

THE FREQUENCY OF TESTING AND ITS EFFECTS ON EXAM SCORES IN A  
FUNDAMENTAL LEVEL BACCALAUREATE NURSING COURSE

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## ABSTRACT

Nursing faculty are constantly seeking ways in which to improve retention of students' knowledge. Historically, nursing students have been given a few assessments per semester, followed by a comprehensive exam at the conclusion of the course. Utilizing testing as a study tool rather than merely a form of assessment assists students in making the transition from memorization of facts to understanding concepts.

The purpose of this study was to examine the relationship between the frequency of testing within a baccalaureate undergraduate nursing course and students' examination scores. This quasi-experimental study was conducted with four cohorts of students enrolled in a fundamentals nursing course. The control group consisted of two cohorts of students who received only unit exams and a comprehensive final. The experimental group was given quizzes in addition to unit exams and a comprehensive final. Students in the experimental group were further assessed to determine if there was a relationship between exam scores and their utilization of quizzing as a study tool. Additionally, one of the quizzing cohorts was provided information on the benefits of the use of quizzing as a study tool. Exam scores were then compared to the quizzing cohort who did not receive this information to determine if there was a relationship between students' knowledge of the potential benefits of testing and final exam scores.

When comparing the quizzing and non-quizzing cohorts, quizzing was found to improve both unit and final exam scores. There were no statistically significant differences between students who reported using quizzing as a study tool and those who did not use quizzing as a

study tool. There was also no statistically significant difference between the cohort of students who received information regarding the benefits of testing as a study tool and the cohort who did not. These findings indicate quizzing is an effective tool to help improve students' grades, regardless of how the quizzes are utilized by the students.

## DEDICATION

This dissertation is dedicated to my husband and precious children. Hunter, thank you for your steadfast support along the way. Thank you for knowing when to give me a push and when to reign me back in. To my daughter, Ensley, you have reminded me to keep my focus on the priorities in life. You have sensed when I needed a hug or just a break. You have given me more encouragement than you will ever know. To my son, Camden, you literally started this journey with me. As a newborn, I would hold you while I wrote papers and completed assignments. Your sweet spirit has brought much joy to this journey. My love for each of you is unwavering. I pray you will reach your highest goals and know that I am your biggest cheerleader along the way.

## LIST OF ABBREVIATIONS

<i>ATI</i>	Assessment Technologies Institute
<i>BSN</i>	Bachelor of Science in Nursing
<i>CINHAL</i>	Cumulative Index of Nursing and Allied Health Literature
<i>CMS</i>	Content Mastery Series
<i>ERIC</i>	Educational Resources Information Center
<i>GPA</i>	Grade Point Average
<i>IPT</i>	Information Processing Theory
<i>IRB</i>	Institutional Review Board
<i>MSN</i>	Masters of Science in Nursing
<i>NCLEX-RN</i>	National Council Licensure Examination for Registered Nurses
<i>PCA</i>	Patient Care Assistant
<i>PI</i>	Primary Investigator
<i>RN</i>	Registered Nurse
<i>SPSS</i>	Statistical Package for the Social Sciences

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## CHAPTER I

### INTRODUCTION

At the collegiate level, course examinations have been utilized to assess students' knowledge for many years. Currently, many educators administer unit exams, which address multiple concepts and chapters of material concurrently (Roediger & Karpicke, 2006a). This format typically allows no more than three or four exams to be administered per semester for each course, meaning each exam carries a heavier weight when calculating a student's final course grade. Students are inclined to procrastinate studying for these exams; consequently, the bulk of preparation only occurs a day or two in advance. This technique, commonly known as "cramming," may allow for short-term recall of information on the examination; however, research reveals this method provides little comprehension of the material, which ultimately results in a poor ability to recall the information long-term (Karpicke & Roediger, 2007; Kling, McCorkle, Miller, & Reardon, 2005).

Summative assessments provide feedback at the conclusion of a course or a unit of material. This type of assessment does not allow students the opportunity to receive adequate feedback throughout the course regarding comprehension of the material. These assessments merely provide a "snapshot" of students' understanding of content at one moment in time (Rezaei, 2015; Shute & Rahimi, 2017). Formative assessments are administered more often than summative assessments; therefore, these have greater potential to support students' learning needs. One rationale as to why formative assessments are regarded more favorably than summative assessments is due to the fact that the more often feedback is provided to learners, the

great the opportunity for students to correct misinformation before it is stored incorrectly. More frequent assessments not only allow students the opportunity to review areas for improvement, they also allow faculty the opportunity to evaluate areas of weakness, both individually and collectively (Roediger & Karpicke, 2006b). Faculty then have the opportunity to provide students with supplementary information to clarify areas of weakness (Rezaei, 2015; Roediger & Karpicke, 2006b; Shute & Rahimi, 2017).

### **Significance of Problem**

As early as 1934, there were indications that a lesser amount of material on examinations resulted in improved student performance (Kling et al., 2005). Until the introduction of computerized testing, the process of assessing students' knowledge was a laborious process. Many times, examinations were oral, meaning faculty had to examine each student individually (Bangert-Drowns, Kulik, & Kulik, 1991). In later years, paper and pencil examinations were developed, but due to the time intensiveness of creating and grading each exam, most educators preferred to administer unit examinations, rather than testing each topic separately. Technology has greatly improved the testing environment; therefore, frequent testing is now less labor-intensive, and examinations may be more easily administered (Kling et al., 2005; Shute & Rahimi, 2017). The matter of frequent assessments and their effect on knowledge retention in the undergraduate nursing population has yet to be thoroughly investigated since the advent of computerized assessments (Kling et al., 2005).

The process of testing is, many times, thought of only as an evaluative process. Recognizing testing as a study tool rather than merely a form of assessment is crucial in promoting students' ability to recall information when needed. Educators utilize tests to determine students' knowledge base; however, testing has additionally been found to improve

memory and perhaps stimulate a deeper level of learning (Agarwal et al., 2011; Atabek Yiğit, Balkan Kıyıcı, & Çetinkaya, 2014). The process of actively recalling information is a more difficult task than simply re-reading material or listening to a recorded lecture multiple times (Kaplar, Weston, & Cepeda, 2012). Even further, short answer examination questions are shown to be more effective in forcing recall than multiple choice questions, due to the fact that students are required to recall an answer from their knowledge base rather than simply recognizing the correct choice (Kapler et al., 2012).

Current trends in higher education have shifted the focus from teaching students content, to teaching students how to learn (Rezaei, 2015). In nursing, lifelong learning is a necessary component, because health care practices are ever evolving. Nursing students must not only be able to memorize content, but students must be able to understand and apply concepts to a variety of patient care scenarios (Foster, 2012). Utilizing testing as a study tool will assist students in making the transition from simply memorizing facts to understanding concepts. When students understand these concepts, they will be able to incorporate them into nursing care throughout their career (Foster, 2012).

### **Problem Statement**

Nursing students must acquire, comprehend, and retain a considerable amount of new knowledge during a relatively short nursing education (Gibbons, Dempster, & Moutray, 2011). In order to be adequately prepared to care for patients, nursing students must, initially, have the ability to recall and retrieve information for course examinations, as well as in the clinical setting. At the end of a student's nursing education, the next goal is to accurately retrieve and apply the information on the NCLEX-RN examination. Once in the role of a practicing nurse,

the ability to evaluate and synthesize this information will be of even higher importance (van Merriënboer & Sweller, 2010).

Nursing students progress from basic learning strategies to higher order thinking using evaluation, synthesis, and interpretation (van Merriënboer, & Sweller, 2010). The more often an individual must recall and retrieve information, the more learning is strengthened, thus knowledge is able to be stored and recalled long-term (Brown, Roediger, & McDaniel, 2014). In order to have the capability to apply this knowledge to various patient care scenarios, nursing students must focus on truly retaining the content, not simply passing the test.

Previously conducted research, which specifically addressed knowledge retention and the frequency of examinations, demonstrated conflicting results. Advocates of more frequent testing, such as Brown and Tallon (2015); Kika, McLaughlin, and Dixon (1992); and Rummer, Schweppe, Gerst, and Wagner (2017) were convinced the use of frequent testing promotes an increase in knowledge retention; however, there are others, who indicated little to no improvement in the academic performance of students who utilize frequent testing (Burns & Vinchur, 1992; Urtel, Bahamonde, Mikesky, Udry, & Vessely, 2006). The previously conducted studies have been performed in fields outside the field of nursing; therefore, a significant gap exists in the evidenced-based literature focused on the subject of baccalaureate nursing students and the frequency of testing. The focus of this study was to examine the retention of knowledge, as evidenced by performance on summative exams, in relationship to the frequency of testing in baccalaureate level nursing students.

### **Theoretical Framework**

The information processing theory (IPT) guided this study. First appearing in the 1970s, the IPT is a theory of human problem solving, which focuses on the way in which information is

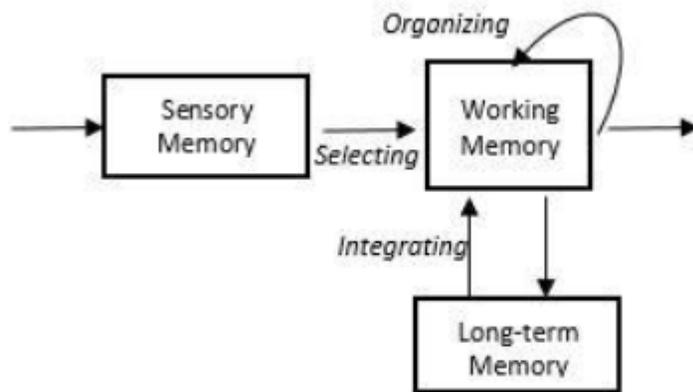
processed and stored within the brain (Candela, 2012; Tschikota, 1993). This theory has previously been used to explore various facets of nurses' decision-making practices, which aligns well with the overarching objective of this study (Offredy & Meerabeau, 2005).

The IPT views memory as a multifaceted system. As information is processed by the brain, data are either immediately forgotten, or processed and moved to the individual's short-term or long-term memory. The human mind forms mental images from environmental stimuli, and then applies these images to various intellectual processes, which allows the brain to create new mental images. Each time a learner hears or sees new information, the learner will then apply the information to previously formed mental images. After these images are formed, the learner can then organize and categorize them (Mayer, 2012). Once information has been categorized, the information must be rehearsed within the mind of the individual in order to progress from short-term memory to long-term memory (Candela, 2012).

Short-term memory, also known as working memory, only has the capacity to store between five and nine pieces of information at one time—noting this is information with which the individual has previously been familiar (Brown, 2015; Simon, 1979). Data may be stored in the short-term memory without rehearsal for very short periods, usually less than 30 seconds (Mayer, 2012, p. 85). Unlike the restricted capacity of short-term memory, it is believed the capacity of long-term memory is limitless, leaving a significant amount of room for the permanent storage of information (Candela, 2012).

One of the greatest challenges for students is retrieving stored information when needed. Information holds greater meaning when it is rehearsed more often; therefore, the more it is practiced, the greater likelihood it has of being encoded in long-term memory. When information is properly applied and encoded, it is more easily retrieved for use when compared

to memorization alone. Memorization has less meaning to the individual, because the information is not fully understood. Spaced practice of information recall enables individuals to more easily retrieve and apply previously learned content (Brown, 2015). Long-term memory is broken down into three additional categories: episodic memory, semantic memory, and procedural memory. Episodic memory stems from an individuals' life experiences, whereas procedural memory is where an individual holds the knowledge regarding performance of skills. Semantic memory is where meaningful information is organized into associated concepts. The focus of organizing concepts correlates nicely with the needs of baccalaureate nursing students; therefore, semantic memory was the primary focus of this study (Candela, 2012). This theoretical model (see Figure 1) is relevant for the present study because it evaluates the ways in which individuals process, retain, and retrieve information.



*Figure 1.* Basic information processing model.

### **Statement of Purpose**

The purpose of this study was to examine the relationship between the frequency of testing within a baccalaureate undergraduate nursing course and students' examination scores.

