Evaluation of a Math and Medication administration Proficiency Program in a Pre-Licensure Nursing Program

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ABSTRACT

EVALUATION OF A MATH AND MEDICATION ADMINISTRATION PROFICIENCY PROGRAM IN A PRE-LICENSURE NURSING PROGRAM

Dianne Hoekstra, EdD
Department of Counseling and Higher Education
Northern Illinois University, 2023
Dr. Gudrun Nyunt, Director

Calculation of the correct dosages is a key factor for safe patient medication administration. For decades nurse educators have aimed to improve the knowledge and skills of the pre-licensure nursing students for medication administration. In a midwestern prelicensure nursing school, a program was implemented using a curriculum wide approach for the teaching, remediation, and assessment of the math skills required for safe medication administration; known as the Math and Medication Administration Proficiency (MMAP) program.

This dissertation evaluates the MMAP program using a logic model and mixed methods approach. Results indicated improvement in the pre-licensure nursing students’ success with the testing of calculations required for safe medication administration; and improved scores on national benchmarked testing completed by senior students. Subsequently, a survey was completed by the pre-licensure nursing faculty who teach in the clinical setting and/or the simulation lab. Survey responses indicated missed opportunities to reinforce the skills for safe medication dosage calculations at the bedside. Faculty survey also reported a lack of confidence in their abilities to teach students about safe medication dosage calculations. Findings of this program evaluation can guide undergraduate nursing faculty in the development of a curriculum wide program to improve mathematical calculations for safe medication dosages.
EVALUATION OF A MATH AND MEDICATION ADMINISTRATION PROFICIENCY PROGRAM IN A PRE-LICENSURE NURSING PROGRAM

BY

DIANNE HOEKSTRA
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A DISSERTATION SUBMITTED TO THE GRADUATE SCHOOL IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE DOCTOR OF EDUCATION

DEPARTMENT OF COUNSELING AND HIGHER EDUCATION

Doctoral Director:
Gudrun Nyunt
ACKNOWLEDGEMENTS

I have successfully completed my doctoral studies and my dissertation only because of the power of the holy trinity; my God the father, Jesus my savior, and the Holy Spirit my sustainer. I am also blessed with a wonderful family. The love and support of my amazing husband Darrin carried me. Our three sons, Caleb, Ethan, and Jesse encouraged me. Hopefully, I have passed down my love of learning to each of you! Thank you, Mom, for the example you set when you pursued and achieved your educational goals as an older adult. The prayers of my family and friends are priceless. Even though I may not have mentioned you by name, I am forever grateful for you and your prayers. Finally, I give a huge thank you to Dr. Gudrun Nyunt, my chair and coach.
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PREFACE

INTRODUCTION TO THE DISSERTATION OF PRACTICE

The dissertation of practice is a scholarly endeavor that explores a complex problem of practice embedded in the work of a professional practitioner (Perry, 2015). The purpose of the dissertation of practice is to prepare students to become scholar practitioners, who use practical research and applied theories to improve their practice while contributing to the knowledge base in the field of higher education and student affairs.

The dissertation of practice consists of three artifacts: (a) The dissertation of practice research proposal (Chapter 1): The purpose of this chapter is to showcase the proposal that guided the research. The purpose of my dissertation was to appraise the Math and Medication Administration Proficiency (MMAP) program implemented at a college of nursing in the mid-western United States. By definition, a program evaluation includes a judgement of the value of the program. One way to consider value is determine if the program is meeting its self-established goals (Mertens & Wilson, 2019). At the beginning of this program evaluation, the MMAP program did not have formalized goals. This led to a two phased approach to the evaluation of the MMAP program completed for my dissertation. The first phase involved development of MMAP program goals with the key faculty stakeholders with prioritization for goal evaluation. This goal development and prioritization process with the key faculty
stakeholders led to an evaluation different from the one I originally proposed. (b) A manuscript for a scholarly publication (Chapter 2): After conducting my dissertation research, I developed a manuscript that could be published in a scholarly journal in my field. Important to note is that during the first phase of the program evaluation, key stakeholders defined goals for the program and identified which goals had been achieved. This first phase altered the approach taken during the second phase of the program and the data that was collected during that second phase. The manuscript presents this new approach and the results of the completed program evaluation. I reflect on the differences between the proposed evaluation of the MMAP program from the program evaluation completed in the manuscript for scholarly publication in the third artifact, the scholarly reflection. (c) A scholarly reflection (Chapter 3): In the final chapter, I reflect on the dissertation process and discuss applications of the research and newly gained skills to my professional practice and future engagement in research. Specifically, I highlight the benefits of the MMAP program to the institution. I also provide recommendations for future improvements and subsequent evaluation of the MMAP program at this institution.
CHAPTER 1

DISSERTATION PROPOSAL

Introduction and Statement of the Problem

Acute care nurses spend about 40% of their time passing medications (Asensi-Vicente et al., 2018). A lack of nurse competency in calculating medication dosages may lead to medication errors and possible patient harm (Owegi et al., 2021). More than twenty years ago, the report To Err is Human (Kohn et al., 2000) was published by the Institute of Medicine, now known as The National Academy of Medicine (NAM). In this report, NAM estimated that within the United States 98,000 deaths annually could be attributed to a lack of quality care. The report not only identified how preventable health care errors undermine safety, but also prompted health care reform. A few years later, the NAM Health Professions Education Report (Greiner & Knebel, 2003) concluded that nursing education is essential to patient safety and that reform of nursing education would improve safety outcomes.

To ensure the competency of newly graduated nurses within the United States, a certification exam has been developed and is maintained by the National Council of State Boards of Nursing (NCSBN). Only after successfully passing this National Council Licensure Examination for Registered Nurses (NCLEX-RN®) exam can the newly graduated nurse claim the Registered Nurse (RN) designation. On this exam, nurse graduates must be able to
demonstrate their ability to perform the calculations needed for medication administration (particularly intravenous and parenteral therapy) and be able to apply mathematics for evaluation and treatment of client nutrition issues (Hughes et al., 2019). Therefore, the instruction and assessment of the mathematics required for calculation of safe medication administration is part of pre-licensure nursing education.

The State Boards of Nursing and other national accrediting bodies also approve and evaluate pre-licensure nursing education programs (Spurlock, 2013; Dreher et al., 2019). One measure is to follow trends in the pre-licensure nurse graduates’ ability to pass the NCLEX-RN® upon their first attempt. To meet this requirement, many pre-licensure nursing programs have implemented the use of standardized and high-stakes testing (Dreher et al., 2019; Eastridge, 2019; Spurlock, 2013). Additionally, most nursing programs implement a test of mathematic skills needed for safe medication administration.

Benchmarking with other pre-licensure nursing programs within the Midwest United States, Kratovil et al. (2021) revealed a great variety of practices and processes for testing math for safe medication administration. At the most extreme, some nursing programs dismissed students for unsuccessful math competency testing (Kratovil et al., 2021). Findings by Kratovil et al. (2021) also revealed inconsistencies in the quality of the math questions included in the high-stakes tests and variation in the protocols regarding the administration of the math testing. A lack of students’ retention of math skills was an additional problem apparent within the surveyed pre-licensure nursing programs (Kratovil et al., 2021).

