Faculty may understand that this may actually provide time for either innovative teaching strategies or work in other areas. The training for this simple curriculum map will be completed during their paid faculty work days. Although no financial incentive can be offered, the college will provide verbal acknowledgement of this group's efforts.

Proposal for Implementation and Timetable

Faculty work days occur throughout the academic year. To facilitate implementation of this project in fall of 2016 and to complete it in spring of 2017, the 2016-2017 academic calendar was used as a guideline. Immediately preceding the start of the fall semester, the calendar includes two assigned faculty workdays. Two weeks before the end of the previous spring semester, the involved faculty members will receive an email from the project coordinator requesting that they participate in the curriculum planning project. The faculty members who agree to participate will then be provided with the course competencies for all six of the aforementioned courses, again via email. The first faculty work day is scheduled for August 23, 2016. This day will comprise training during which the project coordinator will provide an introduction to curriculum mapping, the rationale for the project, evidence-based best practices, potential benefits and challenges, and plans to address the challenges (see Appendix A for PowerPoint). Within one day of the initial work group meeting, faculty members will receive an email with a link to an online survey via Survey Monkey. The survey will request information on the instructor's own courses, including whether the specific competency is (a) introduced, (b) reinforced, or (c) assessed. Faculty members will be given two weeks to complete the survey. Once the survey results are complete, the results will be placed in a table that can be projected via a PowerPoint slide.

The next faculty work day, scheduled for October 26, 2016, will comprise another block of time during which the survey results are shared. The project coordinator, acting as moderator, will utilize several guided reflection questions to elicit the actual means

used by each instructor to address course competencies. Another focus area will be potential opportunities to integrate and reinforce information between the six courses. The template for the curriculum map, with courses and competencies pre-printed, will be provided to each faculty member with instructions on how to complete it and a timeframe to completion.

The next faculty workday is January 17, 2017. At this time, all members will return with a completed curriculum map of his or her own course. The project coordinator/moderator will again use guided reflection, but this time the groups will comprise both nursing and science instructors. Each will complete the template with specific examples of the methods used to introduce, reinforce, and assess the course competencies. The final session in May 2017 will include the creation of a single curriculum map that includes all courses and all competencies. Special attention will be given to the identification of gaps and redundancies with discussion on how to eliminate them. The curriculum map will be housed on the college's shared drive. In fall 2017, the group will again convene to discuss how the curriculum map may have affected student achievement, curriculum alignment, and collaboration.

Roles and Responsibilities of Student and Others

My role will be to act as project manager and I will retain responsibility for the project from start to finish. Responsibilities already completed included gaining permission from the Vice-President for Academic Affairs and the Divisional Dean for Nursing to allow faculty workdays to be utilized for curriculum mapping. Additional responsibilities will include (a) initial contact with faculty, (b) providing information

regarding course competencies to all participants, (c) coordinating meeting spaces for faculty work days, (d) designing a concise presentation on curriculum mapping, (e) designing and distributing a survey via Survey Monkey, (f) aggregating and trending survey results, (g) designing a presentation of the survey results, (h) design guided reflection questions to elicit feedback during collaboration sessions, (i) coordinate printing of all materials, and (j) coordinate uploading of information to the college's shared drive.

The Vice President for Academic Affairs and the Divisional Dean for Nursing will briefly address the group to reinforce their support for the project. The Print Shop Technician will print the materials within the specified deadlines. Administrative staff in the Division of Nursing will assist with emailing and will record meeting proceedings. Campus food service will provide lunch for participants, but this is not in addition to the lunch provided to all faculty members. Network technicians will assist with any difficulties in distributing information and will instruct faculty members on how to upload results to the shared drive.

Project Evaluation

The project will be evaluated to determine whether the "design and delivery…were effective and whether the proposed outcomes were met" (Caffarella & Daffron, 2013, p. 233). Since the curriculum mapping project will commence with three specific goals and a deliverable procduct, a goal-based approach will be used. The curriculum mapping project had three goals: (a) to educate science and nursing program faculty on the benefits of creating a curriculum map for the three science prerequisites

and the three nursing courses that rely most heavily on the prerequisites, (b) to accurately document intended learning outcomes, content, teaching and learning activities, assessment criteria, and assessment methods for Microbiology, Anatomy and Physiology 1, Anatomy and Physiology, Nursing Health Alterations, Nursing Complex Health Alterations 1, and Nursing Complex Health Alterations 2; and (c) to empower science and nursing faculty to collaborate in the creation of a curriculum map.

To evaluate whether the goals were met, data will be collected by survey, product review, and self-assessment (Caffarella & Daffron, 2013). The survey will be sent via email to all participants after the curriculum map is drafted. To address the first goal, participants will be asked specific questions about uses and benefits of curriculum mapping. To evaluate the second goal, a product review checklist will be conducted on the completed curriculum map to determine whether all intended learning outcomes, content, teaching and learning activities, assessment criteria, and assessment methods criteria were documented. The third goal will also be addressed in the survey with questions regarding the participant's self-assessment of his or her part in the divisional collaboration and the resulting curriculum map. The data will be entered into a spreadsheet, aggregated, and quantitatively analyzed. Most of the questions will be scales and forced-choice, but an open-ended question will also provide a qualitative component.

The next step in the project will be to reconvene the faculty members to determine how the curriculum might be modified to eliminate gaps and redundancies. Included in this discussion will be all faculty participants, Divisional Deans, the Vice-President for

Academic Affairs, and the representative from the state curriculum committee. The follow-up meetings will resemble the initial project meetings and will comprise discussion between the content experts and the curriculum designers (Harden, 2001).

In the short term, the three goals will be used to evaluate the project's success. However, the impetus for the study was the lack of timely completion and the higher than desired attrition rate in the college's nursing program. The curriculum map is only a first step in determining possible methods to improve nursing student progress by creating a more stable cognitive structure in the general sciences. If curricular change is successful, a long-term effect of this project may be better retention, lower attrition, and lower semesters to completion. Ideally, this would lead to an increase in program graduates who are successful in becoming registered nurses. This increase may have local and far-reaching effects.

Implications Including Social Change

Local Community

The population served by three out of the college's four campuses has higher poverty rates, lower mean household incomes, older residents, and higher unemployment than the state average (State Demographics Website, 2013). Students who graduate from the Associate Degree nursing program, pass a licensing exam, and begin working as registered nurses will earn a salary that is above the state average. Furthermore, most of the program's graduates remain in the area to work (Technical College Website, n.d.).

The population served by a majority of the college's graduates is older than the state average, leading to a potential increase in requirement for nursing care. An increase

in the number of students who are academically and professionally successful will result in more residents who are able to receive care close to home (Juraschek et al., 2012). A large percentage of nursing graduates are fully employed in their field within one year of graduation (Technical College Website, n.d..). This reduces the unemployment rate.