More frequent assessments throughout a semester have the potential to improve student's ability to recall information on summative exams; thus, have the potential to improve exam scores (Dobson, 2013; Roediger & Karpicke, 2006b). Frequent assessments stimulate a deeper level of learning, motivate more frequent studying of material, and provide students with more frequent feedback (Roediger & Karpicke, 2006b). For the purpose of this study, frequent assessments were defined as 10 or more assessments in 1 semester, which included proctored as well as non-proctored exams (Dobson, 2013). Students from all four cohorts had the opportunity to review each unit exam, however, the exam review was optional; therefore, not all students may have taken advantage of the opportunity. The unit exam reviews allowed students to see their entire exam and written rationales were provided for any question missed. For Cohorts Three and Four, feedback was provided in the form of a written rationale for each test item immediately following each quiz. Following each unit assessment or quiz, all students also had the opportunity to meet with a course faculty member to verbally discuss any missed items.

### **Research Questions**

The following research questions guided this study:

*Research Question 1:* To what extent do frequent assessments in an undergraduate nursing course improve final examination scores when compared with the use of traditional unit exams alone?

*Hypothesis:* Students who utilize frequent assessments in an undergraduate nursing course will be more likely to have higher final examination scores than students who utilize traditional unit exams alone.

*Research Question 2:* What is the relationship between the frequency of assessments in an undergraduate nursing course and students' exam scores?

*Hypothesis:* Students will see an improvement in course exam scores with an increase in the frequency of assessments.

*Research Question 3:* To what extent do frequent assessments improve final exam scores for students who report using non-proctored assessments as a study tool when compared to final exam scores of students who did not utilize non-proctored assessments as a study tool?

*Hypothesis:* Students who report using non-proctored assessments as a study tool will achieve higher final exam scores when compared to students who did not utilize non-proctored assessments as a study tool.

*Research Question 4:* Does informing students, regarding the use of quizzing as a study tool, affect students' academic performance, as evidenced by final exam scores?

*Hypothesis:* Students who receive instruction regarding the use of quizzes as a study tool will have improved final exam scores.

With these questions as a guide, this study assessed exam performance of undergraduate baccalaureate nursing students. Comparison of scores was made between fundamental level nursing students who utilized frequent assessments in coursework to cohorts who utilized only traditional unit exams. This study sought to determine if improvement was noted in course exams for students who utilized frequent assessments.

### **Need for Study**

Many times, students who are unsuccessful in nursing education, whether in coursework or on the NCLEX-RN, fault others for their lack of success. Very few of these unsuccessful students utilize optional resources that are available to them. These may include practice assessments, optional review sessions, or meetings with course faculty to create a plan of study (Eddy & Epeneter, 2002). Research, which correlates unit exam and/or comprehensive exam

scores of students who participate in optional learning activities versus those who do not, would be beneficial to nursing education programs. The ultimate goal of any nursing student is to be successful on the NCLEX-RN. It would also be of interest to follow these four cohorts of students and compare success on NCLEX-RN between the cohorts of students to determine if frequent assessments improve long-term retention of knowledge.

### **Definition of Key Terms**

Definitions of terms essential to this research are presented. Conceptual definitions have been derived from evidence-based literature, while operational definitions describe concepts specific to this research study.

- Frequent testing: for the purpose of this study, frequent tests are defined as 10 or more tests in one semester, including all proctored and non-proctored tests (Dobson, 2013).
- Unit exam: a 60-question assessment created by course faculty composed of a variety of alternate format questions which may include multiple choice, multiple answer, matching, fill in the blank, true/false, hot spot questions
- Quiz: a 20-30 question assessment composed of a variety of alternate format questions, which may include multiple choice, multiple answer, matching, fill in the blank, true/false, hot spot questions [Assessment Technologies Institute (ATI), 2016].
- Comprehensive final exam: a 100-question assessment created by course faculty composed of a variety of alternate format questions which may include multiple choice, multiple answer, matching, fill in the blank, true/false, hot spot questions

### **Summary**

Nursing students are inundated with information during a relatively short nursing education. It is crucial students retain the information provided since there is the potential to

care for a variety of patients throughout one's nursing career. Students must be taught to actively rehearse retrieval of this information, so when immediate recall is needed, the data are easily retrievable. Initially, students must be able to retrieve this information for course examinations and later be able to recall the information for the NCLEX-RN and patient care (Brown, 2015)

## CHAPTER II

### REVIEW OF LITERATURE

Nursing students are challenged to retain significant amounts of information in a relatively short time frame. This challenge leaves nursing faculty seeking ways to improve the way students are taught, to ultimately result in greater retention of knowledge (Gibbons et al., 2011). One instructional method, which has shown benefit in improving knowledge retention, is that of frequent assessments in the classroom. This literature review will address the frequency of assessments and its effects on students' unit and final exam performance. More specifically, the literature review will address the use of non-proctored assessments (quizzes) as a study tool, in conjunction with unit exams versus the use of unit exams alone. This literature search was conducted primarily using the Cumulative Index of Nursing and Allied Health Literature (CINAHL), Pro Quest Nursing and Allied Health, Educational Resources Information Center (ERIC), and EBSCOhost databases.

#### **Retrieval Practice**

For nursing educators, the goal is not only for students to learn concepts but for students to be able to understand, retrieve, and apply these concepts when necessary. Critical thinking is an essential component in nursing education because concepts build on one another; therefore, no concept can be understood in isolation from others. Utilization of retrieval practice through repetitive testing improves encoding and, ultimately, recollection of information (Karpicke & Roediger, 2008)

The technique of expanding retrieval practice involves attempting to retrieve information immediately following learning and then gradually increasing the timing between future recall attempts. This is considered an effective way to enhance long-term retention of knowledge (Karpicke & Roediger, 2007; Roediger & Karpicke, 2006a, 2006b). When the learner requires a more effortful processing, greater long-term retention is noted. Using testing as a study tool, in comparison to simply studying material alone, has been shown to improve memory, a phenomenon known as the testing effect (Karpicke & Roediger, 2007).

### **The Testing Effect**

The testing effect is a technique utilized by educators, which is thought to improve not only knowledge retention, but memory encoding as well (McDaniel, Roediger, & McDermott, 2007; Nguyen & McDaniel, 2015). This phenomenon purports that testing increases retention of previously learned material; therefore, the information is more easily retrievable later (Atabek Yiğit et al., 2014; Karpicke & Roediger, 2007). As information is processed within the mind, it flows through three cognitive processes. The initial process, known as *selecting* is when information is received from an outside source. The mind then proceeds to *organizing* the information into a comprehensible form, where the individual can then begin *integrating* the information with current information (Mayer, 2012, p. 89). The testing effect works to assist individuals in moving information from the organizing phase to the integrating phase. This information is then considered to be in the working memory, where it is more easily retrievable (Mayer, 2012).

### **Testing and Learning**

Testing has been shown to benefit college-aged students as a tool to improve long-term memory (Meyer & Logan, 2013). Testing may not only be used to assess students' learning, but

tests have also been found to enhance learning (Storm, Bjork & Storm, 2010; Tullis, Finley, & Benjamin, 2013). Testing, as a tool for learning, is not a new way of thinking. This philosophy dates back as early as the 1800s. As stated in *The Principles of Psychology*, James (1890) contended that rereading material is not the most effective way to learn.

A curious peculiarity of our memory is that things are impressed better by active than by passive repetition. I mean that in learning (by heart, for example), when we almost know the piece, it pays better to wait and recollect by an effort from within, than to look at the book again. If we recover the words in the former way, we shall probably know them the next time; if in the latter way, we shall very likely need the book once more. (p. 646)

When information is tested, it becomes more recallable in the future. The more complex the level of retrieval is during a test, the more powerful the retrieval will be in future recall of that information. If information is immediately recalled, as in an initial test immediately following the lesson, the likelihood of remembering long-term is lessened; therefore, testing as a study tool is likely ineffective. When there is delayed recall, there is greater likelihood of the information being retained long-term; however, the greater the delay between learning and recall, the less likely the individual is to recall the information. In order to utilize testing most effectively, there should be a test relatively soon following the lesson, followed by delayed recall later (Storm et al., 2010).

## **Frequent Testing**

### **Negative Findings of Frequent Testing**

When increasing the number of assessments throughout a semester, Proger and Mann (1973) reported not enough evidence was demonstrated to support an improvement in learning, as evidenced by final exam grades. Anderson (1984), Burns and Vinchur (1992), Connor-Greene (2000), and Olsen, Weber and Dorner (1968) all concurred that an increased number of assessments during the semester does not automatically result in improved student performance,

as evidenced by their final course grades. While Urtel et al. (2006) agreed there is conflicting evidence when assessing the effectiveness of increasing the frequency of assessments, the authors noted there may be an increase in student engagement within the classroom.

Brown and Tallon (2015) found mixed outcomes in their review. In this work, the authors discovered several research studies to show positive outcomes, some to show inconclusive outcomes, as well as a few studies which actually showed an unfavorable result on long-term knowledge retention in relationship to examination scores (Brown & Tallon, 2015).

### **Positive Findings of Frequent Testing**

In a study of high school algebra students, Kika, McLaughlin, and Dixon (1992) found significant improvement in course grades of students who were tested more frequently than the course grades of their counterparts. More specifically, the lower and middle level achievers were found to have the most significant improvement. The authors also found 88% of students preferred weekly testing compared with other patterns for testing (Kika et al., 1992, p. 161).

McDermott, Agarwal, D'Antonio, Roediger, and McDaniel (2014) conducted a multi-experiment study to assess knowledge retention in middle and high school students, as it relates to quizzing and unit exam performance. McDermott et al. found quizzing to be beneficial in all four of the experiments. In the study, the authors found the format of the quiz, such as multiple-choice or short answer, did not have to be identical to the unit exam to note benefits. McDermott et al. acknowledged, "Questions previously quizzed exceeded that for questions not quizzed by 18 percentage points" (p. 15). The investigators also found the use of two quizzes (post-lecture and review quiz) were found to have just as much benefit as the use of three quizzes (pre-lecture, post-lecture, and review quiz, or two post-lecture quizzes and a review quiz) (McDermott et al., 2014).

Bangert-Drowns et al. (1991) conducted a multi-site study of 35 classrooms. These classrooms included science, social science, mathematics, and reading courses at the secondary education level, as well as philosophy, government, psychology, accounting, mathematics, geography, engineering, law, veterinary medicine, business, statistics, sociology, and physiology courses at the collegiate level. In their study, Bangert-Drowns et al. found most classrooms to have a positive effect from more frequent testing. Of the 35 sites, 29 classrooms noted positive effects of frequent testing, while only 6 classrooms noted negative effects. When assessing the results, it was found that an average student in the courses with frequent testing outperformed 59% of students who utilized traditional testing (Bangert-Drowns et al. 1991, p. 94). Thirteen of the classrooms which reported positive findings found the posttest achievement scores to be statistically significant when comparing the experimental and control groups (Bangert-Drowns et al., 1991). The findings by Bangert-Drowns et al. paralleled to a qualitative review conducted by Phelps (2012) which reported, “Ninety-three percent of the qualitative studies analyzed reported positive effects of testing, whereas only 7% reported mixed effects, negative effects, or no change” (p. 39).

In the field of nursing, students are expected to learn concepts, which are building blocks for future nursing courses. When Agarwal et al. (2011) conducted a study on middle school science students, the investigators found frequent quizzing did enhance the learning of concepts, rather than simple memorization of facts. Learning concepts is crucial in the field of nursing education, as nursing students must be able to identify general concepts and then be able to apply these concepts to a variety of patient situations (Agarwal et al., 2011). One limitation noted in Agarwal et al.’s study was the questions were the same on the low-stakes examinations as well as the summative evaluation. Nursing students need to be able to recall pertinent information

and apply it to different situations, based on the patient's needs; therefore, assessment questions should not be identical (Agarwal et al., 2011).

Agarwal's et al. (2011) study, conducted with middle school science students, paralleled to the findings of Rezaei's (2015) study conducted with a collegiate level quantitative research methods course. Rezaei also indicated positive outcomes, both with short-term and long-term knowledge retention. Rezaei found frequent testing was shown to not only increase memorization of factual content, but quizzing was also shown to increase a student's critical thinking abilities, which is a fundamental component of nursing students' education (Rezaei, 2015).

### **Advantages of Frequent Testing**

If questioned about their attitudes regarding testing, the majority of students would report an aversion to testing; however, it is interesting to note, in the classrooms in which frequent testing was implemented, there was an improvement in overall course satisfaction (Bangert-Drowns et al., 1991; Roediger & Karpicke, 2006b). This finding stood true even when there was no significant difference in comprehensive examination scores (Brown et al., 2014). Increased course satisfaction appears to be related to greater satisfaction with more frequent examinations because each examination covers a smaller amount of material; therefore, each examination usually accounted for an overall lower percentage of their course grade (Grover, Becker & Davis, 1989; Kika et al., 1992).