Several years ago, a team of nursing faculty members in a pre-licensure, baccalaureate nursing program at a university in the midwestern United States developed, proposed, piloted, implemented, and refined a Math and Medication Administration Proficiency (MMAP) program
for pre-licensure nursing students. To date the formal development of goals for the MMAP program at this institution has not occurred. Suggested goals for the MMAP program are to:

1. Improve the math skills to promote safe medication administration for pre-licensure nursing students.
2. Ensure consistency in teaching and assessment of math for safe medication administration.
3. Maintain the pre-licensure nursing students’ math skills for safe medication administration throughout their pre-licensure nursing program; and
4. Increase the student’s confidence in their math skills for safe medication administration.

Currently, there has been no formal evaluation of the MMAP program. The need for potential MMAP program revisions, the time required by the MMAP faculty team, and the consequences for the students should be formally evaluated. For example, any changes and edits to the MMAP program to date have been instinctive and/or responsive to student or faculty concerns. Additionally, the MMAP team spends hours implementing the MMAP program at the beginning of each semester, resulting in time being diverted from their course assignments. A third example involves the policies approved by the nursing faculty which have significant implications for student progression. In addition to delineating the administration of the testing, the MMAP policies identify the consequences of a student not being successful. Inability to pass the MMAP testing within three attempts result in the student being ineligible to complete clinical activities at the local hospitals. This compels the student to withdraw from any nursing course(s) with clinical requirements for that semester. Withdrawal from one of more courses will decrease the number of credit hours in which the student is enrolled. A lower course load may drop a student below full-time status which may have consequences for their financial aid and
scholarships. The potentially serious implications for more than 200 pre-licensure nursing students who complete the MMAP testing each semester and the time required by the MMAP faculty necessitates a formal evaluation of the MMAP program.

Purpose Statement and Evaluation Questions

The purpose of this program evaluation is to appraise the Math and Medication Administration Proficiency (MMAP) program implemented at a college of nursing in the midwestern United States. As part of the program evaluation, nursing faculty will be involved in developing program goals which will guide the evaluation. For the purpose of this proposal, suggested goals of the MMAP program provide a foundation for the following potential program evaluation questions:

1. How does the Math and Medication Administration Proficiency program influence the success of the pre-licensure nursing students with math for safe medication administration?

   a. Have the scores on questions related to math and medication administration within a standardized nursing exit examination increased since the implementation of the MMAP program, as compared to the two years prior to implementation of the MMAP program?

   b. Does the MMAP program maintain the nursing students’ math skills for safe medication administration from early in their nursing program through to their
final semester, as demonstrated by consistent rates of successful completion within three attempts?

c. Does the MMAP program improve the students’ confidence in their math skills for safe medication administration?

d. Does the nursing faculty who teach in the hospital and simulation environment perceive that the MMAP program increases the skills and safety of pre-licensure nursing students with medication administration in clinical and simulation lab?

2. How does the MMAP program ensure consistency in the teaching and assessing of math for safe medication administration?

   a. Are the MMAP question types consistently achieving an item difficulty grade that averages between 75 - 90% of students answering the question correctly?

Review of the Literature

Medication administration is a complex and high-risk nursing activity (Gregory et al., 2022). For decades, safe medication administration and math skills of both registered nurses and nursing students have been studied, and yet nursing students’ math skills have not improved (Dyjur et al., 2011). Previous research highlights the low number of nursing students achieving a perfect score on medication calculation skills exams despite focused education strategies (Fleming et al., 2014; Stolic et al., 2014). According to clinical nurse educators, two of the most common unsafe student nursing behaviors relate to medication administration (Karlstrom et al.,
Even after gaining experience as a registered nurse, nurses’ numeracy skills do not necessarily improve (van de Mortel et al., 2014).

The literature points to several issues that warrant further exploration related to math for safe medication administration with nursing students: a need for improved numeracy skills; how to teach and assess competency in math for safe medication administration; the confidence and anxiety of the nursing students in their math skills for safe medication administration; and the implications for faculty in pre-licensure nursing programs.

**Improvement of Numeracy Skills**

Two fundamental activities are involved in administering medications, the ability to calculate the dose accurately and the capacity to correctly prepare and administer the medication to a patient (Gregory et al., 2022). Math skills for calculating medication dosages is known internationally as numeracy. Numeracy skills needed by nurses include estimation, addition, subtraction, division, multiplication, fractions, decimals, international units, ratio, percent, use of formulae, use of tables and graphs, budgeting, appreciation of statistics, bookkeeping, measurement, and negative numbers (Young et al., 2013). Previous research indicates that nursing students struggle with multiplication of fractions, converting fractions to decimals, calculation of intravenous fluid administration rates, and proportion questions when converting from one unit to another (i.e., mcg into mg; Bagnasco et al., 2016). Numerical ability made the strongest unique contribution in predicting drug calculation ability (McMullan et al., 2012; Williams et al., 2016). Therefore, early testing and review of numerical skills before introducing
drug calculations are recommended (McMullan et al., 2012; Stolic, 2014; Williams et al., 2016). While Grugnetti et al. (2014) recommended adding a preparatory basic mathematics course in the first year of the nursing program, Bagnasco et al. (2016) suggested that math skills, or numeracy, should not be acquired once only, but need to be refreshed over time with constant exercise and application of the math rules and principles.

How to Teach and Assess

Nursing students’ self-reported weaknesses with the testing of math for safe medication administration included an inability to estimate correct answers, low self-efficacy, and the lack of contextualization (Mackie et al., 2012). An identified strength reported by these students was early evaluation of general math ability during the nursing program, and the variety of methods taught for calculation, including dimensional analysis and ratio/proportion methods (Mackie et al., 2012). The use of the Dimensional Analysis (DA) method was further recommended to address the errors commonly committed by nursing students, with the stipulation of instructing all nursing faculty in the use of DA as well (Koharchik et al., 2014). However, simply teaching a formulaic method for math calculations for safe medication administration may be short sighted. Students often abandon the use of a formula in a hospital or clinical setting and used a method more suited to the clinical context (Stolic et al., 2014). A need exists for flexibility in the teaching and evaluation of math for safe medication administration “because the ways in which professional nurses solve these problems vary and involve a variety of numeracy skills, most of
which arise from the context of drug administration rather than from formal arithmetic” (Hughes, et al., 2019, p. 4).

Prior to 2014 teaching strategies for math for safe medication administration primarily included four formats: didactic, technology aided (e.g. videos), psychomotor, and a combination of all of these (Stolic, 2014; Dutra et al., 2022). In 2013, Weeks et al. conducted interviews with students and discovered that students need exposure to authentic learning environments to increase their confidence, not talk and chalk presentations. Subsequently, clinical skills workshops in a simulation center have addressed a lack of contextualization and allow nursing students to apply learning regarding math for safe medication administration by using the methodological approaches taught in a more traditional lecture setting (Grugnetti et al., 2014; Ham, 2016; Harris et al., 2014; Mackie et al., 2016; Sanko & Mckay, 2017; Sears et al., 2010; Stolic et al., 2019; Weeks et al., 2013). Further, nursing students prefer a contextualized pen and paper testing format. Adding pictures of medication labels and syringes to pen and paper tests resulted in students with a higher self-reported confidence in math skills (Ramjan et al., 2014).

A whole curriculum approach to improving nursing students’ medication calculation skills resulted in the early identification of struggling students, referral for remediation, setting the pass rate at 100% for the medication calculation exams, developing learning contracts for students at risk, requiring six medication calculation exams throughout the pre-licensure program, and an on-line web-based support site with learning resources (van de Mortel et al., 2014). Stolic (2014) also warned that no errors for drug calculations are acceptable and thus a 100% pass rate should be the goal. If errors in testing occur, remediation and practice with math for safe medication calculations need to be completed before additional testing attempts are made (Owegen et al., 2021). In addition to testing at multiple points throughout the curriculum,
instructional scaffolding with math skills for safe medication administration leads to increased student confidence (Weeks et al., 2013).