Many students at the college are the first in their family to attempt higher education, and many have children of their own (Technical College Website, 2013). Successful completion of the nursing program and the resulting full employment is likely to set a positive example for these children and may contribute to a better-educated local workforce in the future. Conversely, community college students who either fail or withdraw from a course are less likely to return and finish a program of study (Pitt, Powis, Levett-Jones, & Hunter, 2012). Therefore, any evidence-based improvement that will benefit student retention and completion is likely to improve the circumstances of the student and the student's family.

The nursing program must undergo accreditation every seven years. The measurement of program completion is a requirement for ongoing accreditation. Students who graduate from an accredited program have better opportunities for employment and continuing education. Therefore, all students, families, instructors, administrators, and community partners benefit from the nursing program's ongoing accreditation.

Far-Reaching

A majority of registered nurses in the United States receive their initial degree at a community or technical college (U.S. Department of Health and Human Services Health

Resources and Services Administration [HRSA], 2013). Local, state, and federal governments invest substantial amounts of taxpayer money in community and technical colleges, and the return on investment is substantial if the student completes a program of study (Schneider & Lin, 2011). If students are unsuccessful, a significant financial burden is placed on both student and taxpayers in the form of loan default. This leaves fewer resources in communities, states, and the nation for other priorities. Therefore, increasing retention and decreasing attrition may result in financial benefits on many levels. Students will still need to pay back student loans, but will do so from a position of earning a higher than average salary.

A deficit of nearly one million registered nurses is predicted by 2030 in the United States. One strategy to address this shortage is the maximization of educational resources (Juraschek et al., 2012). Since nursing courses are sequential, students who are unsuccessful in a course and either fail, withdraw, or remain out of sequence cannot be replaced in their cohort. This results in inefficient use of resources, including nursing faculty. Nearly 80,000 applicants were turned away in 2012 due to a shortage of faculty and other resources, so it is important to use these wisely (American Association of Colleges of Nursing website, 2014). This project, with its examination of the relationship between prerequisites and academic progress, may result in changes and best practices that allow more students to progress. In this way, resources may be more wisely utilized, more students may graduate, and the registered nursing shortage may be alleviated.

Conclusion

A curriculum mapping project was proposed as a means to address a longer than desired number of semesters to completion in an associate degree nursing program. Faculty and students expressed concern that science prerequisites may not have provided the cognitive structure required for student progress in the more rigorous core nursing courses. After analysis of 20 semesters of data, it was concluded that differences existed between the four campuses of the college both in terms of mean science grades and semesters to completion. A negative correlation between science grades and semesters to completion was expected based on the review of literature. The data analysis showed only a small minority of science course grades correlated negatively with the number of semesters to completion. This problem had both local and far-reaching effects on students and other stakeholders. The project's goal was to bring together science and nursing faculty to collaborate on the problem. Based on a review of literature, curriculum mapping was chosen as a means to accurately determine how course competencies were achieved in each of six science and nursing courses. The completed curriculum map will be the first step in determining how to improve student progress in the nursing program.

Section 4: Reflections and Conclusions

Introduction

As I created a proposal for this project, collected and analyzed data, searched the literature, and designed my project, I drew extensively from work on the scholarship of teaching and learning (SoTL) (Bishop-Clark & Dietz-Uhler, 2012). After working as a registered nurse in an acute care setting for several decades, I was accustomed to using evidence-based practice to care for patients. I also have 7 years of experience as a nurse educator. However, I am only beginning to understand how important it is to examine exactly how educators teach and how students learn (see Bishop-Clark & Dietz-Uhler, 2012). Therefore, much of my reflection in this section is grounded in what I have come to understand about SoTL.

Project Strengths

Evidence-informed teaching results from reflecting upon and documenting a practice, usually within one's own discipline (Rehrey et al., 2014). As shown in the earlier review of literature, nurse education and science education are significantly interrelated. Documentation of course content in both science and nursing courses will provide information and clarification to faculty in both disciplines. Because science prerequisites provide an important foundation for student mastery of the content in core nursing courses, collaboration between the disciplines may increase the strength of this foundation. Therefore, to increase nursing student success at my institution, I designed a curriculum mapping project designed to document the course content in three science courses and three core nursing courses.

A major strength of this project was that it provided an opportunity to definitively determine what is introduced, reinforced, and assessed in each of these courses. The completed curriculum map will provide guidance for faculty across the four campuses in knowing what students have or have not been taught in previous courses. It is designed to lessen speculation about differences between instructors and campuses and perhaps eliminate gaps and redundancies, leaving more time to address the course competencies. Furthermore, it will, hopefully, provide evidence for faculty to use in holding students accountable for what has already been taught (see Moser et al., 2011).

I have three primary goals for nursing and science faculty who participate in the project. I hope that participants will begin to think about the manner in which they teach and the manner in which students learn and to question their assumptions regarding perceived deficiencies in student performance. I also hope that the collaboration between faculty in the two disciplines will very likely result in best practice and creative ideas on different ways to present material in the classroom. The creation of a dynamic curriculum map, housed on the college's shared drive, will encourage ongoing examination of course content. When questions arise or changes are made, teachers will have the ability to consult and revise this map.

Collaboration between divisions is rare in higher education (Watts & Hodgson, 2015). By providing dedicated training, I hope to foster an example of how the obstacles to working together may be overcome. The study college as a whole is accredited by the Higher Learning Commission (HLC), a regional accreditor of degree-granting post-secondary institutions in the U.S. This accreditation requires continuous quality

improvement (Higher Learning Commission, 2015) similar to the requirements of the nursing program's accreditation (ACEN, 2013). This project has the potential to become a model for collaboration between all divisions, thus improving student achievement of competencies and improving the prospects for reaccreditation of both the college and the nursing program.

Alternative approaches to addressing the problem of student attrition were demonstrated in my review of the literature. I found no articles suggesting collaboration between divisions to improve student outcomes for current nursing students. Many nursing schools used strict admission criteria. Others gave preadmission exams and required remediation prior to students entering the nursing program. Still other schools had a complete subprogram within the division of nursing that was only for remediation (Eick, et al., 2012; Melillo et al., 2013; Wang et al., 2011). These approaches would be less than optimal for the study college's student population and values. The additional cost of testing would need to be either absorbed by the college or passed on to the students, which is unlikely given the current budget. Technical and community colleges in the state in which the study took place are largely open access and very low cost. Furthermore, the philosophy of the current Vice-President for Academic Affairs of the study college is "rather than wish for better students, we need to do better with the students we have" (personal communication, November 2014).

Recommendations for Remediation of Limitations

One central limitation of the project is that it will address only three courses each in study college's Divisions of General Studies and Nursing. To fulfill the requirements

for an Associate Degree in Nursing, a student must satisfactorily complete a total of 10 General Studies and 16 Nursing courses. The focus of this study was the relationship of science courses to academic progress. However, courses in writing, speaking, and the social sciences are also potential roadblocks to nursing student success.