In addition to better examination scores, it is also interesting to note improved faculty evaluations by the students were also reported. This is, perhaps, due to more frequent feedback provided by faculty (Kling et al., 2005). Bangert-Drowns et al. (1991) also found students who

were tested more frequently had more favorable ratings of their classroom experience than those who were tested less frequently.

Even though frequent testing may require adjustments in course scheduling to allow time for additional testing; online assessments or short in-class assessments may be incorporated without considerable disruption to current practices (Agarwal et al., 2011; Waite, 2007). When an online test-administration system is utilized, students have greater flexibility in the time and place of the assessment's administration. This flexibility could result in greater student satisfaction; however, it is also important to note, exam security would not be as stringent as proctored testing that occurs in a classroom (Angus & Watson, 2009).

### **Disadvantages of Frequent Testing**

With the advent of computerized examinations, some of the labor intensiveness of exam creation has been removed; however, one must take into consideration the possibility of technical difficulties which may arise when utilizing computerized assessments. If students encounter difficulties during the assessments, faculty or support staff may note an increase in workload from answering technological questions. Students may become frustrated if they frequently encounter difficulties while testing, which could decrease the benefit of testing. Students must also prepare for and take assessments in conjunction with an already heavy academic load (Heroff, 2009).

In order to accommodate an assessment for each area of study, more frequent testing may result in an overall increase in the number of exam questions (Agarwal et al., 2011; Heroff, 2009). This has the potential of creating additional workload for the faculty. If frequent assessments are a component of a student's course grade, faculty will also have to ensure all

grades are appropriately entered into the grade book or course management system (Heroff, 2009).

The majority of learning management systems have the option of providing immediate feedback to students after taking a computerized exam. Unfortunately, standardized feedback, such as this, is typically generalized, and it cannot substitute individualized feedback provided by faculty. In an effort to provide students further individualized feedback, additional faculty workload may be necessary to review each assessment with students (Agarwal et al., 2011).

### **Populations Investigated**

When reviewing the populations which have been studied, middle school, high school, and collegiate level students have been investigated. None of the studies reviewed included nursing courses. Grover et al. (1989) and Kling et al. (2005) investigated students at the collegiate level. Grover et al. specifically studied introductory Psychology students, while Kling et al. studied marketing students at two different universities. At the secondary education level, Kika et al. (1992) studied high school algebra students, while Agarwal et al. (2011) studied middle school science students. Bangert-Drowns et al. (1991) conducted a multi-site study, which included high school and collegiate level students in philosophy, psychology, mathematics, government, sociology, and veterinary medicine courses. A variety of students, at different levels of education, has been studied, yet the research remains inconclusive. The field of nursing education has received little consideration when evaluating the topic of frequent examination and long-term retention of knowledge; nonetheless, quick recall of information is one of the most essential aspects for a nurse.

## **Assessment Technologies Institute**

Some of the assessments provided within the study have been created by the Assessment Technologies Institute; therefore, it is important to discuss the process by which these assessments are created. The ATI Content Mastery Series (CMS) is a comprehensive product which is based directly from the National Council Licensure Examination for Registered Nurses (NCLEX-RN) test plan. This product provides books and online resources for students, proctored and non-proctored exams, as well as remediation materials. Following the NCLEX-RN plan, content from each of the following categories is offered to students: management of care, safety and infection control, health promotion and maintenance, psychosocial integrity, basic care and comfort, pharmacological and parenteral therapies, reduction of risk potentiation and physiological adaptation. The questions on the assessments include multiple choice, multiple response, fill in the blank, hot spot, chart, ordering, and graphic question options (ATI, 2017b).

When developing test items, items are written by nurses who hold, at a minimum, a Masters of Science in Nursing (MSN) and have teaching and/or practical experience in the content areas for which they are writing. After item construction, a committee reviews each of the items. Questions then undergo multiple editorial reviews before receiving final validation from the committee. After receiving final validation, the questions then undergo bias review, to ensure no questions contain wording specific to a cultural group or region. The questions are then pretested with students by being placed on proctored exams, as non-scored items. Psychometricians then analyze the questions, and questions which are flagged are either revised and retested or removed from the test bank (ATI, 2017b).

ATI (2017a) highly encourages faculty to provide incentives for students to complete non-proctored assessments. Students typically fail to take assessments seriously if they are not compensated for the work (ATI, 2017a). Non-proctored exams, such as the quizzes provided by ATI, are excellent resources which allow students to prepare for proctored examinations. These non-proctored exams not only allow students to identify areas which need further review, but they also allow students the opportunity to practice answering critical thinking questions, such as those administered on proctored unit exams (Heroff, 2009).

### **Information Processing Theory**

In the early 1950s, theories of human problem solving began to evolve. These theories would eventually lay the foundation for the IPT, which focuses on the mind as that of a computer processor (Simon, 1979). The IPT is a cognitive theory, which focuses on the way in which humans learn and remember, and it is focused on improving the teaching-learning process (Brown, 2015; Candela, 2012; Tschikota, 1993). The IPT views memory as a multifaceted system which works in three phases: sensory memory, working memory, and long-term memory. Initially, individuals associate information with a sense, such as sight or sound. From here, if perceived as important, the information may move to working memory (Brown, 2015).

Information is then temporarily stored in working memory. The greater attention an individual gives to a piece of information, while in working memory, the greater likelihood the information will gain meaning. One way meaning is attached to information is through active rehearsal, such as through frequent assessments. Rehearsal allows an individual to begin to apply associated concepts; therefore, it increases the likelihood of being able to retrieve the idea when needed. During assessments, students are able to practice retrieval of information, both incoming and previously learned; and thus, improve the likelihood of encoding the information

into long-term memory (Brown, 2015; Tybout, Calder, & Sternthal, 1981). Assessments not only measure an individual's level of learning, but they also evaluate a learners' ability to apply changes based on learning. IPT is applicable to assessments because it focuses on the cognitive processes by which a learner processes, stores, and retrieves information (Mayer, 2012).

### **Summary**

It is crucial for nursing students to retain information provided within the curriculum, as nurses have the potential to care for a variety of patients throughout a nursing career (Foster, 2012). It is essential students are able to move beyond memorizing facts and move to remembering concepts and applying these concepts to patient care. Frequent testing has the potential to improve knowledge retention by stimulating a deeper level learning, improving memory encoding, motivating more frequent studying of material, and providing more frequent faculty feedback (Brown, 2015; Roediger & Karpicke, 2006b).

When investigating the topic of frequent testing and knowledge retention, it was found that much of the research was completed as long as 10 to 20 years ago. In addition, no studies regarding frequent testing were found specifically with Baccalaureate level nursing students. Since the advent of computerized testing, limited research was available regarding frequent testing and knowledge retention. Roediger and Karpicke (2006b) reported that frequent testing has the potential to improve standardized examination scores, but it warrants further research. A gap exists in the evidence-based literature regarding the frequency of testing and Baccalaureate nursing students, specifically, with the use of computerized testing; therefore, further investigation of this topic is warranted.

CHAPTER III  
RESEARCH METHODOLOGY

**Statement of Purpose**

The purpose of this study was to examine the relationship between the frequency of testing within a baccalaureate undergraduate nursing course and students' examination scores. More frequent assessments throughout a semester have the potential to improve student's ability to recall information on summative exams; and thus, have the potential to improve exam scores (Dobson, 2013; Roediger & Karpicke, 2006b). Frequent assessments stimulate a deeper level of learning, motivate more frequent studying of material, and provide students with more frequent feedback (Roediger & Karpicke, 2006b).

**Research Questions**

The following research questions guided this study:

*Research Question 1:* To what extent do frequent assessments in an undergraduate nursing course improve final examination scores when compared with the use of traditional unit exams alone?

*Hypothesis:* Students who utilize frequent assessments in an undergraduate nursing course will be more likely to have higher final examination scores than students who utilize traditional unit exams alone.

*Research Question 2:* What is the relationship between the frequency of assessments in an undergraduate nursing course and students' exam scores?

*Hypothesis:* Students will see an improvement in course exam scores with an increase in the frequency of assessments.

*Research Question 3:* To what extent do frequent assessments improve final exam scores for students who report using non-proctored assessments as a study tool when compared to final exam scores of students who did not utilize non-proctored assessments as a study tool?

*Hypothesis:* Students who report using non-proctored assessments as a study tool will achieve higher final exam scores when compared to students who did not utilize non-proctored assessments as a study tool.

*Research Question 4:* Does informing students, regarding the use of quizzing as a study tool, affect students' academic performance, as evidenced by final exam scores?

*Hypothesis:* Students who receive instruction regarding the use of quizzes as a study tool will have improved final exam scores.

### **Need for Study**

Many times, students who are unsuccessful in nursing education, whether in course work or on the NCLEX-RN, fault others for their lack of success. Very few of these unsuccessful students utilize optional resources available to them. These may include practice assessments, optional review sessions, or meetings with course faculty to create a plan of study (Eddy & Epeneter, 2002). Research which correlates unit exam and/or comprehensive exam scores of students who participate in optional learning activities versus those who do not would be beneficial to nursing education programs. The ultimate goal of any nursing student is to be successful on the NCLEX-RN. It would also be of interest to follow the students within the study to compare success on NCLEX-RN between the cohorts of students to determine if frequent assessments improve long-term retention of knowledge.

## **Design**

This quasi-experimental study was conducted with nursing students in the 2nd semester of a 5-semester baccalaureate nursing program. More specifically, these individuals were students registered in a fundamentals nursing course. Fundamentals nursing students were chosen because these students are in the first clinical nursing course; therefore, have little, if any, clinical experience, which could affect the outcomes of the study. Students within this course were offered the opportunity to voluntarily participate.

Prior to being able to register for the fundamentals nursing course, students must first be admitted to the nursing program. Currently, students are admitted twice per year, once in the summer semester and once in the fall semester. Applicants are assessed based on GPA and entrance exam scores. From the applicants, the top 112 students are selected to be admitted to the incoming cohort. Students then complete the 1st semester of nursing coursework which includes pathophysiology, health assessment, and conceptual foundations of nursing. After successfully completing these courses, the student may then progress to the 2nd semester, where he or she will take fundamentals of nursing.

For this study, the initial two cohorts of students participated in their coursework as required, consisting of only unit exams and a comprehensive final examination, which were created by course faculty. Cohort One completed fundamentals of nursing in the fall of 2016, while Cohort Two completed the course during the spring of 2017. Historical data, which included students' exam scores, were obtained from these cohorts for comparison to the intervention groups. The intervention groups, Cohorts Three and Four, participated in their coursework as required; however, in addition to unit exams students were given quizzes, which review major content areas covered within the course. In addition to unit exams, the following

assessments were required: musculoskeletal quiz (20 questions), neurosensory quiz (30 questions), renal and urinary quiz (20 questions), gastrointestinal quiz (20 questions), respiratory quiz (20 questions), immune and infectious disease quiz (30 questions), fundamentals online practice assessment A (60 questions), and a proctored RN Fundamentals assessment (60 questions). Table 1 provides a chart to indicate the conditions for each cohort and Figure 2 provides an outline of the study schematic and the order in which the assessments were presented within the course.

After required coursework was complete, the primary investigator (PI) examined the students' unit and final examination scores for each of the cohorts. The PI then examined the relationship between the frequency of testing and the students' unit and comprehensive examination scores. For students who provided consent, additional information was obtained to determine any significant differences between the cohorts. This included demographic data (race, gender, and age at the beginning of the course), students' lower division overall and science GPA, and, when applicable, students answered questions regarding their use of the assigned quizzes.