The ability of pre-licensure nursing faculty in the development of classroom teaching and evaluation may be lacking. A deficiency in the education of faculty, or little experience with reliable and rigorous test writing may explain some of the struggles experienced by nursing faculty (Dreher et al., 2019; Killingsworth et al., 2015; Smith-Glasgow et al., 2019; Stolic, 2014). In the *NLN Vision: Fair Testing Imperative in Nursing Education (2020)*, “Faculty are aware that evaluative measures should be used not only to evaluate student achievement, but, as importantly, to support student learning, and evaluate and improve teaching and program effectiveness” (p. 6).

**Student Confidence and Anxiety**

In the United States, nursing school accrediting bodies and state boards of nursing require high-stakes testing as a measure of accountability for students, faculty, and the nursing program (Smith-Glasgow et al., 2014; Sullivan, 2014). The purposes of these high-stakes tests include determining progression, guiding remediation, assessing readiness to take the national nursing certification exam (NCLEX-RN®), and making decisions for curricular change (Hunsicker & Chitwood, 2018). The positives of testing included student motivation, confidence, and knowledge. The identified negatives of testing included faculty bias, student and faculty stress, attrition, financial impact, and potential litigation. A need exists within pre-licensure nursing
programs to balance student testing anxiety with patient safety and public harm (Dreher et al., 2019).

In support of testing, Eastridge (2019) identified the benefits of testing by describing the Testing Effect as the retrieval of information leads to that information becoming part of the student’s knowledge more effectively. Knowledge retrieval for tests leads to better knowledge retrieval later and better situational application of knowledge. The benefits of high-quality teaching and testing are critical to the nursing student’s success with math for safe medication administration.

The high stakes situation dramatically increases the test anxiety for all students regardless of their mathematics self-concept (Røykenes et al., 2014). High-stakes testing contributes to students’ anxiety and negatively impacted self-concept and self-confidence; “math calculation and numerical ability were not the major factors disrupting or causing increased anxiety, but overwhelming stress related to the high-stakes nature of math calculation tests” (Owegi et al., 2021, p. 739). The text anxiety also interferes with the preparation for testing (Quinn & Peters, 2017) and leads to a decrease in working memory (Williams, et al., 2016).

Nurse educators need to decrease anxiety in order to increase math self-efficacy. A supportive and positive environment, more practice, and flexible teaching approaches to cater to all learning styles are recommended (Williams et al., 2016). Additional environmental strategies nurse educators can use to decrease the test anxiety of nursing students may include use of therapy dogs, classical music, and aromatherapy in the testing centers (Quinn and Peters, 2017). Student-centered recommendations targeted deep breathing and progressive muscle relaxation techniques during high-stakes testing (Quinn & Peters, 2017). “In the end to reduce math anxiety and improve numerical ability, the best remedy is a caring teacher in a supportive environment
using multiple teaching strategies that addresses the needs of all students” (McMullan et al., 2012, p. 184).

Anxiety, guilt, and shame were reported by nursing students during a systematic review of articles analyzing nursing student medication errors in Spain (Asensi-Vicente et al., 2018). During the nursing students’ clinical experiences at a hospital, errors were committed by 28 – 30% of students, and more than half of the students (about 54%) reported near misses, that is errors that almost occurred. Dosage calculation errors was one of the top two errors reported. Surprisingly the students did not report a loss of self-confidence after committing a medication error (Asensi-Vicente et al., 2018).

**Implications for Faculty**

To alleviate some of the anxiety, nursing students should have more than one attempt to pass the test of math for safe medication administration, and remediation can be provided for those with unsuccessful attempts (Dreher et al., 2019). Nursing students must be informed that high-stakes math testing is coming and therefore can prepare for it (Dreher et al., 2019). Tagher and Robinson (2016) further recommended the development of high stakes testing philosophy or policy within schools of nursing with clear testing and remediation policies to guide faculty in making decisions about placement of examinations, identification of students at risk with development of an individualized learning plan, and implementation of faculty led remediation. As identified, many authors recommended the use of simulated learning environments, or sim labs, as a strategy allowing students the ability to manipulate and practice skills needed for math
for safe medication administration. The time-consuming nature of simulation-based experiences will need to be overcome by nursing faculty (Sears et al., 2010). “There was compelling evidence that collectively, students in clinical placement generate fewer medication errors if they have had prior exposure to a related, simulation-based experience” (Sears et al., 2010, p. 54).

Exiting literature provides guidance on how to improve the nursing students’ math skills for safe medication administration. Adopting these recommendations may not always be possible due to time constraints of faculty or unique circumstances of the nursing program. Programs should conduct their own evaluations to understand the effectiveness of their program in improving the nursing students’ skills with math for safe medication administration.

MMAP Program Description

The Context of the MMAP Program

The context for this program evaluation is a pre-licensure nursing program at a public teaching university in the mid-western United States. Located in a metropolitan area, the student body for this campus is primarily Hispanic and numbers approximately 8500 undergraduate and graduate students. Faculty in the nursing program are predominately white females whose degrees ranging from master’s level to Doctor of Philosophy in nursing. The pre-licensure nursing program offers a traditional four-year baccalaureate degree and an accelerated 15-month baccalaureate nursing degree for students with a bachelor’s degree in another specialty. A baccalaureate completion degree for students with an associate degree in nursing (often called
RN to BSN), master’s degrees in nursing education and administration, a master’s degree for nurse practitioners, and a Doctor of Nursing practice are all offered at this institution. Only the pre-licensure programs are considered in this program evaluation and are part of the MMAP program. Since most pre-licensure nursing students follow a traditional plan of study at this institution, the traditional plans of study will be referenced.

**Stakeholders, Staff, and Participants**

The stakeholders include pre-licensure nursing students, the nursing faculty members of the MMAP team, and pre-licensure nursing faculty who teach courses with a clinical component. Nursing advisors provide guidance to those students who are not successful in completing the required MMAP testing and may also be considered stakeholders. Student participation in the MMAP testing process is mandatory for all pre-licensure students during their junior and senior years. All college of nursing faculty and administrators were and continue to be involved in the approval of policies related to the MMAP program. The coordinator and staff of the on-campus testing centers assist with scheduling of the MMAP testing. The instructional design staff assist the MMAP faculty with guidance for the student MMAP resources and testing within the Learning Management System (LMS).
Program Structure

During the second semester of the sophomore year for the pre-licensure nursing students at this institution, a two-credit hour course regarding the essentials of safe medication administration is required. This course is taught by a nursing faculty member and includes basic numeracy skills, two methods for calculating medication dosages (i.e., dimensional analysis and ratio/proportion methodology), and appropriate techniques for preparing and administering medications to patients. Additionally, a 300-level statistics course is required early in the nursing program during the nursing students’ sophomore year. These two courses provide early identification of numeracy skills of the pre-licensure nursing students.

Beginning their junior year, the pre-licensure nursing students must attain 90% or greater on an examination testing math for safe medication dosage calculation. Students are allowed three attempts to pass the MMAP test each semester, with different questions drawn from a large pool of questions for each attempt. Consequences for students who are not successful between attempts two and three are required to remediate with MMAP faculty, as specified within the MMAP policy. If a student is not successful after their third attempt, they are not allowed to attend clinical and must withdraw from all courses with a clinical component. Since all testing is intentionally completed during the first week of the semester, unsuccessful students can withdraw from the course without penalty, that is without a failure or withdrawal on their academic record and full tuition reimbursed. Unsuccessful students are entitled to enroll in the course(s) during the subsequent semester.