To remediate these limitations, I suggest that curriculum maps be constructed by all General Studies and Nursing instructors. This would be a long-term project tied to the college's plan for continuous improvement. Each academic year would require a team of faculty from each division to commit to the construction of a curriculum map for a small number of courses. If this process were to be built into the process of reaccreditation, it might be possible to provide time, training, and financial incentives to the participating faculty.

Scholarship

I am a registered nurse. Like most nurses, I hold Florence Nightingale in high esteem. Nightingale did not set out to achieve greatness, but she possessed the vision, determination, and personal commitment to improve the health and hygiene of the British Army during the Crimean war. By contributing to health care and nurse education through dissemination of her letters and publications, she improved the health of the public and improved the education of nurses (Conrad & Pape, 2014). To me, this is the embodiment of a scholarly life.

Certain characteristics contribute to one's ability to be considered a scholar. First, a scholar must observe. By closely observing the characteristics of a problem, the first steps may be taken to provide greater knowledge about the problem (Conrad & Pape,

2014). In SoTL, the first step of scholarly inquiry is to formally reflect and observe in order to generate a research question (Bishop-Clark & Dietz-Uhler, 2012). A scholar also needs to be very inquisitive, concise in communication, and able to integrate new knowledge into a larger setting. Part of this inquisitiveness comprises the willingness to elucidate practices that are perhaps outdated or ineffective (Conrad & Pape, 2014). The goal in SoTL is "to transform the hunches and ideas you've had about your teaching and student learning into research questions and hypotheses that can be answered empirically" (Bishop-Clark & Dietz-Uhler, 2012, p. 14). This is very much how I became passionate about the question of the relationship between science and nursing program success.

Another characteristic of a scholar is integrity, particularly when one is working alone. Although it is difficult to remain neutral in the face of anecdotal data, any bias in either data collection or analysis is ultimately damaging to stakeholder trust. In order to either integrate or generalize new knowledge into existing practice, the researcher must be perceived as trustworthy (Conrad & Pape, 2014). Finally, scholarship involves the encouragement of others to become more inquisitive by being a role model for lifelong learning (Conrad & Pape, 2014). This may comprise the development of an educational session for sharing knowledge with others. It may also involve encouraging others to practice scholarship. SoTL has not always been valued in higher education but is increasing in importance. Besides time and assistance, any faculty member wishing to embark upon a SoTL project will need to have at least a basic level of scholarly expertise (Bishop-Clark & Dietz-Uhler, 2012).

Project Development and Evaluation

The project I chose could be classified within SoTL as scholarship of curriculum practice (SoCP). This particular category sometimes includes technology that is used for learning, but is mostly concerned with "grounding specific practices in scholarly literature" (Hubball et al., 2013). A literature review provided the information needed to design a project that will result in a curriculum map.

The initial motivation for this project was the unsatisfactory accreditation report. College administration was made aware of this report during a period of intense change for the Division of Nursing. The Dean of Nursing had left unexpectedly and suddenly without making any preparation for the upcoming accreditation visit, while the Vice-President for Academic Affairs had only been on the job for around six months. Although the program remained accredited with conditions, the consequences of the program possibly losing its accreditation were slowly absorbed by administration and the Board of Directors. The Division of Nursing had been starved of funding and proactive leadership for nearly a decade and this was an unfortunate result. This project was developed as a first step in correcting a problem.

The development of this project illuminated the importance of timing. Only one year previously, faculty and administration did not realize that the nursing program would face difficulty in accreditation. I believe that there would have been no motivation at that time to allow this data collection, analysis, and curriculum map project. During the period that the project was developed, administration's attention was turned toward the Division of Nursing.

Besides timing, support from administration was crucial as the data were analyzed and the project was conceptualized. Both the Divisional Dean for Nursing and the Vice-President for Academic Affairs requested frequent updates during project development. Nursing faculty members expressed relief that this problem was being investigated while at the same time worrying that this would be added to their workload. Reassurance was provided by the Divisional Dean with additional support from the Vice-President for Academic Affairs. The College President acknowledged that problems needed to be remedied and offered his support.

As the purpose of the project became clear, an examination of several prototype curriculum maps resulted in the decision to use a printed map and to map only six classes. Although some training will be provided in the first meeting, the map will need to be simply and concisely constructed to enable ease of use. Starting simply with a limited number of courses will enable the group to accomplish the objectives and will enhance collaboration, positively affecting buy-in from key stakeholders.

As the timeline and necessary resources unfolded, it became clear that there would be little monetary expense, but that faculty members would need to be released from some duties during faculty work days. Deans for both divisions were willing to release faculty for the three days required. The project may clarify whether it is realistic to complete a curriculum map using only this release time or if it will become necessary to utilize a more formal task force or committee. If so, money may become an obstacle.

The literature supported curriculum mapping to help with student achievement, curriculum alignment, and faculty collaboration. Existing college resources will be used

to enable faculty members to complete this project. The project coordinator will facilitate the training and evaluation.

Leadership and Change

When faculty members are informed that a change is imminent, there is often a feeling that something is about to be done to them rather than with them (Loughran, 2014). This project was created as professional development for teachers, which is sometimes regarded by participants as an increase in workload with little useful information to be obtained. Therefore, it is important to engage the faculty members in the process from the beginning. As the project manager, I will compose and send the initial email to participants, but I plan to speak individually to each of the faculty beforehand. I plan to present the project as an opportunity to collaborate between divisions for the purpose of solving a mutual problem. However, most, if not all, may be utilizing a curriculum map for the first time. Because of this, they may have anxiety or fear of this novel method of looking at the curriculum. This will require me to provide reassurance that guidance will be provided in each step. If participants feel that they will be supported during this unfamiliar process, they may be more willing to fully commit to it. Providing this supportive leadership before, during, and after the project will be important.

I found myself in the interesting position of having frequent discussions with my Divisional Dean and other administrators. This was a change for me, since I am usually fairly involved with my own teaching duties and students. I was provided with a different viewpoint in which my own plans and needs were balanced and weighed against

the needs of the program, the college, the stakeholders, and the accrediting agencies. Although I remain a teacher, I find that I have a much better idea of the greater priorities that sometimes drive the administrative decisions that are made. I noted that suggestions and ideas for change within the program or the college often required the approval of many people. Certain changes could not be made without approval of the Board of Directors. I also found that some changes cannot be made because of the college's mission, which is governed by state statute. It occurred to me that this may be one of the reasons that the nursing program had not progressed in the past decade and had continued to operate in an antiquated manner. It is possible that the former leadership lacked the energy or motivation to create change when faced with these obstacles.