<b>Table 1</b>					
<i>Cohort Conditions</i>					
	<b>Semester/Year Taking Fundamentals of Nursing</b>	<b>Unit Exams</b>	<b>Comprehensive Final</b>	<b>Quizzing</b>	<b>Instruction on quizzing as a study tool</b>
<b>Cohort 1</b>	Fall 2016	√	√		
<b>Cohort 2</b>	Spring 2017	√	√		
<b>Cohort 3</b>	Fall 2017	√	√	√	
<b>Cohort 4</b>	Spring 2018	√	√	√	√

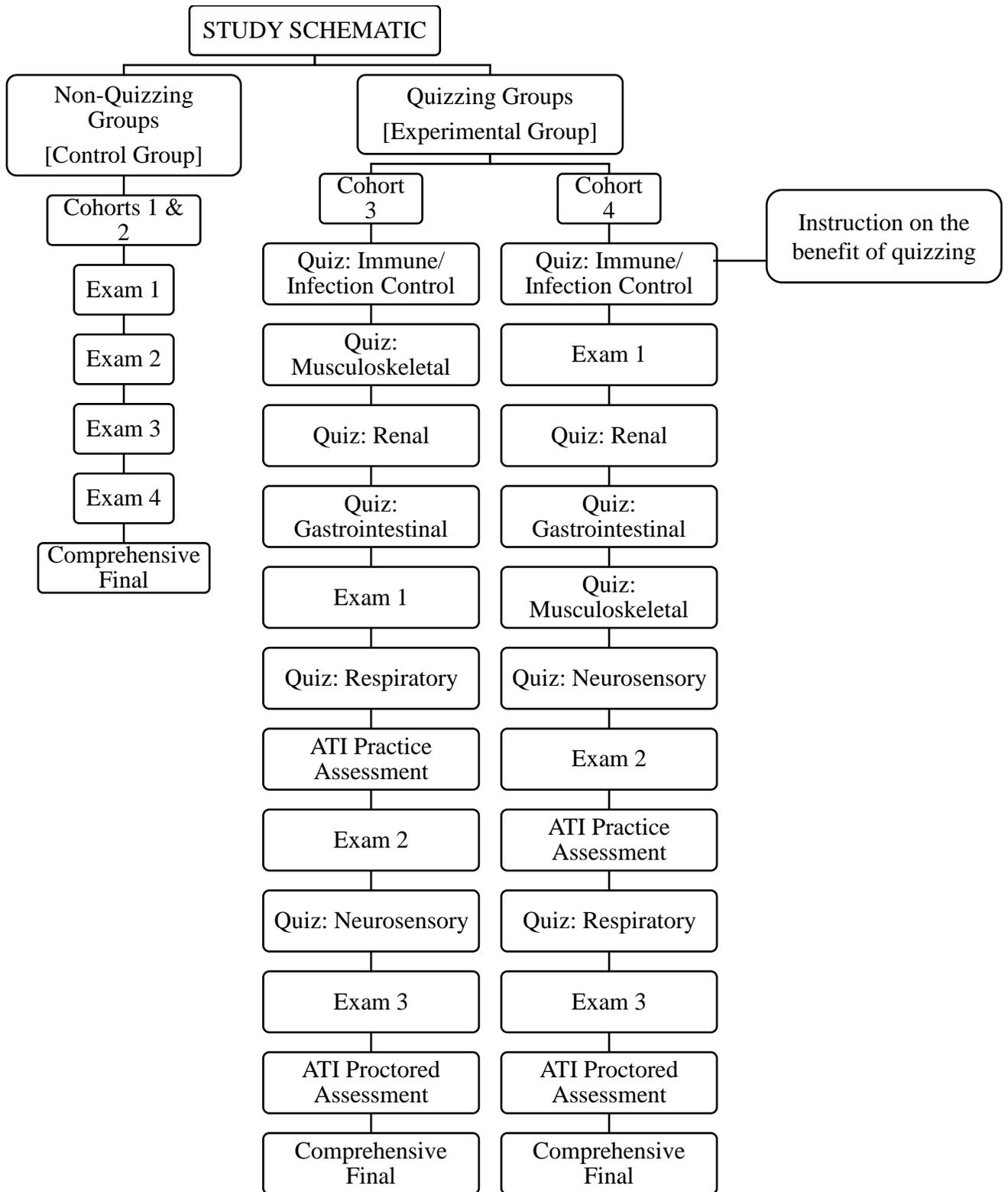


Figure 2. Study schematic.

As a point of disclosure, the PI was a faculty member during the 4 semesters in which the study occurred and was the course coordinator in the course for 3 of the 4 semesters (spring 2017, fall 2017, and spring 2018). Due to this, the Assistant Dean of the undergraduate programs approved all components of the study to ensure there was no researcher bias. The nursing program where the research was conducted implemented a program-wide policy for the Assessment Technologies Institute (ATI) testing. This policy included required assessments as a component of the curriculum; therefore, the course curriculum was not altered from the policy.

It must be noted that during the time of the study, there were faculty changes within the course. These changes were made based on needs of the college and personal preference by some faculty who changed jobs or positions within the college. While the same textbooks were used and the same content was taught, variations in instructional techniques may have been noted. Due to the fact that no research has been found assessing the effectiveness of the use of frequent assessment in the undergraduate nursing population, this research will help confirm or refute the benefit of frequent testing.

### **Sample**

Participants in this study were a convenience sample, consisting of students in the 2nd semester of an upper division baccalaureate nursing program from a flagship public university in the southeastern United States. More specifically, it consisted of students enrolled in the fundamentals nursing course. This population was selected because exposure to real-life clinical situations is limited. Greater clinical experience could potentially expand the students' knowledge base, thus altering the findings of the study.

The name(s) of the student(s) who have previously taken the course were obtained from the course leader of the fundamentals of nursing course. Students who had previously taken the

course have already been exposed to the course material; therefore, their knowledge base would be different than those receiving the information for the first time. These students had also potentially experienced a greater amount of time on the clinical unit. After consideration, it was decided to keep these students within the sample rather than excluding them due to the fact that each cohort of nursing students was likely to have students repeating the course.

Historically, students who are admitted to the nursing program in the summer cohort have a stronger academic makeup than those admitted in the fall cohort (see Table 2). After completing the 1st semester of coursework, students progress to the 2nd semester of the program, where they take fundamentals of nursing. This means as a whole, students who take the course in the fall are stronger academically than those who take the course in the spring. Descriptive statistics related to the final and unit exam averages may be found in Table 3. When comparing Cohorts One and Two, statistically significant differences were noted between the academic composition of the fall and spring cohorts for both the final [ $F(1,228) = 35.14, p < .001 \eta_p^2 = .134$ ] and unit exams [ $F(1,228) = 18.77, p < .001 \eta_p^2 = .076$ ]. A comparison was also made of the academic composition of Cohorts Three and Four. Significant differences were also noted with the final [ $F(1,208) = 2.818, p = .095 \eta_p^2 = .013$ ] and unit exams [ $F(1,208) = 156.94, p < .001 \eta_p^2 = .43$ ].

Cohort	Admission GPA	Science GPA (upon admission)
<b>1</b>	3.949	3.75
<b>2</b>	3.617	3.28
<b>3</b>	3.961	3.763
<b>4</b>	3.733	3.458

Cohort	N	Final Exam		Exam Average	
		Mean	SD	Mean	SD
1	128	84.45	4.65	83.12	3.72
2	102	80.7	4.92	80.88	4.1
3	108	85.44	4.88	88.1	3.98
4	102	84.38	4.28	80.1	5.17

The sample consisted of four cohorts of students. Enrollment for each of the cohorts was as follows: Cohort One ( $n = 128$ ), Cohort Two ( $n = 102$ ), Cohort Three ( $n = 108$ ), Cohort Four ( $n = 102$ ), resulting in an aggregate sample size of  $n = 440$ . The investigator also provided the opportunity for students to complete a survey which provided additional information regarding demographics and students' activities related to quizzing. Survey responses from each cohort were as follows: Cohort One ( $n = 104$ ), Cohort Two ( $n = 19$ ), Cohort Three ( $n = 10$ ), Cohort Four ( $n = 74$ ). This resulted in a total survey response rate of  $n = 207$  nursing students. Students in Cohorts One and Two only received traditional unit exams and a final comprehensive assessment. Cohort Three received traditional unit exams, a comprehensive final, and the addition of quizzes to their required coursework; however, no instruction was provided regarding the usefulness of quizzing as a study tool. The fourth cohort received unit exams, a comprehensive final, quizzes, and these students received instruction on the usefulness of quizzing as a study tool (Appendix A).

### **Recruitment**

The PI received permission from the Assistant Dean of the Undergraduate Programs at the College of Nursing prior to recruiting students. The PI then gained approval from the Institutional Review Board (IRB) at The University of Alabama by completing the electronic research review process (Appendix B). IRB approval allowed for aggregate data from all

cohorts to be utilized, ensuring this information was not linked to students' individual scores or personal information. Students who provided written consent did allow for individual exam scores to be linked to survey responses. Following IRB approval, students were recruited using face-to-face communication during the students' class time (Appendices C and D). For Cohort Four, the students most recently enrolled in fundamentals of nursing, a faculty colleague was utilized to recruit students, rather than the PI; because the PI was a faculty member in the course at the time of data collection (Appendix D). This provided additional assurance that students would not feel coerced to participate in the study. Students were informed of the purpose of the study, the potential risks and benefits, and then an invitation to participate in the study was extended. The informed consent and survey were distributed, and the investigator, or faculty colleague, answered any questions from prospective participants. Students had the option to participate in the survey; however, the treatment remained the same for each cohort of participants, regardless of their desire to participate.

### **Timeline**

Implementation of quizzing began in the fall of 2017 based on a curriculum change within the College of Nursing. This cohort of students (Cohort Three) received no instruction regarding the benefit of testing as a study tool. In spring 2018, Cohort Four, utilized quizzing in conjunction with unit exams, and they received instruction regarding the benefits of quizzing as a study tool (Appendix A). After the intervention was complete, data were analyzed in summer 2018.

### **Instrumentation**

For both the control and intervention group, the unit exams were created by the fundamentals of nursing course faculty, using routine exam creation strategies. The students in

the intervention group utilized a component of ATI Pulse™, a learning solution offered by the Assessment Technologies Institute (ATI). This component, entitled Learning System RN, is a quiz bank which provides unique assessments which cover content specific to the course. After each major lecture, the students completed a quiz specific to that topic. Students were allowed to take the quizzes as many times as desired to achieve a desired score; however, there was a 12-hour lock out window between attempts. This lock out allowed time for reflection on the content, and it prevented students from taking the assessment numerous time back to back without processing the content. After completing each of the assessments, students were given written feedback on their performance. This feedback included not only a numerical score, but it also included the correct answer(s) along with a rationale (ATI, 2016). If students had additional questions after receiving the generalized feedback, they had the opportunity to make an appointment with a course faculty member to discuss the item further.

### **Data Collection**

After obtaining IRB approval and participant consent, data collection began in spring 2018. Consents and paper documentation were stored in a locked drawer in the investigator's office. All electronic data were stored on a password protected device, to which only the investigator had access. Initially, the participants' campus wide identification numbers (CWID) were used as an identifier, to allow matching between exam scores. After data were linked to the appropriate student, the data were deidentified to maintain student confidentiality. Students were then assigned a random number, which was used as an identifier for the remainder of data collection. Only aggregate data are shared to maintain student and institutional confidentiality.

Data were analyzed in three phases. The first set of data compared the overall examination scores of the non-quizzing cohorts (Cohorts One and Two) to the quizzing cohorts

(Cohorts Three and Four). The second phase compared Cohort One (fall 2016) and Cohort Three (fall 2017). The final set of data compare the examination scores of Cohort Two (spring 2017) and Cohort Four (spring 2018). Historically, when comparing the academic make-up of the fall and spring cohorts, there are noticeable differences in GPA and entrance exam scores. Due to these differences, it was determined a comparison between fall to fall and spring to spring cohorts would result in a more detailed data analysis.

After completion of all required coursework, students from each cohort, who consented to the study, were provided a short survey. For Cohorts One and Two, which only received unit exams and a comprehensive final, the survey asked only about their demographic data and any clinical experience prior to taking Fundamentals of Nursing (see Appendix E). For Cohorts Three and Four, which utilized quizzing in addition to the traditional assessments, the survey asked about demographic data, prior clinical experience as well as their use of quizzing as a study tool (see Appendix F).