During the development of the MMAP program, the MMAP faculty identified common errors committed by the students. Subsequently the MMAP faculty team created multiple
learning resources that are housed in a MMAP course within the Learning Management System (LMS). At the beginning of each semester, the resources offered to the students by the MMAP faculty team include:

- a tip sheet with conversions of units of measure and rounding rules
- four pre-recorded review videos
- a practice quiz with pre-recorded review of how to calculate the correct answers
- live and virtual review sessions
- scrap paper used during testing
- optional remediation with MMAP faculty if unsuccessful after attempt one
- mandatory remediation with MMAP faculty if unsuccessful after two attempts

These resources are made available to students at least two weeks prior to the start of each semester. Additionally, the MMAP faculty team promotes a general understanding of Dimensional Analysis (DA) with the nursing faculty.

The policy and process regarding MMAP includes the division of students into two levels with varying number of questions from each of the seven categories. The MMAP test consists of 20 questions randomly selected from seven pools of question types housed within the LMS. The test questions often include pictures of medication labels and/or equipment for measuring volume and dosing. During the completion of the on-line MMAP testing, students are provided paper on which they show their work used to calculate their answers. These papers are later referenced during the remediation process if a student is not successful on the MMAP test. The required pass rate for these on-line MMAP tests is 90% for juniors and first semester seniors, while 100% is required for senior students in their final semester of the nursing program. The number of questions from the most complex of the seven question categories is higher for
the second semester senior students. Repeated testing of the students’ competency during their junior and senior years of the baccalaureate nursing program allows students the opportunity to improve and maintain their knowledge and skills with math for safe medication administration. Faculty in all nursing courses at the sophomore, junior, and senior levels are also encouraged to include class discussions and test questions involving math for safe medication administration throughout their course.

History of the MMAP Program

The concept for the MMAP program began in 2018 when some faculty members within the baccalaureate nursing program bemoaned the inconsistencies in testing math skills for safe medication administration. Also concerning were the students’ math skills for safe medication administration were not transferring from one semester to the next. At that time, junior and senior nursing students were required to successfully complete a math and medication test prior to attending clinical experiences at a local hospital. However, the consequences of not passing, the number of attempts allowed, and the quality of test questions was inconsistent between faculty, courses, and semesters. A pilot sub-committee was formed that included the concerned nursing faculty members and the nursing faculty members who taught the essentials for safe medication administration class during the sophomore year of the students’ baccalaureate nursing program. This group collected medication math tests from all faculty who required such testing prior to the students’ clinical experiences at the local hospitals. Over the course of an academic year, content and question format from these tests were evaluated by the sub-committee.
Questions were edited and divided into pools of seven categories. Since the testing was completed during the first week of the semester, questions concerning course specific information were omitted due to students lack of familiarity with the content at the time of testing.

Also, during this planning year, the concerned faculty members benchmarked with other midwestern pre-licensure nursing programs regarding their processes with math for safe medication administration competency. The team also worked closely with the on-campus testing center and the office of information technology throughout the planning process. The team successfully made a proposal to the nursing faculty and the pilot occurred during the summer semester of 2019. Much evaluation occurred after the pilot, leading to the development of a tip sheet and a document for “showing your work” when completing the on-line medication math testing. In July 2019, the process for the development of the program and benchmarking results were shared via posters at a regional nurse educator’s conference. At this time the program officially became the Math and Medication Administration Proficiency (MMAP) program. During the fall semester in 2019, the MMAP testing process was rolled out to all five pre-licensure nursing courses that require competency testing for math and medication administration, approximately 200 students completed the MMAP testing. Data was collected and evaluated with the assistance of a statistician. The MMAP program with accompanying statistics was presented to the nursing faculty in December 2019 with unanimous faculty approval for permanent adoption and creation of a formal sub-committee. Ongoing improvements have included adding more questions to the seven pools of questions and including questions with pictures. During 2021, the MMAP team shared poster and podium presentations at the Quality and Safety Education for Nursing (QSEN) International virtual...
conference. Also, two more members were added to the MMAP faculty team, one of whom is a former middle school mathematics educator.

The literature concerning math for safe medication administration strongly suggests the use of simulation lab experiences. The simulation nursing faculty at this institution incorporate calculation, preparation, and administration of medications into all simulation scenarios during the students junior and senior years. There is no simulation time for the sophomore students who are enrolled in the essentials of safe medication administration course. Additionally, the junior and senior students struggle with the medication administration while in the hospital clinical settings. It is possible the students need more time in the simulation lab with a focus on the calculation, preparation, and administration of various types of medications.

Evaluation Model

This evaluation of a Math and Medication Administration Proficiency (MMAP) program will follow the template for a theory-based logic model introduced by the W. W. Kellogg Foundation (WKKF, 2004). This model provides greater detail and complexity than other logic models, and according to Mertens and Wilson (2019) “explains what the project wants to accomplish and how it will accomplish those intended results” (p. 232). Assumptions that underlie the decisions to plan and implement the MMAP are incorporated into the WKKF model (Mertens & Wilson, 2019). The six identified steps of this WKKF theory-based logic model will provide guidance throughout the evaluation of the MMAP program. This evaluator will continue to work with the key faculty stakeholders at each step of the model. Feedback from pre-licensure
nursing students will be collected and also considered during the implementation of this logic model. See Figure 1 for the proposed theory-based logic model.

**Figure 1: Proposed Theory based Logic Model**
The first step is to identify the problem or issue that led to the MMAP program development. Errors during the administration of medications continues to be an issue in healthcare despite decades of attention given to the training of pre-licensure nursing students. Many nursing students report errors or near-misses when providing care to their patients. The teaching, assessing, and consequences of failing a math test for safe medication administration within this nursing program were inconsistent. While many nursing students struggle with numeracy skills, the nursing faculty at this institution showed a variety of interest and skill. The original MMAP faculty developers were frustrated with their fellow faculty members’ inconsistency with the testing process and the consequences for not passing. These inconsistent testing processes and consequences may have contributed to the high levels of nursing student anxiety during the testing of math for safe medication administration. This anxiety likely had a negative impact on student success. Additionally, six local hospitals who hire a large number of the graduates from this nursing program, administer a math and medication test to all incoming nurses. To promote patient safety, the hospitals require either 80% or 90% pass rate on this testing. In 2018, the frustration of the key faculty stakeholders with this problem. Thus, the program needed to figure out a better and more consistent approach to teaching and testing math skills for safe medication administration.

List the community’s needs and assets, also known as the strengths and weaknesses, is the second step. At this pre-licensure program, an asset includes the two credit-hour didactic course reviews necessary numeracy skills and introduces math concepts for safe medication administration. This course is taught by a dedicated faculty member who incorporates multiple methods of calculating dosages (e.g., dimensional analysis, and ratio/proportion methodology). Classroom teaching methods go beyond talk-and-chalk and frequently include realistic
medication problems with pictures and hands-on manipulatives. The benefit of these interactive teaching methods and their impact on the MMAP testing success have not been evaluated. An additional asset within many pre-licensure nursing programs, including the evaluand, is the simulation laboratories with advanced technology to allow students hand-on experience with all aspects of nursing care in a safe setting. Pre-licensure students can practice administering medications in a realistic environment. Nationally, a recently developed asset includes the Quality and Safety Education for Nursing (QSEN) group partnering with a group of college math educators to evaluate content and pedagogy for pre-licensure nursing students (Ozimek et al., 2021). Recommendations and resources expected from this union will be beneficial to pre-licensure nursing programs. A potential weakness within the university the location of the university within a neighborhood with a lower socioeconomic status. The lack of strong numeracy skills in some incoming freshman due to inadequate preparation in their earlier education creates a need. Similarly, the enrollment of students in the pre-licensure program who are older is a need, since more time has passed from when they participated in high school math education. Additional community needs and/or assets may be identified by key stakeholders throughout the MMAP program evaluation process.