Analysis of Self as Scholar

In both my career as an educator and during my doctoral journey, I have spent many hours reflecting upon and observing possible reasons for students' failure. I have also spoken to stakeholders including students, faculty, administration, and employers. This reflection enabled me to conceptualize a broad research question, since many of the people I talked to perceived a lack of student preparation in science. As a person very interested in science, this research question elicited great excitement for me. The exhaustive literature review was enlightening; I found that little agreement existed in how best to teach science to nursing students. I also found that some of the stakeholder speculation was grounded in the literature. If students did well in science, it generally meant that they would have success in nursing. After the literature review, I was able to create my specific research questions based on my scholarly knowledge. I am now

certain that the first step in problem solving is a review of what has already been studied. This was followed by a thoughtful reflection on how to apply the body of research to the local problem.

After teaching the courses that rely most heavily on the sciences, I did have a "hunch" that students were not well prepared. My inquisitive nature led me to question faculty, students, and other stakeholders regarding how the general science courses were taught. As it turned out, this "hunch" was supported by my data analysis. I then proposed a project to communicate the results and integrate the knowledge into the college culture. In this way I was able to transform my "hunch" into research questions and hypotheses, collect and analyze data, and arrive at conclusions (Bishop-Clark & Dietz-Uhler, 2012).

The data I received gave me a realistic look at how long it was taking students to complete an associate degree. The mean number of semesters to completion was higher than what I had anticipated. The number of students who completed the program in the time frame I examined was smaller than I had anticipated. This led me to retroactively look at the data that was used to determine the number of students that completed the program in six semesters, which is what was analyzed for the program's accreditation report. The data was not in agreement. I found that there had been a slight oversight by the person who collected the accreditation data, which I corrected in the data that I used. This added around a month to my data collection and analysis, but I was confident that the numbers were correct. Of course, it would have been possible to overlook this

disparity, but I practiced acholarly integrity to provide a more accurate analysis. The results will allow the college to move forward to improve student outcomes.

By completing all of the classes required for this degree and completing this project study, I have attained a very rudimentary level of scholarly expertise. By writing a proposal, I learned that any research project needs to be carefully planned. For example, data must be available, stakeholders must be willing, and research questions must be appropriate to the problem and aligned with the approach and design. Writing a research proposal requires so much attention to detail that one becomes almost pedantic while doing it. This has been a tremendous learning experience. While I am still very much a novice, I now know the steps that are needed to conduct research. I plan to continue to do so within the limits of my faculty position.

Analysis of Self as Practitioner

I experienced a transformation during the planning and writing of this project study. I have a different level of involvement with my students. The knowledge that I gained through deep investigation of the theory of subsumption has increased my ability to assist students in always relating new information to something that they already know. My conversations with students in class now frequently include the terms “link this”, “relate this”, and “differentiate this”. In this way, I believe that my students are more likely to learn broad concepts and methods by which to figure things out.

While active learning was always a part of my teaching strategy, I am careful now to choose activities that can provide cognitive structure. For example, I will design a pre-assessment for students to complete in class. They are free to collaborate and use books

and notes to complete this pre-assessment, which serves as preparation for some didactic learning. Next, I will talk to them about a concept that was introduced in the pre-assesment. During this lecture, I remind them frequently of what they already know and how the new information relates to the old. Finally, the class will conclude with a case study or low-stakes quiz that requires application of the information. This produces meaningful learning.

The creation of the curriculum mapping project took me outside of my comfort level at the college. As an extreme introvert, I am not generally comfortable telling others how to improve their practice. I was able to overcome this by grounding my project in evidence and framing the resulting curriculum map as something that would result in higher student achievement. The support of the Divisional Dean and other administrators also helped me to understand that the project has great value and will allow two divisions to work together for the benefit of students and the college as a whole.

Analysis of Self as Project Developer

According to Caffarella and Daffron (2013), planning a program for adult learners includes:

- knowledge of the project's context
- building a base of support
- developing goals and objectives
- selecting the format and schedule

These criteria provide a basis for my self-evaluation as the project developer.

The project's context comprised the people who would be contributing to the project deliverable as well as the organization's structural, political, and cultural environment. Structural factors to be addressed were the organization's mission, vision, values, and tenets; the administrative hierarchy, and the decision-making patterns within both the college and the Division of Nursing. The college's mission is "Learning First"; the vision is "An Innovative Journey", and the values are "Empowerment, Excellence, Innovation, Integrity, and Collaboration". The applicable college tenets are "Quality and continuous improvement are expected in all aspects of the college" and "Decision-making is collaborative and research-based" (Technical College Website, 2015).

In my project study, I utilized these contextual factors. The basis for my inquiry was student learning. I addressed the anecdotal concerns of faculty and students related to student learning by collecting and analyzing specific data. This analysis provided insight and concrete information on a topic that had been previously discussed, but not systematically studied. The curriculum map was an innovative method to empower faculty by using evidence and collaboration. The administrative hierarchy was followed both for obtaining permission to collect data and to disseminate the results. Although I found this cumbersome at times, I now know the proper channels to follow for future research. I am also aware that the administrative decisions made regarding my project may have been driven by an increasing sense that the nursing program was in some trouble. Once the immediate problems are solved, it is possible that the nursing program will no longer be an administrative priority. This will require any future project

proposals to be designed with the same amount of detail with which this project study was designed. I now have the skills to do this.

Similarly, the base of support was available because of the recent accreditation visit. As mentioned, administration's attention was turned toward the nursing program for the first time in many years. Administrative support in addressing the faculty regarding this project was crucial. A coalition was also built among nursing and general studies faculty. However, this may have been more difficult to accomplish without the administrative support. Future collaboration will require the same level of administrative support. Realizing this, I plan to speak personally to any faculty members who will be impacted by future research. In this way, I will try to reduce the feeling that things are done to them and not with them (Loughran, 2014).

The goals and objectives were designed to be realistic and logical. In this way, the participants see how the work in one session leads to achievement of a goal in the next. Since this is the first attempt at collaboration within the two divisions that will result in a work product, the goals need to remain clear but flexible. I am prepared to rework or renegotiate some of the objectives based on feedback from the participants (Caffarella & Daffron, 2013). This will also be an important component of any future research undertaken.

The scheduling of the project sessions was uncomplicated once approval was received from administration. The participants were already scheduled to be in a central location. This administrative approval was once again a result of the increased attention given to the nursing program during this time. In the future, entire days may not be

available for collaboration. In that case, I would request a few hours on faculty work days for collaboration. In the future, it is possible that I may design and develop a project involving all courses and all faculty. I now understand the logistics and details that such a project would require. Furthermore, a project of that magnitude would likely require time, training, and incentive (Brownell & Tanner, 2012). Creating this project made me aware of the many details that are involved in successful project planning. It may be possible to write a grant to provide the funds for a large-scale curriculum mapping project. With the review of literature completed and the project logistics determined, I believe that I could write such a grant.