### **Statistical Analysis**

A univariate analysis of variance was used to perform statistical analysis. For this study, the independent variable was the cohort of students, while the dependent variable was the students' examination scores. For Cohorts One and Two, the condition was unit and final exams only. The third cohort had the condition of quizzing, unit exams, and a comprehensive final exam. The fourth cohort had identical conditions as the third cohort, but this cohort also received instruction regarding testing as a study tool (Appendix A). The control groups (Cohorts One and Two) only received unit exams and a comprehensive final exam. The experimental groups (Cohorts Three and Four) received content specific quizzes in addition to the unit exams and a comprehensive final exam. Covariates for the study included previously taking

Fundamentals of Nursing or prior experience in a clinical setting. Improvement in exam scores when utilizing frequent testing, would strengthen the concept that frequent rehearsal improves an individual's ability to retrieve data when necessary, as the IPT suggested (Brown, 2015).

### **Summary**

Faculty are continuously seeking ways to improve the methods in which course content is delivered, as well as ways in which students are assessed and evaluated. Frequent quizzing offers a way to strengthen students' study habits as well as their long-term knowledge retention and transfer. This pedagogical method offers a way for enhanced learning, which may assist students in retaining the information long term (Kling et al., 2005). It is crucial for nursing students to retain the information provided within the curriculum, so they are able to care for a variety of patients throughout their nursing career. Nursing faculty strive to facilitate students' learning to guide them to go beyond simply memorizing facts and move them to remembering concepts and applying these newly learned concepts to patient care.

Frequent testing has the potential to improve knowledge retention and application by stimulating a deeper level learning, motivating more frequent studying of material and providing more frequent faculty feedback. A gap exists in the evidenced-based literature regarding the frequency of testing and baccalaureate nursing students, specifically, with the use of computerized testing; therefore, further investigation of this topic is warranted. This study sought to add to the existing knowledge regarding this approach to learning.

## CHAPTER IV

### RESULTS

The purpose of this study was to examine the relationship between the frequency of testing within a baccalaureate undergraduate nursing course and students' examination scores. This study also compared the relationship between examination scores of students who reported using quizzing as a study tool and students who reported not using quizzing as a study tool. All data were entered into Statistical Package for the Social Sciences (SPSS) version 22 for data analysis. A description of the demographic characteristics will be discussed, as well as results of data analysis in relationship to the research questions and hypotheses.

#### **Research Questions**

The following research questions guided this study:

*Research Question 1:* To what extent do frequent assessments in an undergraduate nursing course improve final examination scores when compared with the use of traditional unit exams alone?

*Hypothesis:* Students who utilize frequent assessments in an undergraduate nursing course will be more likely to have higher final examination scores than students who utilize traditional unit exams alone.

*Research Question 2:* What is the relationship between the frequency of assessments in an undergraduate nursing course and students' exam scores?

*Hypothesis:* Students will see an improvement in course exam scores with an increase in the frequency of assessments.

*Research Question 3:* To what extent do frequent assessments improve final exam scores for students who report using non-proctored assessments as a study tool when compared to final exam scores of students who did not utilize non-proctored assessments as a study tool?

*Hypothesis:* Students who report using non-proctored assessments as a study tool will achieve higher final exam scores when compared to students who did not utilize non-proctored assessments as a study tool.

*Research Question 4:* Does informing students, regarding the use of quizzing as a study tool, affect students' academic performance, as evidenced by final exam scores?

*Hypothesis:* Students who receive instruction regarding the use of quizzes as a study tool will have improved final exam scores.

### **Demographic Data**

The sample for this study was a convenience sample consisting of four cohorts of nursing students who had previously been enrolled in Fundamentals of Nursing in the upper division of a baccalaureate nursing program. Enrollment for each of the cohorts was as follows: Cohort One ( $n = 128$ ), Cohort Two ( $n = 102$ ), Cohort Three ( $n = 108$ ), Cohort Four ( $n = 102$ ). Aggregate data from the cohorts were used to analyze the relationship between overall examination scores. Each cohort of students was given the opportunity to complete a research survey which further analyzed students' use of quizzing as a study tool, demographic data, and prior clinical experience. Response rates for the survey were as follows: Cohort One ( $n = 107$ ), Cohort Two ( $n = 19$ ), Cohort Three ( $n = 10$ ), Cohort Four ( $n = 74$ ). Three students from Cohort One were excluded due to the fact they took fundamentals of nursing in the spring of 2016, which was outside of the study timeframe, leaving the final response rate for Cohort One at 104.

Demographic statistics revealed a sample that consisted of 195 (94.2%) females and 12 males (5.8%). Three participants (1.5%) did not disclose their age, 191 (92.24%) students were between the ages of 19 and 21, 12 (5.78%) students were between the ages of 22 and 25, and 1 (0.48%) student was older than 26 years of age during his or her time in the fundamentals of nursing course. Ten (4.83%) students reported African American ethnicity, 1 (0.48%) student reported Asian/Pacific Islander ethnicity, 189 (91.3%) students reported Caucasian ethnicity, 6 (2.9%) students reported Hispanic or Latino ethnicity, and 1 (0.48%) student reported Native American/American Indian ethnicity.

Participants self-reported their GPA upon admission into the upper division nursing program. Two (0.9%) students did not report their preadmission GPA. Three (1.5%) students reported a GPA between 3.2 and 3.3, 20 (9.7%) students reported a GPA between 3.4 and 3.5, 31 (15%), students reported a GPA between 3.6 and 3.7, 82 (39.6%) students reported a GPA between 3.8 and 3.9, and 69 (33.3%) students reported a GPA of 4.0 or higher. Forty-one (19.8%) students reported having some form of clinical experience prior to entering fundamentals of nursing. Of this experience, 13 (31.7%) students reported previously taking the course, 20 (48.78%) students reported working as a patient care assistant, and 8 (19.51%) students reported “other” experience. Some of the responses to the “other” category included shadowing of a health care provider, participation in a high school clinical experience, and employment as an emergency medical technician (EMT). Of the students reporting prior clinical experience ( $n=41$ ), 21 (51.22%) students reported less than 1 year of clinical experience. Fifteen (36.58%) students reported 1-2 years of clinical experience. Four (9.76%) students reported 3-4 years of clinical experience and one (2.44%) participant reported 5 years or more of clinical experience. Demographic data for all survey participants may be found in Table 4.

<b>Table 4</b>		
<i>Demographic Characteristics of Survey Participants (n = 207)</i>		
Descriptor	N	%
<b>Gender</b>		
Male	12	5.8
Female	195	94.2
<b>Age</b>		
Did not disclose	3	1.5
19-21	191	92.24
22-25	12	5.78
26 +	1	0.48
<b>Ethnicity</b>		
African American	10	4.83
Asian/Pacific Islander	1	0.48
Caucasian	189	91.3
Hispanic/Latino	6	2.9
Native American/American Indian	1	0.48
<b>GPA</b>		
Did not disclose	2	0.9
3.2-3.3	3	1.5
3.4-3.5	20	9.7
3.6-3.7	31	15
3.8-3.9	82	39.6
4.0 +	69	33.3
<b>Prior Clinical Experience</b>		
Yes	41	19.8
No	166	90.2
<b>Years of Clinical Experience</b>		
Less than 1 year	21	51.22
1-2 years	15	36.58
3-4 years	4	9.76
5 years or more	1	2.44

## Findings

*Research Question 1: To what extent do frequent assessments in an undergraduate nursing course improve final examination scores when compared with the use of traditional unit exams alone?*

*Hypothesis:* Students who utilize frequent assessments in an undergraduate nursing course will be more likely to have higher final examination scores than students who utilize traditional unit exams alone.

To address Research Question 1, the investigator performed three comparisons of data. Data were entered into Statistical Package for the Social Sciences (SPSS) software (Version 22, IBM, 2013) and a univariate analysis of variance was performed to determine if a relationship existed between the implementation of quizzing and students' final exam scores. First, an overall comparison was made of students who did not utilize frequent quizzing (Cohorts One and Two) to students who did utilize frequent quizzing (Cohorts Three and Four). The investigator then performed a fall (Cohort One) to fall (Cohort Three) comparison and a spring (Cohort Two) to spring (Cohort Four) comparison.

**Comparison of all Students in Quizzing Cohorts vs. Non-quizzing Cohorts**

When comparing overall student data, there was a positive statistical relationship noted between the use of frequent quizzing and final exam scores. Quizzing was found to improve students' final exam scores by 2.5% (see Table 5). The data indicated a statistically significant relationship between frequent quizzing and final exam scores [ $F(1,438) = 21.03, p < .001 \eta_p^2 = .046$ ].

<b>Table 5</b>			
<i>Descriptive Statistics: Final Exam: All Students</i>			
<b>Cohorts</b>	<b>Mean</b>	<b>Standard Deviation</b>	<b>N</b>
1 & 2 (no quizzing)	82.79	5.12	230
3 & 4 (quizzing)	84.93	4.62	210

### Fall to Fall Cohort Comparison: Final Exam Scores

When comparing students by cohort, it is important to remember historically the fall cohorts typically have a stronger academic makeup than students in the spring cohorts (see Tables 2 and 6); therefore, the cohorts were further analyzed, comparing the fall cohorts to one another and the spring cohorts to one another. A univariate analysis of variance was again performed to compare final exam scores of Cohort One (fall 2016) to Cohort Three (fall 2017). While there was an increase in average final exam score of 1.16% (see Table 7), there was no statistical significance noted when comparing the quizzing to the non-quizzing group [ $F(1,234) = 2.54, p=.112 \eta_p^2 = .011$ ].

<b>Table 6</b>				
<i>Fall to Spring Cohort Comparison</i>				
	Year 1 Comparison (Non-Quizzing)		Year 2 Comparison (Quizzing)	
	Fall 2016	Spring 2017	Fall 2017	Spring 2018
Unit Exam Average	83.12	80.88	88.05	80.1
Final Exam Average	84.45	80.7	85.44	84.38

<b>Table 7</b>			
<i>Descriptive Statistics: Final Exam: Cohorts 1 &amp; 3 (Fall to Fall Comparison)</i>			
<b>Cohort</b>	<b>Mean</b>	<b>Standard Deviation</b>	<b>N</b>
1.0	84.45	4.65	128
3.0	85.44	4.88	108

### Spring to Spring Cohort Comparison: Final Exam Scores

When comparing Cohort Two (spring 2017) to Cohort Four (spring 2018), there was an increase in the average final exam score by 4.37% as well as statistically significant findings [ $F(1,202) = 32.46, p<.001 \eta_p^2 = .138$ ] (see Table 8). When comparing the overall findings to the breakdown by fall and spring cohorts, the findings potentially indicate that quizzing is more

effective in improving final exam scores for lower and middle performers, as discussed by Kika et al. (1992).

Cohort	Mean	Standard Deviation	N
2	80.7	4.92	102
4	84.38	4.28	102

When accounting for previous clinical experience, no significant differences were noted between students with prior clinical experience and those without  $F(3,203) = .469, p=.704 \eta_p^2 = .007$ . It must also be noted, these findings may have been affected by survey response rates. Figure 3 and Table 9 illustrate the findings of the final exam scores in relationship to prior clinical experience.

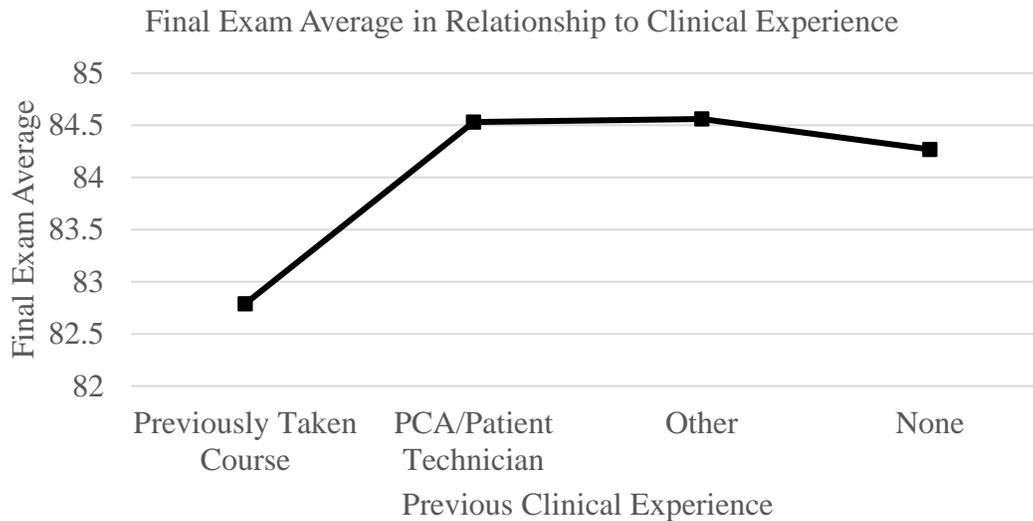


Figure 3. Final exam score in relationship to clinical experience

<b>Table 9</b>			
<i>Descriptive Statistics: Final Exam Averages by Clinical Experience</i>			
	<b>Mean</b>	<b>Std. Deviation</b>	<b>N</b>
<b>Previously Taken Course</b>	82.79	4.72	13
<b>PCA/Patient Technician</b>	84.53	4.68	20
<b>Other</b>	84.56	5.10	8
<b>None</b>	84.27	4.57	166
<b>All Survey Participants</b>	84.21	4.59	207

### Comparison of all Students' Unit Exam Averages

*Research Question 2:* What is the relationship between the frequency of assessments in an undergraduate nursing course and students' exam scores?