Step three is to specify the desired results in terms of outputs, outcomes, and impacts. Within the WKKF logic model, outputs are the direct results or products generated by the completion of activities (Rincones-Gómez, 2009). Outputs will include the number of MMAP preparatory sessions, the MMAP online preparatory materials, number of students who attended the preparatory sessions, the quality of the MMAP quiz questions, and the number of students who were remediated after one or two unsuccessful attempts. Outcomes are the short, medium, and long-term effects or changes the intervention is designed to bring about (Rincones-Gómez,
Outcomes for this evaluation will include short term results in the form of changes in individual student’s skills. Each semester the outcome involving the number of students who successfully complete the MMAP testing within three attempts versus the number of students who were not successful will be assessed. Impacts are longer-term goals of the project (Mertens & Wilson, 2019), and in this instance extending over four semesters. Trends in scores for math questions integrated within end-of-program standardized testing, faculty perceptions of the students’ abilities with math for safe medication administration, and students’ self-reports of their confidence level will be impacts included in this evaluation logic model. Additional outputs, outcomes and impacts will be considered in consultation with stakeholders of the MMAP program.

The identification of influential factors is step four. Influential factors may be internal or external to the evaluand and include the identification of factors that may be a barrier or a facilitator to the program. Barriers to the successful implementation and outcomes for the MMAP program include factors such as a lack of faculty time and expertise, lack of student time, incoming students with weak numeracy skills, and no pre-admission requirements for Math and English. The limited time for students to practice medication calculations and administration in the simulation labs is a barrier. Another barrier includes the quality of studies that have been completed and published regarding teaching math for safe medication administration. To date, there are only a few longitudinal studies, little randomization of participants in the published studies, and rare studies with a qualitative focus. Facilitators for the success of the MMAP program include a motivated core MMAP faculty team, a simulation lab, a dedicated two-credit hour course for math and safe medication administration, and the attention given to the topic in the number of published studies over the past couple of decades.
The fifth step is to determine the strategies or activities required to achieve the desired results. The MMAP team developed many training materials and provided both live and virtual review sessions. A policy was approved by the nursing faculty regarding the testing process and the consequences for those students who are not successful. A learning management system (LMS) upgrade allows pictures of medication labels and the syringes and equipment used to administer medications. An excellent resource for the MMAP faculty team was the Office of Instructional Technology at this institution who helped with the LMS.

The sixth and final step in the logic model is to state the assumptions underlying the project. The assumption underlying this MMAP program is that the coordination and standardization of teaching, assessment, and consequences for math for safe medication administration, the students would be more successful and experience less anxiety. It is also assumed the scores on math and medication tests required by local hospitals upon hiring will also improve.

Logic models should be seen as a “picture-in-time of what an intervention might look like” (Rincones-Gómez, 2009, p. 4). Continued communication between the evaluator and the key faculty stakeholders will occur throughout the evaluation of the MMAP program at this institution. As interventions are implemented, it is possible the proposed logic model will change.
To undertake a program evaluation, one must first define the term evaluation. A simple to remember definition for program evaluation is “a value judgment based on defensible criteria” (Rincones-Gómez, 2009, p. 1). Evaluation is also defined as a profession that “uses formal methodologies to provide useful empirical evidence about public entities (such as programs …) in decision-making contexts that are inherently political and involve multiple often-conflicting stakeholders, where resources are seldom sufficient, and where time-pressures are salient (Trochim, 1998 as cited in Mertens & Wilson, 2019, p. 5, emphasis added by Mertens and Wilson). Similar to this definition, when evaluating this MMAP program formal methodologies will be used to provide empirical evidence about the program to inform decision-making of the stakeholders. A program evaluation is not considered to be research and a primary difference between the two lies in the purpose. The purpose of research is to create new knowledge or theories, while the purpose of evaluation is to support decision making. Additionally, the use of judgement to determine value further distinguishes program evaluation from research. Terms such as merit and/or worth are often used when discussing the value of program evaluations. Merit is an intrinsic value focusing on the worth of a program to those who are intended to benefit from the program. On the other hand, worth is more extrinsic and looks at the value of a program to those who are outside of the program (Mertens & Wilson, 2019). An important question to ask when determining the purpose of an evaluation is whose values to use to establish the value of a particular evaluation study? (Mertens & Wilson, 2019). For this evaluation of the MMAP program, the values and goals of the program will be established by the key faculty stakeholders during the qualitative data collection to determine the merit of the program.
This evaluation of the MMAP program will utilize the pragmatic paradigm, focusing “primarily on data that are found to be useful by stakeholders” (Mertens & Wilson, 2019, p. 84). Pragmatism is problem-centered and oriented in real-world practice (Creswell & Creswell, 2018) and has a strong focus on the use of the knowledge gained from an evaluation (Mertens & Wilson, 2019). Pragmatism addresses the frustration previous evaluators experienced when their program evaluations were ignored by the evaluand, since pragmatists see the value of an evaluation when it is used and then produces new program results (Mertens & Wilson, 2019). Less focus is on the discovery of truth but rather what works. Evaluators within the pragmatic paradigm will develop a relationship with the stakeholders with the intent to achieve the purpose of the evaluation. Evaluators will choose a methodology based on what is right for a particular program. The choice is often a mixed methods approach to program evaluation which is advocated by many pragmatic evaluators (Mertens & Wilson, 2019).

To determine whether the goals for the MMAP program are being met, a formative evaluation will be conducted, which focuses on the implementation of a new program and whether this program needs improvement or to change practices (Mertens & Wilson, 2019). Overall questions an evaluator may ask include “Why was the outcome achieved? Why wasn’t the outcome achieved? What do we need to change?” (Mertens & Wilson, 2019, p. 259). Therefore, evaluations associated with improvement and process change are formative evaluations that allow the key stakeholders, such as the MMAP faculty, to make plans and adjustments for change and improvement. According to Mertens and Wilson (2019) a formative evaluation is conducted during the development or the delivery of a program with the intention to provide feedback to improve, whereas a summative evaluation typically occurs at the end of a program.
The overall evaluation design, for the evaluation of the MMAP program, will use a mixed methods approach (Creswell & Creswell, 2018). According to Chatterji (2005), the complexity of the contexts within which evaluations occur requires mixed methods evaluations (as cited in Mertens & Wilson, 2019). Creswell and Creswell (2018) identify one benefit of mixed methods design as providing different types of information from different perspectives. The open-ended data from qualitative methods and closed-ended data from quantitative methods is a strength of mixed method design and will provide more insight into the evaluand. The mission for the evaluator using mixed methods evaluation approaches lies with the integration of the data types. Additionally, the large amount of data and the required familiarity with both qualitative and quantitative research methods may be challenging for an evaluator (Creswell & Creswell, 2018).