The Project's Potential Impact on Social Change

Community and technical colleges in the state are uniquely positioned to assist students who may not consider higher education (Fike & Fike, 2008; Mertes & Hoover, 2014). As mentioned, three of the four campuses are situated in counties with high unemployment, low incomes, and older residents (State Demographics Website, 2013). Students who progress academically and professionally will earn above-average wages and are likely to remain in the state (Technical College Website, 2013). If students are unsuccessful either academically or professionally, they have wasted both money and time. Therefore, it is important to improve the success of students who are admitted into the nursing program. This project has great potential to do so.

Information that was gleaned from this study has the potential to improve student success. The literature review addressed many facets of nursing student academic and professional success. This review led to research questions that, when answered,

provided a guideline for potential improvement of one aspect of nursing student progression. The expected correlation between science grades and academic success was not demonstrated, so a project was designed to help determine possible reasons. If collaboration between divisions reduces the number of semesters to completion by even one semester, the financial savings to students will be significant. A student who can begin working six months earlier has greater earning potential, greater opportunity for employment, and less student debt.

Locally, an increase in the number of successful nursing students is likely to have an impact on the number of registered nurses available for employment in the community. An increased number of nursing students who pass the licensing exam will enhance the college's reputation, may lead to increased applicants, and may improve the employment opportunities at the college. In this way, the community benefits doubly from nursing student success.

Implications, Applications, and Directions for Future Research

The results from this project study not only provided some answers, but also illuminated some questions. The implications of the data analysis were: (a) there are significant differences among campuses in mean science grades, (b) there are significant differences among campuses in mean semesters to graduation, (c) most science grades do not demonstrate the expected negative correlation with time to program completion.

It will be important to continue to study program completion in a scientific manner. It seems clear that science preparation may be one area of concern. A next step

may be to design a study that examines the same correlation, but only on students who have taken science courses elsewhere and transferred them in.

Of particular interest was that Campus 2 had the highest mean semesters to completion. However, Campus 2 also had the only statistically significant correlations between both anatomy and physiology 1 and 2 and the number of semesters to completion. This suggested that other factors were involved. Since Campus 2 has a longer wait for nursing program entry than the other campuses, this could be investigated as a possible factor in student success. I would suggest an examination of the number of semesters between completing the science prerequisites and beginning the core nursing courses as it relates to academic success. This correlation may provide information or motivation for the college to expand the number of students admitted.

It may be possible to design or utilize a standardized science challenge exam to be administered prior to program entry. A correlational study on whether this score had the expected relationship with program completion may provide information on how mastery of concepts affects academic success. If a relationship is noted, a possible solution would be to provide remediation to entering students who are below a benchmark.

Funding for the technical and community college system in the state has recently become dependent on outcomes. The specific percentage of funding varies, but the number of students who are placed in high-demand jobs is one factor. It is likely that this trend will continue (Technical College Website, 2013). Students who enter, but do not complete, a program of study are not able to enter the job market at the same level of employment as their more educated peers. The amount of state reimbursement to the

college is dependent on students finishing a program of study in a timely manner. Thus both the student and the college have negative consequences when the student does not progress. On a much broader level than this project study, future research should address the high attrition rates and lengthy completion times at the associate degree level. One question that needs to be addressed is whether the associate degree level can accommodate the increasing complexity of registered nurse education.

Conclusion

A curriculum mapping project was proposed after data analysis did not demonstrate the expected inverse relationship between science grades and number of semesters to completion in the associate degree nursing program. The process of proposing a quantitative research study, collecting and analyzing the data, and designing a project to address the results provided an opportunity to work as a novice scholar. Using SoTL as a model, I analyzed my scholarly work and determined that I was able to complete this research with inquisitiveness and integrity. The project's development was enhanced with administrative support.

Project development was grounded in a review of literature on curriculum mapping and faculty resistance to change (Brownell & Tanner, 2012) and based on planning programs for adult learners (Caffarella & Daffron, 2013). Concise goals for the work of creating a dynamic curriculum map were developed. The program will be evaluated based on goal achievement.

The added responsibility of managing a project removed me from my usual role as a faculty member. I was supported by administration and learned how the many layers

of approval required can sometimes be discouraging. I developed an understanding of the details required to plan, propose, and successfully complete a project.

The deep knowledge of subsumption theory that I gained throughout this project has helped me to become a more alert teacher. I find that my students are able to grasp more complex concepts when they are reminded of how much they already know. This increased my perception that a strong base in the general sciences is necessary for success in nurse education.

It is my hope that this curriculum project, based in evidence, will become a model for the college. I believe that a college-wide curriculum map would identify gaps and redundancies in our teaching. If these are addressed by collaboration between divisions, we will have a more aligned curriculum. This may lead to improved student outcomes, which will be a benefit to the community.

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Appendix A: Curriculum Mapping Project

Purpose:

The purpose of this curriculum mapping project is to improve student achievement, align the curriculum, and to provide an opportunity for faculty collaboration between the Division of General Studies and the Division of Nursing.

Goals:

1. Educate science and nursing program faculty on the benefits of creating a curriculum map for the three science prerequisites and the three nursing courses that rely most heavily on the prerequisites
2. Accurately document intended learning outcomes, content, teaching and learning activities, assessment criteria, and assessment methods for 10806197 (microbiology), 10806177 (anatomy and physiology 1), 10806178 (anatomy and physiology 2), 10543105 (nursing health alterations), 10543109 (nursing complex health alterations 1), and 10543113 (nursing complex health alterations)
3. Empower science and nursing faculty to collaborate in the creation of a curriculum map.

Target Audience:

Faculty from the Division of General Science and the Division of Nursing

Participant Objectives:

After completing the first session, participants will:

1. List several benefits of curriculum mapping.

2. Describe the rationale for curriculum mapping the six courses that comprise the project.
3. Analyze the manner in which curriculum mapping provides an evidence-based best practice.
4. Complete, within two weeks, an online survey specifying whether competencies in their courses are introduced, reinforced, or assessed.

During the second session, participants will:

1. Participate in a discussion of survey results.
2. Reflect upon the means by which course competencies are addressed in each course.
3. List potential areas that may be integrated and reinforced between courses.
4. Examine and discuss the template on which the courses will be mapped.
5. Complete, before January 17, 2017, the template with specific examples of the methods used to introduce, reinforce, and assess the course competencies.

During the third session, participants will:

1. Collaborate with colleagues to synthesize a curriculum map using the template provided.
2. Identify gaps and redundancies in introduction, reinforcement, or assessment of material.
3. Discuss strategies to eliminate gaps and redundancies.