*Hypothesis:* Students will see an improvement in course exam scores with an increase in the frequency of assessments.

To address Research Question 2, the investigator again performed three data analyses using SPSS (version 22, IBM, 2013) software. A univariate analysis of variance was used to evaluate the relationship between unit exam averages and the implementation of frequent quizzing. The first analysis conducted compared all students within the non-quizzing groups (Cohorts One and Two) to the quizzing (Cohorts Three and Four) groups (see Table 10). When comparing all students, there was an increase in average unit exams by 2.45%, and the data revealed a positive statistical relationship between unit exam scores and frequent quizzing [ $F(1,438) = 17.89, p < .001 \eta_p^2 = .039$ ].

<b>Table 10</b>			
<i>Descriptive Statistics: Unit Exam Average: All Students</i>			
<b>Cohorts</b>	<b>Mean</b>	<b>Standard Deviation</b>	<b>N</b>
1 & 2 (no quizzing)	82.13	4.03	230
3 & 4 (quizzing)	84.19	6.08	210

### Fall to Fall Cohort Comparison: Unit Exam Average

Second, a univariate analysis of variance was used to determine the relationship between unit exam scores and frequent quizzing for the fall cohorts (Cohorts One and Three), and lastly to compare the spring cohorts (Cohorts Two and Four). There was an increase in unit exam average of 5.6% for Cohort Three in comparison to Cohort One (see Table 11). There was also a positive statistical correlation between quizzing and overall improvement on unit exams [ $F(1,234) = 96.79, p < .001 \eta_p^2 = .293$ ].

<b>Table 11</b>			
<i>Descriptive Statistics: Unit Exam Average: Fall to Fall Comparison</i>			
<b>Cohort</b>	<b>Mean</b>	<b>Standard Deviation</b>	<b>N</b>
<b>1</b>	83.12	3.72	128
<b>3</b>	88.05	3.98	108

### Spring to Spring Cohort Comparison: Unit Exam Average

When comparing Cohort Two to Cohort Four, there was no difference noted in unit exam averages (see Table 12). Thus, there was no statistical significance noted in unit exam averages for the spring cohorts with the implementation of quizzing [ $F(1,202) = 1.44, p = .231 \eta_p^2 = .007$ ].

<b>Table 12</b>			
<i>Descriptive Statistics: Unit Exam Average: Spring to Spring Comparison</i>			
<b>Cohort</b>	<b>Mean</b>	<b>Standard Deviation</b>	<b>N</b>
<b>2</b>	80.88	4.09	102
<b>4</b>	80.10	5.17	102

Results from survey data were analyzed to determine if a relationship existed between prior clinical experience and exam averages (see Table 13). Figure 4 shows the relationship

between unit exam averages and prior clinical experience. No statistical significance was found between a students' prior clinical experience and exam scores [ $F(3,203) = .492, p=.688 \eta_p^2 = .007$ ]. Had statistical significance been noted, further analysis would have been conducted to determine if experience plus quizzing accounted for the improvement in exam scores.

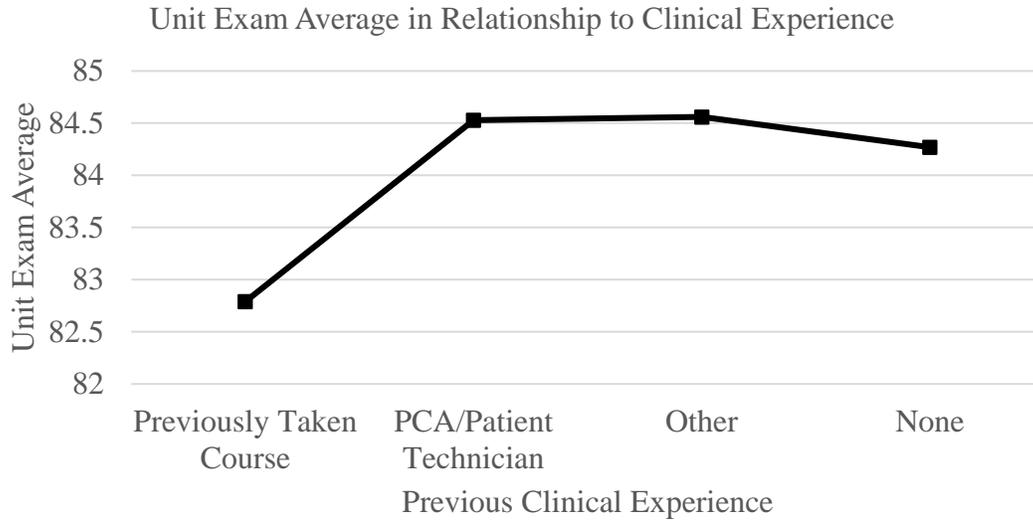


Figure 4. Unit exam average in relationship to clinical experience

<b>Table 13</b>			
<i>Descriptive Statistics: Unit Exam Average by Clinical Experience</i>			
	<b>Mean</b>	<b>Std. Deviation</b>	<b>N</b>
<b>Previously Taken Course</b>	82.10	3.55	13
<b>PCA/Patient Technician</b>	83.36	3.56	20
<b>Other</b>	83.68	5.61	8
<b>None</b>	82.55	4.06	166
<b>All Survey Participants</b>	82.64	4.03	207

*Research Question 3:* To what extent do frequent assessments improve final exam scores for students who report using non-proctored assessments as a study tool when compared to final exam scores of students who did not utilize non-proctored assessments as a study tool?

*Hypothesis:* Students who report using non-proctored assessments as a study tool will achieve higher final exam scores when compared to students who did not utilize non-proctored assessments as a study tool.

To address Research Question 3, the investigator evaluated students’ responses to the following survey question: Which of the following answer choices best describes your use of the ATI quizzes utilized in NUR 324? The students then selected one of the following answer choices:

- a) I used the quizzes as a study tool to help me better prepare for the exams
- b) I took the quizzes simply to meet the requirements of the course, and I did not use them to prepare for exams.

Using SPSS software (version 22, IBM, 2013), a univariate analysis of variance was performed to analyze data. Data were compared to analyze students’ responses to their final exam scores (see Table 14). Final exam scores were the same for both groups of students, and there were no statistically significant differences found between the way in which the students’ utilized the quizzes. Therefore, the way in which students utilized the quizzes was irrelevant to their success on the final exam [ $F(1,81) = .001, p = .982, \eta_p^2 = .000$ ].

<b>Table 14</b>			
<i>Descriptive Statistics: Quiz Usage</i>			
<b>Quiz Use</b>	<b>Mean</b>	<b>Standard Deviation</b>	<b>N</b>
<b>Yes: Used quizzes as a study tool</b>	84.58	4.90	44
<b>No: Did not use quizzes as a study tool</b>	84.60	3.72	39

*Research Question 4:* Does informing students, regarding the use of quizzing as a study tool, affect students’ academic performance, as evidenced by final exam scores?

*Hypothesis:* Students who receive instruction regarding the use of quizzes as a study tool will have improved final exam scores.

To address Research Question 4, the investigator analyzed final exam scores from Cohorts Three and Four. Cohort Three received no instruction regarding the benefits of using quizzing as a study tool, while Cohort Four received instruction on the benefits of quizzing (Appendix C). The data were evaluated to see if a relationship existed between final examination scores and instruction on the benefits of quizzing as a study tool. Data were entered into SPSS (version 22, IBM, 2013) and were analyzed using a univariate analysis of variance. Table 15 reveals Cohort Three scored approximately 1% higher on their final exam than Cohort Four, and statistical analysis revealed no correlation between the use of an instructional tool and the benefits of frequent quizzing [ $F(1,208) = 2.82, p = .095, \eta_p^2 = .013$ ]. While no statistical significance was noted, it is important to note there was a 4.4% difference between Cohorts One and Two's final exam scores and only a 1.2% difference between Cohorts Three and Four's final exam scores. This difference indicated the intervention did assist with improving the overall mean score.

<b>Table 15</b>			
<i>Descriptive Statistics: Instruction on Quizzing as a Study Tool</i>			
<b>Cohort</b>	<b>Mean</b>	<b>Standard Deviation</b>	<b>N</b>
<b>3 (no instruction)</b>	85.44	4.88	108
<b>4 (instruction)</b>	84.38	4.28	102

### **Summary**

In this chapter, the investigator discussed four research questions which explored relationships that existed between the implementation of frequent quizzing and unit and final examination scores. The first research question addressed the relationship that existed between frequent quizzing and final exam scores. Positive statistical relationships were noted between

implementation of quizzing and unit and students' final examination scores. The second research question investigated the relationship between implementation of frequent quizzing and students' unit exam scores. For this question, a positive relationship was noted for overall student exam scores and for students in the fall cohort, but not in the spring cohort. Further analysis would need to be conducted to determine the rationale for these findings. The third research question investigated final exam scores and students' self-reported use of quizzes. Final exam scores were compared between students who reported using quizzes as a study tool to students' who reported not using quizzes as a study tool. There were no statistically significant relationships noted between student examination scores and their use of quizzing as a study tool. The final research question investigated whether or not providing instruction to students regarding the benefits of quizzing as a study tool would improve their final exam scores. There was no statistical relationship noted between implementation of faculty instruction on the benefits of quizzing as a study tool and final exam scores. Discussion of these findings, implications, limitations, and recommendations for future studies will be discussed in Chapter V.

## CHAPTER V

### DISCUSSION, IMPLICATIONS, LIMITATIONS, AND RECOMMENDATIONS

The purpose of this study was to examine the relationship between the frequency of testing within a baccalaureate undergraduate nursing course and students' examination scores. This study further compared the relationship between examination scores of students who reported using quizzing as a study tool and students who reported not using quizzing as a study tool. Finally, this study compared examination scores of students who received no instruction regarding the benefits of using quizzing as a study tool to students who did receive information regarding the benefits of a quizzing as a study tool. In this chapter, significant findings, implications, limitations, and recommendations for future study will be discussed.

#### **Major Findings**

The information processing theory provided the theoretical framework for this quasi-experimental study. This theory consists of three phases: sensory memory, working memory, and long-term memory. This theory is applicable to frequent testing, as it involves multiple cognitive processes that focus on the way in which information moves through one's mind and is ultimately stored. Frequent testing follows the principles of the information processing theory demonstrating rehearsal of information assists individuals in transfer of knowledge from working to long-term memory (Brown, 2015). Active rehearsal, such as quizzing, improves the likelihood of being able to later retrieve information when compared to retrieval following passive reading. Testing stimulates a deeper level of learning when compared to other study

techniques. It does so by improving memory encoding, allowing learners to apply cues to material, making it more easily retrievable (Brown, 2015; Mayer, 2012; Tybout et al., 1981).

Initially, information enters into the sensory memory through various stimuli. In this study, students were presented course content with both auditory and visual stimuli, through online and in-class lectures, allowing initial contact with information. At times, faculty also used kinesthetic and tactile stimuli to assist students in attaching meaning to the course content.

While sensory memory has a large capacity, information is only able to stay there for a short time. The next step in the IPT is to move the information to working memory. Working memory is where individuals can apply meaning to the concept(s). During individual studying, students are able to organize material and assign prompts for later recall; however, individual study habits vary from student to student and do not elicit the same level of understanding as testing (Agarwal, Karpicke, Kang, Roediger, & McDermott, 2008). Quizzes were implemented to encourage this next line of rehearsal. During quizzes, students were able to retrieve previously learned information, which then strengthened encoding of the material, thus allowed transfer to long-term memory. Once in long-term memory, it could later be retrieved for unit and comprehensive exams. Unit exam averages and comprehensive exam scores were analyzed to determine if implementation of the IPT did encourage transfer of information from short-term to long-term memory, as evidenced by improved examination scores (Brown, 2015; Mayer, 2012).