There are several types of mixed methods research designs, depending on when qualitative and quantitative data are collected and how the different types of data are used in the data analysis. For this MMAP program evaluation, the exploratory sequential design, will be utilized. Exploratory sequential mixed method design involves the collection and analysis of qualitative data which then guides the gathering and interpretation of the quantitative data (Creswell & Creswell, 2018). Mapping of this program evaluation would be “qual -> QUAN ->QUAN” (Creswell & Creswell, 2018). In the sequential mixed methods assessment of this evaluand, data collection will begin with an interview with two key faculty stakeholders where formal identification of the MMAP program goals will occur. These identified MMAP goals will provide the foundation for the quantitative data collection and analysis. See Table of Proposed Data Sources in Appendix A.
Qualitative Data Collection

Qualitative data collection will be collected first during this exploratory sequential design. A semi-structured focus group with two key nursing faculty stakeholders will be conducted using Zoom, with recording of both audio and visual. A benefit of a focus group for data collection includes the sharing of different points of view which can stimulate further discussion, and to build consensus (Jones et al., 2014). Focus groups are appropriate for exploratory data collection, although their use does not imply generalizability (Jones et al., 2014). The use of a semi-structured format also has benefits including flexibility, use of pre-established questions that are open-ended and broad in nature, and the ability of the facilitator to ask clarifying questions (Jones et al., 2014). More specifically, the semi-structured interview format will allow the evaluator control over the line of questioning while still allowing the participants to share their views and opinions (Creswell & Creswell, 2018). Challenges with focus groups involve the expensive, a large time commitment, the participants may not be completely forthcoming, and the information collected may be difficult to quantify (Mertens and Wilson, 2018). Questions posed will seek to firmly establish the goals of the MMAP program and include the perceptions each key stakeholder has regarding the program success and the strategies used to achieve the goals. The determination of the strategies, or activities, used to achieve the goals of the MMAP program which aligns with the fifth step of the selected logic model. By asking the focus group participants to share their opinion of how the MMAP program and its outputs influences the pre-licensure student success, outcomes, and impact (step 3) will be evaluated. The focus group will be a maximum of one-hour in duration. Consent to participate will also incorporate permission to schedule a follow-up Zoom interview if clarification or
additional information is required. Afterward, facilitator memos and notes will include facilitator perceptions.

Participants in Qualitative Data Collection

In addition to the evaluator, two faculty members have been actively involved in the development of the MMAP program since its inception. These two faculty members will be purposefully selected to participate in a small focus group. Verbal permission has been obtained from the two key faculty stakeholders regarding their focus group participation. A formal invitation and the signing of a consent form will occur after the successful defense of this proposal and approval by the institutional review board.

Qualitative Data Analysis

The qualitative data collected through the focus group will lead to the development of questions used in surveys for the collection of quantitative data, aligning with the exploratory sequential design of this MMAP program evaluation. Analysis of the qualitative data collected during the focus interview with key faculty stakeholders will be completed prior to the development of the quantitative data collection tools, that is the two surveys. Briefly, the qualitative data analysis will involve reviewing and coding the data, followed by a collapse of the data into broad themes (Creswell & Creswell, 2018). Quotes will be used for writing items
for the student and faculty surveys. Essential strategies in data analysis acknowledged by Mertens and Wilson (2019) include continuous and ongoing data analysis, and reflectively reading the transcript, and interviewer memos. A website (Otter.ai) will be used to transcribe all the recorded Zoom interviews, word for word. Nonverbal behavior, such as pauses in speech and laughter, will be evaluated for clarification of meaning as required.

More specifically, qualitative data analysis is a process requiring sequential steps, from specific to general. Steps include preparing the data, reading all the data, coding, generating descriptions and themes, and finally representing the description and themes (Creswell & Creswell, 2018). After reading all the transcript multiple times, line by line coding will be completed to separate the data into themes, also known as open codes, without evaluator’s preconceived notions. These open codes will undergo the process of relating them to each other and putting them back together into larger categories or concepts with similar properties, a process known as axial or focused coding (Jones et al., 2014). The open codes will then be used to provide detail for the categories. The results of the focused coding will lead to the development of the formal and final MMAP program goals and guide every step of the logic model being used for this program evaluation. Tentative questions for the focus group and protocol may be found in Appendix A Table of Proposed Data Sources.

Qualitative validity will be assessed through member checking with the two key stakeholders, rich thick descriptions of the data, and sharing of my evaluator bias. Careful and thorough description of the qualitative evaluation steps/process will help ensure qualitative reliability (Creswell & Creswell, 2018, p. 201). Mertens and Wilson (2019) recommend involving stakeholders in data analysis. These authors define the term emergent evaluations as “involvement of stakeholders in evaluations that are allowed to evolve throughout the course of
the project” (p. 426). Interestingly, Stake cautions evaluators to avoid heavy reliance on what the program stakeholders put forth as the goals of the program (Stake 2004, as cited by Mertens & Wilson, 2019). This evaluator will consult with the dissertation committee members to address such issues.

Trustworthiness is associated with the confidence in the findings and can be established through member checking, thick descriptions, transferability, dependability, and confirmability (Jones et al., 2014). During qualitative data collection changes are expected, in part due to the intervention of this evaluator, thus the term dependability is used to describe the evaluator’s adherence to the process of the evaluation and the diligent documentation of the process in a protocol log (Mertens & Wilson, 2019). The credibility of the qualitative data will be strengthened/confirmed through member checks (Mertens & Wilson, 2019). Member checks is the sharing of data with the stakeholders for accuracy. Additionally expert review will be provided by the members of this evaluator’s dissertation committee. The faculty involved in the MMAP program development and implementation will be asked to review the themes and program goals derived from the focus interview, and to review and edit the proposed logic model. Prolonged and substantial engagement is a strategy recommended by Mertens and Wilson (2019) to address credibility. This program evaluator is a key stakeholder and involved in the development and implementation of the MMAP program. Prolonged contact with the evaluand is a benefit.
Quantitative Data Collection

Collection of the quantitative data will occur after the analysis of the qualitative data during this exploratory sequential evaluation design. The student survey will likely include questions that revolve around the students’ perception of their skill and confidence with math for safe medication administration. Tentative student survey questions have been developed and are based on a survey created by Andrews et al. (2009). The tentative student survey questions address a type of mathematical problem common in safe medication administration and require the student to evaluate their confidence in correctly answering the question using a 5-point Likert Scale. Additional questions are likely to arise from the Qualitative data obtained with the focus group.

A separate survey for pre-licensure nursing faculty will be developed from the qualitative findings and will also include the faculty member’s confidence in the junior and senior students correctly answering questions adapted from Andrews et al. (2009). Additional questions and/or edits to the proposed questions are likely to arise from the qualitative data obtained with the focus group. The faculty survey will be emailed to the nursing faculty who are involved in the practice of hands-on nursing care in the simulation lab and/or in the local hospitals with students. Eligible faculty must have at least two semesters of teaching clinical and/or simulation with junior and senior nursing to students in this pre-licensure nursing program. Beforehand, the Associate Dean of the pre-licensure nursing program will confirm if faculty have completed two or more semesters of teaching in clinical or simulation. Emails with consent and a link to an anonymous survey will be sent to the identified faculty. Approximately twenty faculty will be invited to participate, and it is hoped that a minimum response rate of 75%, or 15 responses will
be received. Data collected from the faculty will speak to the outputs, outcomes and impacts of the MMAP program.