After completing the final session, the participants will:

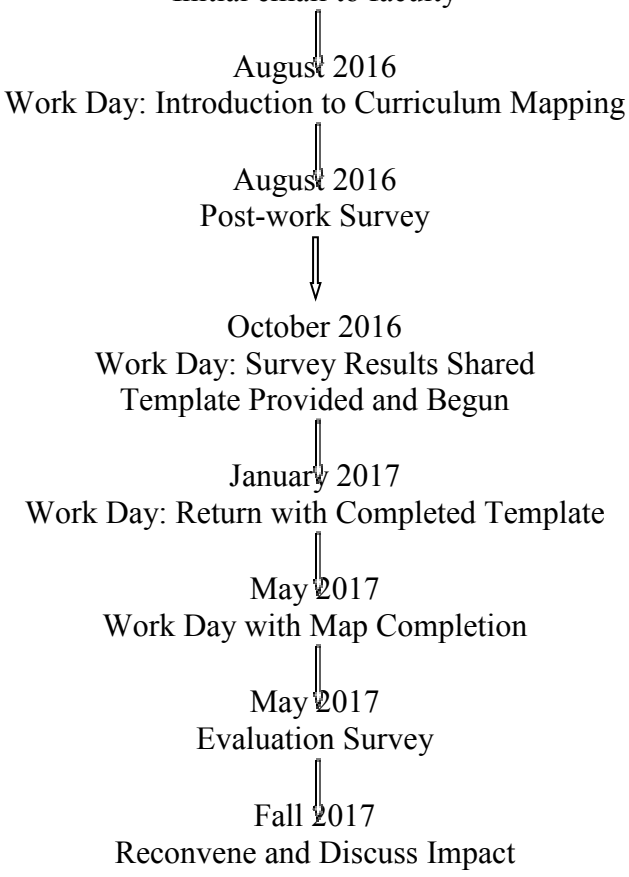
1. Create a legible and organized copy of the curriculum map.

2. Collaborate with the college's technology department to place the map on the shared drive.

After the final session, the project developer will:

1. Send an email to all particiapnts with specific directions on how to access and enter information on the curriculum map.
2. Consult with administration on utilizing a portion of the faculty workday in August 2017 for discussion of the curriculum map's impact on teaching and learning.

Timeline


May 2016
Initial email to faculty
August 2016
Work Day: Introduction to Curriculum Mapping
August 2016
Post-work Survey
October 2016
Work Day: Survey Results Shared
Template Provided and Begun
January 2017
Work Day: Return with Completed Template
May 2017
Work Day with Map Completion
May 2017
Evaluation Survey
Fall 2017
Reconvene and Discuss Impact

Email to Participants

May 5, 2016

Dear _____,

I hope this email finds you well. As we discussed in our brief meeting last week, I would like to invite you to participate in an innovative project that involves the Division of General Studies and the Division of Nursing.

Your dean has authorized you to participate during our faculty work days at the _____ campus in August 2016, October 2016, January 2017, and May 2017. Between October 2016 and January 2017, you will work independently. This work is not expected to take more than a few hours on your own.

The project is called Curriculum Mapping and will be important in the alignment of the curricula between General Studies and Nursing. It is also hoped that student retention in Nursing can be improved. This will be a chance for the faculty to collaborate and brainstorm to solve some of the problems that we all find frustrating.

I look forward to working with you on this project. Please reply to this email and let me know that you are still interested. Once I hear from you, I wll provide you with the course competencies for all of the courses that we will be mapping.

Many thanks and best regards,

Cate

Agenda for August 23, 2016

Time	Content	Instructional Method	Resources
9:00-9:15	Welcome, Introductions	Interactive Discussion	Project Developer Divisional Dean for Nursing VP for Academic Affairs
9:15-10:00	Project Overview	Didactic	Project Developer
10:00-10:15	Break		Coffee Tea Water
10:15-12:00	Introduction to Curriculum Mapping: Rationale Evidence Best Practices Challenges	Didactic	Project Developer PowerPoint
12:00-1:00	Lunch		Provided by College for all Faculty
1:00-1:30	Question and Answer	Interactive Discussion	Project Developer
1:30-2:00	Examination of Course Competencies	Faculty Group Discussion	Project Developer
2:00-2:15	Break		Coffee Tea Water
2:15-4:00	Introduce Template	Discussion	PowerPoint
4:00-4:15	Post-quiz Explanation of Survey	Online	Project Developer

PowerPoint for August 23 Meeting

Curriculum Mapping

An Introduction

Objectives

After completing the first session, participants will:

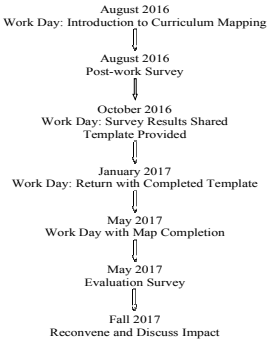
- **List several benefits of curriculum mapping.**
- **Describe the rationale for curriculum mapping the six courses that comprise the project.**
- **Analyze the manner in which curriculum mapping provides an evidence-based best practice.**
- **Complete, within two weeks, an online survey specifying whether competencies in their courses are introduced, reinforced, or assessed.**

What's Going On?

- **Accreditation**
- **Semesters to Completion**
- **Local Problem**
- **Wider Problem**
- **Cognitive Structure**

(Abele et al., 2013; Ausubel, 1963; Harris et al., 2014)

Project Overview and Timeline



Data Analysis in a Nutshell

- **Significant differences among campuses in semesters to completion**
  - **Campus 1 < campus 2**
  - **Campus 4 < campus 2**
- **Significant differences among campuses in mean science grades**
  - **Microbiology on campus 1 < campus 3**
  - **Anatomy and physiology 1 on campus 1 < campuses 2, 3, or 4**
  - **Anatomy and physiology 2 on campus 1 < campuses 2, 3, or 4; scores at campus 2 < campus 3; campus 4 < campus 3**
- **Significant correlations between science grades and semesters to completion:**
  - **Campus 1/Microbiology**
  - **Campus 2/Anatomy and Physiology 1**
  - **Campus 3/Anatomy and Physiology 2**

Why Use Curriculum Mapping?