The findings from this study reflected similar results such as studies by Agarwal et al. (2011), Bangert-Drowns et al. (1991), Kika et al. (1992), McDermott et al. (2014), and Rezaei (2015). All five of the aforementioned studies showed improved outcomes with the implementation of frequent testing, as evidenced by student exam scores. The findings from the current study will be further discussed, in relationship to each research question.

*Research Question 1:* To what extent do frequent assessments in an undergraduate nursing course improve final examination scores when compared with the use of traditional unit exams alone?

*Hypothesis:* Students who utilize frequent assessments in an undergraduate nursing course will be more likely to have higher final examination scores than students who utilize traditional unit exams alone.

The hypothesis for Research Question One was supported. Using a univariate analysis of variance, the statistical analysis of data revealed a significant difference between the final exam scores of the non-quizzing cohorts (Cohorts One and Two) and the quizzing cohorts (Cohorts Three and Four). It should be noted that while there was statistical significance noted for the overall comparison, when the cohorts were further analyzed, there was an overall improvement in the final exam averages for both the fall and the spring cohorts; however, there was no statistically significant difference when comparing the fall non-quizzing group to the fall quizzing group. There was statistical significance noted when comparing the spring non-quizzing group to the spring quizzing group. Due to the academic variances between fall and spring cohorts these findings mimic the findings of Kika et al. (1992), which indicate quizzing is potentially more beneficial to lower and middle achievers. Further research would be warranted to investigate the differences between the cohorts to determine the rationale for the statistical variations between the groups.

*Research Question 2:* What is the relationship between the frequency of assessments in an undergraduate nursing course and students' exam scores?

*Hypothesis:* Students will see an improvement in course exam scores with an increase in the frequency of assessments.

The hypothesis for Research Question Two was supported. When comparing the overall scores of the quizzing and non-quizzing groups, there was a statistical difference noted in the unit exam averages. There was also a statistically significant difference when comparing the fall non-quizzing (Cohort One) group to the fall quizzing (Cohort Three). When comparing the spring non-quizzing (Cohort Two) group to the spring quizzing (Cohort Four) group, there was no statistically significant difference in average exam scores, and the average exam scores were almost identical. It is interesting to note that quizzing improved final exam scores but not unit exam scores for the spring cohort. It is probable this is related to the findings of Storm et al. (2010) which stated each time a learner retrieves information, it makes it easier to retrieve later. As students practice retrieval through quizzing and unit exams, the information is then encoded and is more easily applied on the comprehensive exam (Brown, 2015; Mayer, 2012; Tybout et al., 1981). Further research is indicated to determine the rationale for the variations in statistical findings between these groups.

*Research Question 3:* To what extent do frequent assessments improve final exam scores for students who report using non-proctored assessments as a study tool when compared to final exam scores of students who did not utilize non-proctored assessments as a study tool?

*Hypothesis:* Students who report using non-proctored assessments as a study tool will achieve higher final exam scores when compared to students who did not utilize non-proctored assessments as a study tool.

The hypothesis for Research Question Three was not supported. The findings indicated identical final exam means for both groups. This finding indicated that the manner in which students utilize quizzes does not affect their performance on the comprehensive exam. It is plausible to say that being engaged with the course material on quizzes improved course exam

scores; however, additional research is warranted to confirm this finding. Due to the smaller response rate of the survey, a larger sample size may reflect different findings.

*Research Question 4:* Does informing students regarding the use of quizzing as a study tool affect students' academic performance, as evidenced by final exam scores?

*Hypothesis:* Students who receive instruction regarding the use of quizzes as a study tool will have improved final exam scores.

Exam scores of the two cohorts who utilized quizzing (Cohorts Three and Four) were compared to answer Research Question Four. Cohort Four received information regarding the benefits of frequent testing and the use of quizzes as a study tool. Final exam scores for Cohort Three were slightly higher than the scores for Cohort Four. After performing a univariate ANOVA, no statistical significance was noted; therefore, the hypothesis for Question Four was not supported. While not statistically significant, this intervention did minimize the gap between the fall and spring cohorts' final exam scores by 3.2%. This further acknowledges that neither the manner in which students utilize quizzes, nor their knowledge of the benefits of quizzing affects exam performance. Simply being engaged with course material more frequently, through the use of quizzes, is beneficial to students' exam scores. This aligned with Brown's (2015) findings that active rehearsal of information, through the use of retrieval in testing, assists in transfer of knowledge, making it more easily retrievable during proctored assessments.

### **Implications**

This study has several implications for baccalaureate nursing education. The findings provide evidence that quizzing is a useful tool for baccalaureate nursing students, helping to improve students' examination scores. Improvement in students' grades are noted regardless of

whether or not students are educated regarding the benefits of using quizzing as a study tool, or if students use the quizzes and subsequent feedback to help guide their studies.

Nurse educators may utilize these findings to modify teaching strategies to include more assessments throughout their courses. Educators may implement in-class or online quizzes following each lecture topic which will assist students in transfer of information from working memory to long-term memory (Brown, 2015). Faculty may then incorporate feedback from student performance on quizzes to determine topics in which students struggled. This allows faculty the opportunity to review these topics further prior to the unit or comprehensive exams to improve student comprehension of the material. The more often feedback is provided, the more opportunities students have to correct misinformation, and thus decrease the likelihood of information being stored incorrectly in long-term memory (Rezaei, 2015; Roediger & Karpicke, 2006b; Shute & Rahimi, 2016).

Many times, students report not knowing how to effectively study, therefore, they continue to utilize inefficient study techniques. As faculty, it is important to not only teach students course-related content, but faculty must teach them how to become lifelong learners. Teaching students to use testing as a study tool will generate deeper mental processing, thus allowing students to easily retrieve information when needed. It is essential faculty take into consideration implementation of a course or, at a minimum, a lesson specifically related to effective study techniques (Brown et al., 2014; Foster, 2012; Mayer, 2012; Rezaei, 2015).

In addition to the incorporation of quizzing into the classroom, faculty must ensure policies are written within undergraduate programs to reflect the importance of frequent assessments. Based on the findings in this study, administration should not only encourage, but also require the use of quizzing in the classroom. Valuing testing as a study tool, and not merely

a form of assessment, not only sets students up for greater success, but it teaches them more efficient study techniques (Tullis et al., 2013).

There are several companies that focus on preparing nursing students for high stakes testing, such as the NCLEX-RN. While some of these companies, such as ATI, do offer content-specific assessments, the value of these assessments may not be appreciated by administrators; therefore, not encouraged or required to be utilized by faculty. Findings from the study may encourage NCLEX-RN preparation companies to further investigate the use of frequent testing and offer more comprehensive packages for nursing programs. Instead of only offering a preparation course immediately prior to students taking NCLEX-RN, administrators may choose to implement a more comprehensive program, which could assist with memory encoding and long-term retention of knowledge.

Whether or not nursing faculty implement these testing strategies, nursing students may choose to implement them on their own. Rather than reading or rereading material a student already comprehends, students may utilize optional testing material to quiz themselves and focus studies on material in which he or she is not proficient. Students must be taught the ways in which they study can greatly affect their ability to recall information on exams (Tullis et al., 2013). Students who are able to appropriately apply information during an open-book quiz, such as a non-proctored assessment, are more likely to be able to recall and apply information during a proctored assessment (Heijne-Penninga, Kuks, Hofman & Cohen-Schotanus, 2010). More frequent testing should encourage students to be more frequently engaged with course materials, experience less test anxiety, and ultimately improve success on standardized tests (Roediger, Agarwal, McDaniel, & McDermott, 2011; Roediger & Karpicke, 2006b).

## **Limitations**

It is important to note limitations to this study, which may affect the generalizability of the results. First, the population was a convenience sample, with a very homogenous demographic make-up, and the study was conducted at a single university in the southeastern United States. The use of a more diverse demographic population, at multiple universities, in a different geographic location, may yield different results. This study only utilized one course within a baccalaureate nursing program; therefore, the addition of multiple courses would also strengthen the findings of the study.

The make-up of every cohort of students varies in academic ability, demographics, clinical learning experiences, and individual personalities, which may affect the findings (Beers & Bowden, 2005). The size and characteristic make-up of each cohort may lead faculty to utilize different teaching strategies from semester to semester. While each of the same content areas were covered and tested for each of the four cohorts of students, faculty changes from semester to semester may have resulted in variations in instructional techniques and exam questions. In the non-quizzing academic year (fall 2016 and spring 2017), there were six faculty members teaching the didactic component of the course. In the quizzing year (fall 2017 and spring 2018), the number of faculty was reduced to four faculty teaching the didactic portion. Three of these four faculty members taught all four cohorts. During the 2017-2018 academic year, one new faculty member, who had not previously taught fundamentals of nursing, was added to the course. Each faculty member varied in clinical experience, teaching experience, and educational background; therefore, unique teaching strategies may affect retention of knowledge and, thus, results. The findings of future studies would be enhanced if the same faculty member taught the same content to each cohort, utilizing the same instructional techniques for all classes.

Survey response rates were poor for Cohorts Two and Three. This was likely because the surveys were distributed at the end of the semester, when Cohorts Two and Three had completed all mandatory class sessions. The PI was only able to present the research opportunity to these cohorts during an optional class, in which not all students from the cohort were present. The research opportunity was presented to Cohort One and Cohort Four during a mandatory class session; therefore, all students were present, resulting in higher response rates.

Lastly, the research was conducted at the university where the investigator is currently employed, and the investigator was a primary instructor in the course utilized for the study. This may have created unconscious bias by the PI during interactions and conversations with students. Each of these findings could have affected the study in one way or another; therefore, variations from this may produce different results.

### **Recommendations**

After consideration of the findings, implications and limitations of the study, the investigator has identified the following areas for future research studies. First, it would be important to replicate the study, utilizing multiple sites, in varying geographical locations and at institutions where the investigator is not a faculty member. It would also be beneficial to ensure the same faculty members taught each content area to all cohorts, utilizing the same teaching strategies and exam questions. The current study comprised a very homogenous demographic sample; therefore, the use of a more diverse demographic group would allow findings that are more generalizable. Implementation of quizzing in multiple courses, other than fundamentals of nursing, could also improve the generalizability of the study. The current study could also be expanded to follow the same four cohorts of students to completion of NCLEX. The cohorts

could then be evaluated in relationship to long-term retention of knowledge with the use of quizzing in a baccalaureate nursing program.

### **Conclusion**

Nursing students are expected to acquire, comprehend, and retain a considerable amount of new information in a relatively short period of time. This leaves nursing faculty continually seeking ways in which they can improve knowledge retention within nursing courses. Students and faculty alike realize improved knowledge retention and application will eventually translate to student success on NCLEX-RN; ultimately resulting in improved patient care.

Findings in this study showed a positive correlation between the use of frequent quizzing in conjunction with summative examinations in improving students' overall examination scores. Quizzing encourages students to be engaged with course material throughout the course rather than "cramming" immediately before an exam. This allows students to receive more frequent feedback on their performance, permitting them the opportunity to adjust study techniques to focus on areas of weakness rather than areas they already comprehend (Roediger et al., 2001; Roediger & Karpicke, 2006b). Quizzing also strengthens critical thinking skills and offers students the opportunity to correct faulty reasoning which cannot be accomplished by simply reading or rereading course material (Offredy & Meerabeau, 2005; Rezaei, 2015).

This study explored the effects the implementation of quizzing had on exam grades in a baccalaureate level fundamentals of nursing course. Significance was found among groups, but findings were not consistent for all groups in relationship to unit and final exam scores. The primary results of this study revealed quizzing was a beneficial tool for baccalaureate nursing students; however, once broken down further by semester, the findings were inconsistent. There was no statistical significance noted in regard to educational instruction given to students on the

use of quizzing as a study tool, nor was there any statistical significance noted based on how students reported using the quizzes. Further research is warranted to investigate the inconsistent results.