In this MMAP evaluation, the use of surveys for the collection of data from both students and nursing faculty has both advantages and disadvantages. Surveys are generally considered easy to do, able to reach many participants, gather a large amount of data quickly, and are cost effective. However, for this program evaluation, survey questions will be developed from the findings of the qualitative data and created by the evaluator. Writing survey questions that will objectively provide the data desired (i.e., validity) may be challenging. Questions for the student and faculty surveys will be adapted from a survey created by Andrews et al. (2009). Additionally, surveys have potential bias related to self-reporting. Bias may occur when survey respondents under-report or over-report. It falls to the evaluator to ensure all respondents understand the question, understand it in the same way, and understand the question in the manner intended by the evaluator (Cohen et al., 2018). This evaluator will consider piloting the survey questions with a few college students and seek the input of the key faculty stakeholders. Additionally, a potential concern with the use of surveys is the evaluator has no personal connection with the survey participants (Mertens & Wilson, 2019). However, all the junior and senior students will be familiar with the evaluator as either a current or former professor, and the evaluator is a fellow faculty member. Reassurance of anonymity and careful de-identification of all collected data is imperative for this evaluator.

A third source of quantitative data will be assembled from records maintained by the MMAP team. These records are in Excel files and include de-identified student data. All this quantitative data is housed in a university-maintained drive shared by the key members of the
MMAP faculty team. The evaluation of this qualitative data will provide information regarding Step 3 outputs, outcomes, and inputs. Data to be collected will likely include:

- Number of students who complete MMAP Level 1 testing each fall and spring semester from Fall 2019 through Fall 2022. Note that the pass rate for Level 1 is 90% (or 18/20 questions) and includes students in their junior year and their first semester of their senior year (step 3 output).

- Number of students who complete Level 2 MMAP testing each fall and spring semester from Fall 2019 through Fall 2022. The pass rate for Level 2 is 100% or 20/20 questions. More complex questions are randomly selected from the pool. These students are in their final semester, or second semester of their senior year in the pre-licensure nursing program (step 3 output).

- Number of students who were not successful on their first attempt and required a second attempt, for students who completed either Level 1 or 2 MMAP testing (step 3 outcome).

- Number of students who participated in the mandatory remediation between attempt 2 and 3, for students completing either Level 1 or 2 MMAP testing (step 3 output).

- Number of students who were not successful after 3 attempts, either Level 1 or 2 students (step 3 outcomes).

- Student utilization of the preparatory materials (step 5 strategies), which include:
  - Four Instructional videos on: Basic conversions, Rounding basics, Dimensional analysis, Complex Dimensional Analysis.
  - Online Practice Quiz with 20 questions and unlimited attempts
Practice worksheet with 7 questions (including pictures of medication labels). Students are encouraged to complete this practice worksheet and then watch the video that provides a review of how to determine the correct answer.

Number of students who access the Tip Sheet can also be estimated through the LMS.

A random sampling of questions from the test pool will be evaluated with the assistance of the institution’s Office of Instructional Technology (OIT). See Appendix B MMAP Question Types. For each selected question, the percent of students who answered the question correctly over the past several semesters will be calculated. The standards for the quality of test questions are set by the institution’s nursing program and recorded in their faculty approved testing policy. The policy states if less than 30% of students answer a question correctly, the question is nullified. If 30-50% of the students answer a question correctly, the faculty may consider nullifying the question. For questions where less than 50% of students answer correctly, or questions where greater than 90% of students answered correctly, nursing faculty must consider editing the question (step 3 output).

Participants for Quantitative Data Collection

Recruitment of participants for the collection of quantitative data will be achieved electronically via email. Participants will be limited to pre-licensure nursing faculty and pre-licensure junior and senior nursing students within the institution. Outlook email accounts will be
used to contact the faculty, and the email associated with the LMS will be used for contacting the junior and senior nursing students.

Each semester students who are registered for courses that include a clinical component, are enrolled in the MMAP course within the learning management system (LMS). The pre-licensure administrative assistant and the pre-licensure nursing advisor confirm this list of junior and senior nursing students to be enrolled. All these students will be invited to complete a student survey through an email sent through the LMS. The email will include consent and a link to the anonymous survey for the collection of student quantitative data. Since the number of students completing the MMAP each semester is greater than two hundred, it is hoped that 25% of the students will respond and complete the survey.

Quantitative Data Analysis

A pilot will be conducted with each of the two surveys. Students and faculty who are not targeted participants will be asked to complete the survey and provide feedback to the evaluator. Once the faculty and the student surveys have been completed by the participants, the data collected will be evaluated using descriptive statistics.

At this institution, senior pre-licensure nursing students complete a standardized exit exam during their final semester. For each semester since 2019, the senior student cohort’s average scores on questions related to math for safe medication administration on the standardized HESI exit testing will be listed in a table. Comparison of these scores for 2017
(prior to the MMAP program) with more recent scores for students who fully participated in the MMAP program will be conducted.

Student and faculty survey data will be collected using questions with an ordinal scale. More specifically, a 5-point Likert scale with responses ranging from complete confidence to no confidence at all will be considered by the students and faculty. Presentation and analysis of this data will involve creating a table with crosstabulation by row totals (Cohen et al., 2018).

The third source of quantitative data is the MMAP shared Excel files. For the data regarding the number of Level 1 and Level 2 students who complete the MMAP testing each semester since 2019, a frequency distribution table will be created (Frankfort-Nachmias et al., 2021). For both Level 1 students and Level 2 students, the number who pass on their first attempt, the number who pass on their second attempt, and the number who require three attempts to pass will also be recorded in a frequency distribution table for each semester since 2019. These numbers will be converted to a percentage and comparisons between Levels and between semesters will be performed. This data will allow comparison of number of attempts and hopefully show a decrease in the required number of attempts, thus hinting at the student’s ability to maintain the information regarding math for safe medication administration. The final quantitative data analysis will involve the question types. Also using a frequency distribution table, simple tallies and recording of the percentage of students who answered the randomly selected question correctly will be recorded. This data will show whether the item difficulty grade for a randomly selected group of questions is between 75% and 90%.
Validity and Reliability of Quantitative Data

The value or worth of quantitative data is commonly measured through reliability and validity indicators. Reliability is an indicator of consistency of the data collection tool, while validity is an indicator of whether the tool really measure what it intends to measure (Mertens & Wilson, 2019). Clear reporting of the questions asked in the surveys, the descriptive statistics used, and how the descriptive statistics were measured will speak to the reliability and validity of the quantitative data. The use of a pilot survey with some students and faculty will support reliability, validity, and practicability of the survey tool (Cohen et al., 2018). A discussion of the proposed survey with the students and faculty involved in the pilot will help to prevent poorly worded or ambiguous questions; identify difficult, missing, redundant questions, and leading questions; evaluate layout of the survey; and determine the time required to complete the survey (Cohen et al., 2018). Additionally, the evaluator discussion with pilot survey participants can address the potential for social desirability bias. If the faculty and student survey respondents answer the survey questions in a manner they believe will meet this evaluators purposes, the risk of social desirability bias will be introduced. This risk will be partially addressed through anonymity of the survey respondents and through the initial distribution of the survey one to two weeks after the MMAP testing has been completed during the fall semester.
Quality of Evaluation Design

Issues with the data collection for mixed methods evaluations include all the concerns one would anticipate if using either qualitative or quantitative data collection exclusively (Mertens & Wilson, 2019). Additionally, when mixed methods research methods are used, concerns include construct validity may occur. According to Mertens and Wilson (2019) by demonstrating the legitimacy of all data sources, construct validity is established. Also, according to these authors, a concern with analysis of the qualitative data and quantitative data arises when the two data sets suggest different outcomes. However, the qualitative data collected in this program evaluation will be the foundation for the data collected in the quantitative data collection period. By using the information collected during the focus group interview, formal goals for the MMAP program evaluation will be established and thus determine the final version of the purpose and evaluation questions. The decision to use both qualitative and quantitative data during the MMAP program evaluation is justified.