- **Improved Student Achievement**
- **Curriculum Alignment**
- **Faculty Collaboration**

(Archambault & Masunaga, 2015; English,1980; Harden, 2001; Walker, 2006)

Improved Student Achievement

- Increased attainment of outcomes (Birks et al., 2015; Narayanasamy et al., 2013)
- Degree progression (Fowler et al., 2015; Landry et al., 2011)
- Embedding of competencies (Archambault & Masanuga, 2015)
- Relationship of coursework to competencies (Lam & Tsui, 2013)
- Small changes in curriculum yielded improved critical thinking (Watts & Hodgson, 2015)
- Assurance of a minimum level of competency (Iglar et al., 2011)

Curriculum Alignment

- Learning outcomes reflected in curriculum (Lam & Tsui, 2013)
- Progression in achievement (Lam & Tsui, 2014)
- External accrediting agency requirements (Ellaway et al., 2014)
- Learning outcomes reflected in each course (Steketee, 2015)
- Visual representation of presence or absence of learning outcomes (Wtts & Hodgson, 2015)
- Stated curriculum vs. attained curriculum (Hall, 2014)

Faculty Collaboration

- **Positive outcome**
  - **Intentional**
  - **Serendipitous (Watts & Hodgson, 2015)**
- **Most important step (Steketee, 2015)**
- **Independent mapping » cooperative mapping (Lam & Tsui, 2013)**
- **Deliberative dialogue (Iglar et al., 201; Lam & Tsui, 2014)**
- **Confirm, amend, elaborate (Spencer et al., 2012)**
- **SoTL (Moser et al., 2011; Rehrey et al., 2014)**
- **Increased engagement and communication (Harden, 2001; Uchiyama & Radin, 2009; Zelentisky et al., 2014)**

Courses to be Mapped

- **Microbiology**
- **Anatomy and Physiology 1**
- **Anatomy and Physiology 2**
- **Nursing Health Alterations**
- **Nursing Complex Health Alterations 1**
- **Nursing Complex Health Alterations 2**

Survey

- **Email**
- **Survey Monkey**
- **Individual course**
- **Determine whether competency is**
  - **Introduced**
  - **Reinforced**
  - **Assessed**
- **Complete within two weeks**

Next Meeting

- **October 26, 2016**
- **Faculty work day**
  - **_____ campus**
- **Work on template**
  - **Questions?**

Post-Quiz August 2016

1. Please list at least three potential benefits of developing a curriculum map.

2. In considering your participation in this project, what concerns you the most?

3. What is your understanding of the rationale behind this project?

4. Briefly discuss how curriculum mapping may provide you with an evidence base for your own teaching practice.

Survey (via SurveyMonkey)*

Please indicate which course(s) you will teach during the 2016-2017 academic year.

- o Microbiology
- o Anatomy and Physiology 1
- o Anatomy and Physiology 2
- o Nursing Health Alterations
- o Nursing Complex Health Alterations 1
- o Nursing Complex Health Alterations 2

Please indicate whether the competency is introduced, reinforced, or assessed within your course(s).

Microbiology:

- o I do not teach Microbiology

Anatomy and Physiology 1

- o I do not teach Anatomy and Physiology 1

Anatomy and Physiology 2

- o I do not teach Anatomy and Physiology 2

Nursing Health Alterations

- o I do not teach Nursing Health Alterations

Nursing Complex Health Alterations 1

- o I do not teach Nursing Complex Health Alterations 1

Nursing Complex Health Alterations 2

- o I do not teach Nursing Complex Health Alterations 2

Cell Function

- Introduced
- Reinforced
- Assessed

Fluid and Electrolyte

- Introduced
- Reinforced
- Assessed

Acid-Base

- Introduced
- Reinforced
- Assessed

Musculoskeletal

- Introduced
- Reinforced
- Assessed

Neurological

- Introduced
- Reinforced
- Assessed

Respiratory

- Introduced

- Reinforced
- Assessed

Cardiovascular

- Introduced
- Reinforced
- Assessed

GI

- Introduced
- Reinforced
- Assessed

GU

- Introduced
- Reinforced
- Assessed

Endocrine

- Introduced
- Reinforced
- Assessed
- Introduced
- Reinforced
- Assessed

*To save space in this layout, the competencies are listed once. In the online survey, the course and competencies will be listed individually. When survey results are complete, the results will be placed in a table that can be projected via a PowerPoint slide.

Agenda for October 26, 2016

Time	Content	Instructional Method	Resources
9:00-9:15	Welcome	Discussion	Project Developer
9:15-10:00	Request for Feedback on Survey	Interactive Discussion	Project Developer Participants
10:00-10:15	Break		Coffee Tea Water
10:15-12:00	Summary of Survey Results	Didactic	PowerPoint
12:00-1:00	Lunch		Provided by College
1:00-1:30	Projection of Survey Results	Interactive Discussion	PowerPoint
1:30-4:00	Work on Template	Group Discussion Guided Reflection on Competency Integration	Project Developer Participants Pre-Printed Map Templates
4:00-4:15	Instructions for Individual Work Next Meeting	Interactive Discussion	Project Developer Participants

Objectives will be met if participants:

1. Discussed the survey results.
2. Reflected upon the means by which course competencies are addressed by course.
3. Listed, using the template, potential areas of integration and reinforcement between courses.
4. Examined and discussed the template.
5. Complete a map before the next scheduled meeting.

Curriculum Map Template
Indicate I, R, or A

Course	Cell Function	Fluid-Electrolyte	Acid-Base	Musculoskeletal	Neurological	Respiratory	Cardiovascular	GI	GU	Endocrine
Micro										
AP1										
AP2										
HA										
CHA1										
CHA2										

I=introduced; R=reinforced; A=assessed by individual learning plan

Agenda for January 17, 2017

Time	Content	Instructional Method	Resources
9:00-9:15	Welcome	Discussion	Project Developer
9:15-10:00	Request for Feedback Individual Work	Interactive Discussion	Project Developer Participants
10:00-10:15	Break		Coffee Tea Water
10:15-12:00	Summary of Survey Results	Didactic	PowerPoint
12:00-1:00	Lunch		Provided by College
1:00-1:30	Projection of Survey Results	Interactive Discussion	PowerPoint
1:30-4:00	Work on Map Provide Specific Examples for Learning Plans (I,R,A)	Group Discussion (Mixed Disciplines) Guided Reflection on Gaps and Redundancies	Project Developer Participants Completed Map Templates
4:00-4:15	Next Meeting: Complete Map	Interactive Discussion	Project Developer Participants

Objectives will be met if participants:

1. Collaborated interdisciplinarily to synthesise a curriculum map in the template.
2. Identified gaps and redundancies in introduction, reinforcement, or assessment of material.
3. Discussed strategies to eliminate gaps and redundancies.

Agenda for May 22, 2017

Time	Content	Instructional Method	Resources
9:00-1:00	Divisional Concerns		Divisional Deans
1:00-3:15	Completion of Map in Single Template	Interactive Discussion	Project Developer Participants
3:15-3:30	Break		Coffee Tea Water
3:30-4:00	Completed Map Uploaded to Share Drive	Didactic	Network Technicians Project Developer

Objectives will be met if participants:

1. Create a legible and organized copy of the curriculum map that includes all courses and all competencies.
2. Collaborate with the college's technology department to place the map on the shared drive.
3. The project developer sends an email to all participants with specific directions on how to access and enter information on the curriculum map.
4. The project developer consults with administration to discuss utilizing a portion of an August 2017 faculty work day to discuss the impact of curriculum mapping on teaching and learning.