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APPENDIX A

SCRIPT: BENEFITS OF QUIZZING AS A STUDY TOOL

During this semester, you will be taking several quizzes as a part of your required coursework. These quizzes are intended to enhance your knowledge and retention of course material. Research has shown testing to be a beneficial study tool. You are encouraged to utilize the feedback from the quizzes as a guide to help you with your future studies. You are allowed to take the quizzes as many times as desired prior to the due date; therefore, you are encouraged to first take the quizzes without utilizing any resources. This will allow you to identify concepts in which you are already proficient, as well as, identify concepts with which you need to improve.

APPENDIX B  
IRB APPROVAL

April 20, 2018

Andrea Sartain, MSN  
Instructor  
Capstone College of Nursing  
The University of Alabama  
Box 870358

Re: IRB # EX-18-CM-047 "The Frequency of Testing and its Effects on Exam Scores in a Fundamental Level Baccalaureate Nursing Course"

Dear Ms. Sartain:

The University of Alabama Institutional Review Board has granted approval for your proposed research. Your protocol has been given exempt approval according to 45 CFR part 46.101(b)(1) as outlined below:

*(1) Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.*

Your application will expire on April 19, 2019. If your research will continue beyond this date, complete the relevant portions of Continuing Review and Closure Form. If you wish to modify the application, complete the Modification of an Approved Protocol Form. When the study closes, complete the appropriate portions of FORM: Continuing Review and Closure.

Please use reproductions of the IRB approved stamped consent/assent forms to obtain consent from your participants.

Should you need to submit any further correspondence regarding this proposal, please include the assigned IRB application number.

Good luck with your research.

Sincerely,

Director & Research Compliance Officer  
Office for Research Compliance

358 Rose Administration Building | Box 870127 | Tuscaloosa, AL 35487-0127  
205-348-8461 | Fax 205-348-7189 | Toll Free 1-877-820-3066

APPENDIX C

RECRUITMENT SCRIPT FOR PRIMARY INVESTIGATOR

Hello, my name is Andrea Sartain. You may know me as a member of the faculty here at the Capstone College of Nursing and the course leader for NUR 324: Fundamentals of Nursing; but I am also a graduate student here at The University of Alabama. I am working on my doctoral degree in the area of Instructional Leadership in Nursing Education. I have asked your professor's permission to speak to you today, so that I may make you aware of my dissertation study and invite you to participate in the study. At this time, I will give each of you a copy of the informed consent form and survey. Please read the form as I read it aloud to you. After reading the informed consent, if you decide to participate in the study, you may complete the survey. Do not hesitate to ask any questions you may have.

**THE UNIVERSITY OF ALABAMA  
HUMAN RESEARCH PROTECTION PROGRAM**

**Informed Consent for a Non-Medical Study**

**Study title:**

The Frequency of Testing and its Effects on Exam Scores in a Fundamental Level Baccalaureate Nursing Course

**Investigator's Name, Position, Faculty or Student Status:** Andrea Sartain, Graduate Student

You are being asked to take part in a research study. This study is called The Frequency of Testing and its Effects on Exam Scores in a Fundamental Level Baccalaureate Nursing Course. The study is being done by Andrea Sartain, who is a graduate student at the University of Alabama. Ms. Sartain is being supervised by Professor Vivian Wright who is a professor of Education at the University of Alabama.

**What is this study about? What is the investigator trying to learn?**

This study is being done to find out if the use of frequent quizzes in an undergraduate nursing course helps to improve exam scores of nursing students.

**Why is this study important or useful?**

This knowledge is useful because it is important for nursing students to be able to recall pertinent information when needed. The results of this study will help nursing faculty understand better ways to help nursing students learn.

**Why have I been asked to be in this study?**

You have been asked to be in this study because you are enrolled or have recently been enrolled in NUR 324: Fundamentals of Nursing Practice.

**How many people will be in this study?**

Approximately 400 other people will be in this study.

**What will I be asked to do in this study?**

If you meet the criteria and agree to be in this study, you will be asked to do these things:

- allow the researcher access to your exam scores from NUR 324: Fundamentals of Nursing

- complete a short survey regarding your clinical experience and possibly your study habits

**How much time will I spend being this study?**

The survey should take no longer than 5 minutes of your time.

**Will being in this study cost me anything?**

The only cost to you from this study is your time.

**Will I be compensated for being in this study?**

You will not be compensated for being in this study.

**Can the investigator take me out of this study?**

The investigator may take you out of the study if you are no longer enrolled in NUR 324: Fundamentals of Nursing.

**What are the risks (dangers or harms) to me if I am in this study?**

There is little or no risk foreseen.

**What are the benefits (good things) that may happen if I am in this study?**

Although you will not benefit personally from being in the study, you may feel good about knowing that you have helped nursing faculty identify ways to benefit future nursing students.

**What are the benefits to science or society?**

This study will help identify instructional techniques for nursing faculty to utilize to be more helpful to nursing students.

**How will my privacy be protected?**

You will not be required to answer any questions which make you feel uncomfortable.

**How will my confidentiality be protected?**

Your confidentiality will be protected by keeping signed consents separate from datasheets, using randomly assigned identification numbers for records, keeping all data in locked drawers, encrypting data bases, restricting the number of people who have access to the data, and destroying raw data or identifiers after data have been entered.

**What are the alternatives to being in this study? Do I have other choices?**

The alternative to being in this study is not to participate.

**What are my rights as a participant in this study?**

Taking part in this study is voluntary. It is your free choice. You can refuse to be in it at all. If you start the study, you can stop at any time. There will be no effect on your relations with the University of Alabama.



APPENDIX D

RECRUITMENT SCRIPT FOR FACULTY COLLEAGUE

Hello, my name is [faculty colleague]. I am speaking to you on behalf of Andrea Sartain, who you know as a faculty member here at the Capstone College of Nursing and the course leader for NUR 324: Fundamentals of Nursing. She is also a graduate student here at The University of Alabama. She is working on her doctoral degree in the area of Instructional Leadership in Nursing Education. She would like to make you aware of her dissertation study and invite you to participate in the research study. At this time, I will give each of you a copy of the informed consent form and the research survey. Please read the form as I read it aloud to you. After reading the informed consent, if you agree to participate in the study, you may complete the survey. The surveys and consents will remain in a sealed envelope until after grades have been finalized for this semester. Please do not hesitate to ask any questions you may have.

**THE UNIVERSITY OF ALABAMA  
HUMAN RESEARCH PROTECTION PROGRAM**

**Informed Consent for a Non-Medical Study**

**Study title:**

The Frequency of Testing and its Effects on Exam Scores in a Fundamental Level Baccalaureate Nursing Course

**Investigator's Name, Position, Faculty or Student Status:** Andrea Sartain, Graduate Student

You are being asked to take part in a research study. This study is called The Frequency of Testing and its Effects on Exam Scores in a Fundamental Level Baccalaureate Nursing Course. The study is being done by Andrea Sartain, who is a graduate student at the University of Alabama. Ms. Sartain is being supervised by Professor Vivian Wright who is a professor of Education at the University of Alabama.

**What is this study about? What is the investigator trying to learn?**

This study is being done to find out if the use of frequent quizzes in an undergraduate nursing course helps to improve exam scores of nursing students.

**Why is this study important or useful?**

This knowledge is useful because it is important for nursing students to be able to recall pertinent information when needed. The results of this study will help nursing faculty understand better ways to help nursing students learn.

**Why have I been asked to be in this study?**

You have been asked to be in this study because you are enrolled or have recently been enrolled in NUR 324: Fundamentals of Nursing Practice.

**How many people will be in this study?**

Approximately 400 other people will be in this study.

**What will I be asked to do in this study?**

If you meet the criteria and agree to be in this study, you will be asked to do these things:

- allow the researcher access to your grade point average (GPA), and exam scores from NUR 324: Fundamentals of Nursing
- complete a short survey regarding your clinical experience and possibly your study habits

**How much time will I spend being this study?**

The survey should take no longer than 5 minutes of your time.

**Will being in this study cost me anything?**

The only cost to you from this study is your time.

**Will I be compensated for being in this study?**

You will not be compensated for being in this study.

**Can the investigator take me out of this study?**

The investigator may take you out of the study if you are no longer enrolled in NUR 324: Fundamentals of Nursing.

**What are the risks (dangers or harms) to me if I am in this study?**

There is little or no risk foreseen.

**What are the benefits (good things) that may happen if I am in this study?**

Although you will not benefit personally from being in the study, you may feel good about knowing that you have helped nursing faculty identify ways to benefit future nursing students.

**What are the benefits to science or society?**

This study will help identify instructional techniques for nursing faculty to utilize to be more helpful to nursing students.

**How will my privacy be protected?**

You will not be required to answer any questions which make you feel uncomfortable.

**How will my confidentiality be protected?**

Your confidentiality will be protected by keeping signed consents separate from datasheets, using randomly assigned identification numbers for records, keeping all data in locked drawers, encrypting data bases, restricting the number of people who have access to the data, and destroying raw data or identifiers after data have been entered.

**What are the alternatives to being in this study? Do I have other choices?**

The alternative to being in this study is not to participate.

**What are my rights as a participant in this study?**



APPENDIX E

RESEARCH SURVEY FOR COHORTS 1 AND 2 (UNIT EXAMS ONLY)

1. What is your campus wide identification number (CWID)? \_\_\_\_\_  
*(This information will be used to link your survey to your exam scores, and then the information will be deidentified. The information you provide will be confidential)*
2. What was your age when you began NUR 324: Fundamentals of Nursing? \_\_\_\_\_
3. What is your gender? *(please circle one)*
  - a. Male
  - b. Female
  - c. Prefer not to answer
4. What is your race? **(select all that apply)**
  - a. African American
  - b. Asian/Pacific Islander
  - c. Hispanic or Latino
  - d. Native American or American Indian
  - e. White
5. What was your grade point average (GPA) upon admission to upper division? \_\_\_\_\_
6. In what year/semester did you most recently take NUR 324? *(please circle one)*
  - a. Fall 2016
  - b. Spring 2017
  - c. Fall 2017
  - d. Spring 2018
7. Prior to entering NUR 324, Fundamentals of Nursing, did you have any clinical experience? *(please circle one)*

*(Examples: previously taken the course, worked as a patient care assistant etc.)*

- a. Yes
  - b. No [**if you selected no, then you are finished with the survey**]
8. What previous clinical experience(s) have you had? (**select all that apply**)
- a. previously taken NUR 324
  - b. Worked as a patient care assistant/tech
  - c. other \_\_\_\_\_
9. How many years of clinical experience did you have prior to taking NUR 324:  
Fundamentals of Nursing?
- a. less than 1 year
  - b. 1-2 years
  - c. 3-4 years
  - d. 5 years or more

*Thank you for your time!*

APPENDIX F

RESEARCH SURVEY FOR COHORTS 3 AND 4 (UNIT EXAMS PLUS QUIZZING)

1. What is your campus wide identification number (CWID)? \_\_\_\_\_  
*(This information will be used to link your survey to your exam scores, and then the information will be deidentified. The information you provide will be confidential)*
2. What was your age when you began NUR 324: Fundamentals of Nursing? \_\_\_\_\_
3. What is your gender? *(please circle one)*
  - a. Male
  - b. Female
  - c. Prefer not to answer
4. What is your race? *(select all that apply)*
  - a. African American
  - b. Asian/Pacific Islander
  - c. Hispanic or Latino
  - d. Native American or American Indian
  - e. White
5. What was your grade point average (GPA) upon admission to upper division? \_\_\_\_\_
6. In what year/semester did you most recently take NUR 324? *(please circle one)*
  - a. Fall 2016
  - b. Spring 2017
  - c. Fall 2017
  - d. Spring 2018
7. Prior to entering NUR 324, Fundamentals of Nursing, did you have any clinical experience? *(please circle one)*

*(Examples: previously taken the course, worked as a patient care assistant etc.)*

- a. Yes
  - b. No [**if you selected no, please skip to question #10**]
8. What previous clinical experience(s) have you had? *(select all that apply)*
- a. previously taken NUR 324
  - b. Worked as a patient care assistant/tech
  - c. other \_\_\_\_\_
9. How many years of clinical experience did you have prior to taking NUR 324:  
Fundamentals of Nursing?
- a. less than 1 year
  - b. 1-2 years
  - c. 3-4 years
  - d. 5 years or more
10. Circle the answer choice which best describes your use of the ATI quizzes utilized in  
NUR 324?
- a. I took the quizzes to meet the requirements of the course, but I did not use them as a study tool to prepare for exams
  - b. I used the quizzes as a study tool to help me better prepare for the exams

*Thank you for your time!*