Project Evaluation Survey

1. After participating in the curriculum mapping project, I believe that curriculum mapping will benefit my students.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Comments:

2. After participating in the curriculum mapping project, I am able to discuss the benefits of curriculum mapping with colleagues.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Comments:

3. The curriculum mapping project helped me to understand how learning activities contribute to student attainment of competencies.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Comments:

4. I think that collaboration between divisions was helpful for student achievement.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Comments:

5. I think that collaboration between divisions can contribute to better curriculum alignment.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Comments:

6. I enjoyed collaborating with faculty from another division.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Comments:

Appendix B: Permissions

DATA USE AGREEMENT

This Data Use Agreement ("Agreement"), effective as of July 1, 2015 ("Effective Date"), is entered into by and between Cate Edlebeck ("Data Recipient") and Wisconsin Indianhead Technical College ("Data Provider"). The purpose of this Agreement is to provide Data Recipient with access to a Limited Data Set ("LDS") for use in research **in accord with laws and regulations of the governing bodies associated with the Data Provider, Data Recipient, and Data Recipient's educational program.** In the case of a discrepancy among laws, the agreement shall follow whichever law is stricter.

Definitions. Due to the study's affiliation with Laureate, a USA-based company, unless otherwise specified in this Agreement, all capitalized terms used in this Agreement not otherwise defined have the meaning established for purposes of the USA "HIPAA Regulations" and/or "FERPA Regulations" codified in the United States Code of Federal Regulations, as amended from time to time.
Preparation of the LDS. Data Provider shall prepare and furnish to Data Recipient a LDS in accord with any applicable laws and regulations of the governing bodies associated with the Data Provider, Data Recipient, and Data Recipient's educational program.
Data Fields in the LDS. **No direct identifiers such as names may be included in the Limited Data Set (LDS).** In preparing the LDS, Data Provider shall include the **data fields specified as follows**, which are the minimum necessary to accomplish the research: : a) identification, b) campus, c) grade in microbiology, d) grade in A/P1, e) grade in A/P2, and f) number of semesters to completion of the program.
Responsibilities of Data Recipient. Data Recipient agrees to:
Use or disclose the LDS only as permitted by this Agreement or as required by law;
Use appropriate safeguards to prevent use or disclosure of the LDS other than as permitted by this Agreement or required by law;
Report to Data Provider any use or disclosure of the LDS of which it becomes aware that is not permitted by this Agreement or required by law;
Require any of its subcontractors or agents that receive or have access to the LDS to agree to the same restrictions and conditions on the use and/or disclosure of the LDS that apply to Data Recipient under this Agreement; and
Not use the information in the LDS to identify or contact the individuals who are data subjects.
Permitted Uses and Disclosures of the LDS. Data Recipient may use and/or disclose the LDS **for its Research activities only.**
Term and Termination.
Term. The term of this Agreement shall commence as of the Effective Date and shall continue for so long as Data Recipient retains the LDS, unless sooner terminated as set forth in this Agreement.
Termination by Data Recipient. Data Recipient may terminate this agreement at any time by notifying the Data Provider and returning or destroying the LDS.
Termination by Data Provider. Data Provider may terminate this agreement at any time by providing thirty (30) days prior written notice to Data Recipient.

For Breach. Data Provider shall provide written notice to Data Recipient within ten (10) days of any determination that Data Recipient has breached a material term of this Agreement. Data Provider shall afford Data Recipient an opportunity to cure said alleged material breach upon mutually agreeable terms. Failure to agree on mutually agreeable terms for cure within thirty (30) days shall be grounds for the immediate termination of this Agreement by Data Provider.

Effect of Termination. Sections 1, 4, 5, 6(e) and 7 of this Agreement shall survive any termination of this Agreement under subsections c or d.

Miscellaneous.

Change in Law. The parties agree to negotiate in good faith to amend this Agreement to comport with changes in federal law that materially alter either or both parties' obligations under this Agreement. Provided however, that if the parties are unable to agree to mutually acceptable amendment(s) by the compliance date of the change in applicable law or regulations, either Party may terminate this Agreement as provided in section 6.

Construction of Terms. The terms of this Agreement shall be construed to give effect to applicable federal interpretative guidance regarding the HIPAA Regulations.

No Third Party Beneficiaries. Nothing in this Agreement shall confer upon any person other than the parties and their respective successors or assigns, any rights, remedies, obligations, or liabilities whatsoever.

Counterparts. This Agreement may be executed in one or more counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument.

Headings. The headings and other captions in this Agreement are for convenience and reference only and shall not be used in interpreting, construing or enforcing any of the provisions of this Agreement.

IN WITNESS WHEREOF, each of the undersigned has caused this Agreement to be duly executed in its name and on its behalf.

DATA PROVIDER

Signed: Ellen Riely Hauser

Print Name: Ellen Riely Hauser

Print Title: Vice President
Institutional Effectiveness
Wisconsin Indianhead Technical College

DATA RECIPIENT

Signed: Cate Edlebeck

Print Name: Cate Edlebeck

Print Title: Nursing Faculty, WITC

WISCONSIN INDIANHEAD TECHNICAL COLLEGE
AshlandNewRichmondRiceLakeSuperiorHaywardLadysmith

Administrative Office

August 5, 2015

Ms. Cate Edlebeck
Wisconsin Indianhead Technical College
600 North 21st Street
Superior WI 54880

Dear Cate

We are pleased to work with you in your capacity as a nursing instructor who will be providing instruction to students in the Associate Degree nursing program at WITC during 2015-2016. We agree to supervise and assume responsibility for these activities within the scope of our regular operations. We understand that you will also be undertaking a Walden University student researcher role that is separate from your nursing instructor role.

To support this research inquiry, our organization is willing to release de-identified data to you, as outlined in the attached Data Use Agreement. We reserve the right to withdraw from the study at any time if our circumstances change.

I confirm that I am authorized to approve research in this setting and that this plan complies with the organization's policies.

I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the student's supervising faculty/staff without permission from the Walden University IRB.

Sincerely

Ellen Riely Hauser

Ellen Riely Hauser
Vice President, Institutional Effectiveness

c Bonny Copenhaver
John Will
Jennifer Kunselman

WITC Administrative Office
505 Pine Ridge Drive
Shell Lake WI 54871

715.468.2815
Fax: 715.468.2819
TTY: 711
800.243.WITC

witc.edu

Appendix C: Grade Conversion Scale

Letter Grade	Description	Grades Scored Between	Grade Points/Credit
A	Excellent	95 – 100%	4.00
A-		93 – 94.9%	3.67
B+		91 – 92.9%	3.33
B	Above Average	87 – 90.9%	3.00
B-		85 – 86.9%	2.67
C+		83 – 84.9%	2.33
C	Average	80 – 82.9%	2.00
C-		78 – 79.9 %	1.67
D+		76 – 77.9%	1.33
D	Below Average	72– 75.9%	1.00
D-		70– 71.9%	0.67
F	Failure	0 – 70%	0.00