According to Creswell and Creswell (2018) validity concerns with the use of the exploratory sequential mixed methods design include whether the evaluator will implement the appropriate steps with the development of the surveys. Another concern is the evaluator will not accurately reflect the richness of the qualitative data when developing quantitative measures, such as a survey. Appropriate rigor or depth of interpretation during the collection of qualitative data is required by the evaluator. Additionally, “the sample in the qualitative phase should not be included in the quantitative phase as this will introduce undue duplication of responses” (Creswell & Creswell, 2018, p. 226). Several measures are planned to address these concerns. The two key faculty stakeholders involved in the focus group will not be invited to participate in
the faculty survey. They will be consulted during the formulation of the surveys and the pilot phase to ensure the depth of qualitative data is evident. Also during the pilot phase for the two surveys, students and faculty involved in the pilot will not be drawn from the pool of potential survey respondents. Through all phases of the data collection and data evaluation, expert guidance will be provided by this evaluator’s dissertation committee members.

Evaluator Positionality

It should be noted that this program evaluator is one of the key faculty involved in the development of the MMAP program and I continue to serve as a member of the MMAP faculty team. At this institution, I am a faculty member who teaches junior nursing students in the clinical setting at local hospitals. My position as developer of the MMAP and as a faculty member serves as an advantage for me as the evaluator of the MMAP program. I have access to the pre-licensure nursing students and faculty for the collection of survey information. I also have access to all the data being collected and stored in the secure nursing shared drive. Another role that I, the evaluator hold is that I am the course chair and lecturer for one of the junior level courses requiring successful completion of the MMAP testing. If a student is not successful within three attempts, it is my course from which they must withdraw. This may introduce some bias into the responses shared by the nursing students who are currently in my class. The de-identification of student’s information will help with maintaining the anonymity of students. Also, surveys for the nursing students completing the MMAP testing during the fall 2022 semester will be emailed after all students have completed the MMAP testing. All MMAP testing
is completed within the first week of classes, therefore the student surveys will be emailed during week two or three of the fall semester.

In 2021, the MMAP faculty team shared two posters at a virtual international conference for Quality and Safety for Nursing Education (QSEN). These posters shared information regarding the process of developing the MMAP program at our institution, and data on the benefit of the preparatory resources. Comparative data analysis completed showed that students who watched the review videos achieved greater success on the MMAP testing (Kratovil et al., 2021). The potential for additional publications regarding the process of developing and implementing the MMAP program throughout the pre-licensure curriculum exists for this evaluator. My desire to complete a high-quality evaluation of the MMAP program at this institution stems from my goal for future publication and dissemination of the findings and builds upon previous poster presentations concerning this topic. This desire for dissemination is an advantage for this MMAP program evaluation.

**Significance**

As previously stated, the purpose of this program evaluation is to appraise the Math and Medication Administration Proficiency (MMAP) program implemented at a college of nursing in the mid-western United States. Through consistent teaching and evaluation of math for safe medication administration, it is predicted that safer medication administration will result at this institution. Using the logic model to evaluate the outputs, outcomes and impacts, this formative evaluation will generate suggestions for improvement and hopefully confirm some of the current
practices at this institution. Perhaps the time and effort required for the implementation of the MMAP faculty team each semester also will be justified.

Program evaluations tend to be limited in generalizability. However, other pre-licensure baccalaureate nursing programs can adopt practices implemented at this evaluand. The successful implementation of a comprehensive curriculum-wide program built upon recommendations from the literature may be beneficial for other pre-licensure baccalaureate nursing programs. Despite decades of attention given to the training of pre-licensure nursing students for safe medication administration, errors still occur (Dyjur et al., 2011; Fleming et al., 2014; Stolic et al., 2014). By sharing our process, our successes, and our struggles within the MMAP program, other pre-licensure nursing programs can implement a similar program. Recent recommendations by national nursing education organizations within the United States has led to an interest in scaffolding and competency-based education of pre-licensure nursing students (AACN, 2021). Our MMAP program provides examples of scaffolding and competency-based education for the math skills required for safe education administration. Dissemination of the approaches used for this MMAP program evaluation will also provide a program evaluation example for other nursing programs.

Future improvements for the current MMAP program may include additional hands-on experiences or simulation lab training. Also, future improvements may involve more scaffolding of the methods used for math for safe medication teaching, such as presenting the senior students with calculation methods other than dimensional analysis.
CHAPTER 2
EVALUATION OF A MATH AND MEDICATION ADMINISTRATION PROFICIENCY PROGRAM IN A PRE-LICENSURE NURSING PROGRAM

Introduction

The math skills of nursing students required for the safe medication administration have been studied for decades (Dyjur et al., 2011; Gregory et al., 2022). Despite this attention, nursing students’ math skills for safe medication administration are still a concern. Clinical nurse educators have identified that the most common unsafe student nursing behaviors are related to medication administration (Karlstrom et al., 2019). Additionally, low numbers of nursing students achieve a perfect score on medication calculation skills exams despite focused education strategies (Dyjur et al., 2011; Fleming et al., 2014; Stolic et al., 2014). Even after gaining experience as a graduate with registered nurse certification, nurses’ math skills do not necessarily improve (van de Mortel, et al., 2014).

Medication administration is a complex, high-risk activity that constitutes one of the major responsibilities of a professional, registered nurse (Fusco et al., 2021; Gregory et al., 2022). About 40% of the professional nurses’ time is spent passing medications (Asensi-Vicente et al., 2018; Fusco et al., 2021). A lack of nurse competency in calculating medication dosages
leads to medication errors and possible patient harm (Owegi et al., 2020) which has led to a focus on the skills required for safe medication administration in nursing schools.

To better understand how to improve nurses’ and student nurses’ math skills, a formal program evaluation of a curriculum wide process for the teaching, assessment, and remediation of math skills for safe medication administration with students in a baccalaureate nursing program was conducted. The process, as identified in the college of nursing’s policy, is called the Math for Medication Administration Proficiency (MMAP) program and is the entity to be evaluated, also known as the evaluand (Mertens & Wilson, 2019). A description and formal evaluation of the processes included in the MMAP program will provide practical examples for the teaching, assessment, and remediation for undergraduate or pre-licensure nursing students.

Literature Review

An overwhelming amount of literature exists concerning safety and medication administration. Fewer articles specifically address the math or numeracy skills required for safe dosage calculations. Many of these authors have recommended active learning strategies with medication dose calculations, such as hands-on practice and return demonstration in the skills or simulation labs. The struggle for many pre-licensure programs, including the one that was evaluated here, involves a lack of simulation faculty and time slots in the labs where our students can practice, review, and demonstrate competence.
Improvement of Numeracy Skills

The literature points to several issues that warrant further exploration related to math for safe medication administration with nursing students: a need for improved numeracy skills, approaches for teaching and assessing competency in math for safe medication administration, and the implications for faculty in undergraduate nursing programs. For safe administration of medication to patients, a fundamental nursing activity is the ability to calculate the dose accurately (Gregory et al., 2022). Math skills for calculating medication dosages is known internationally as numeracy and nurses need numeracy skills such as estimation, addition, subtraction, division, multiplication, fractions, decimals, international units, ratio, percent, use of formulae, use of tables and graphs, budgeting, appreciation of statistics, bookkeeping, measurement, and negative numbers (Young et al., 2013). To review and bolster the numeracy skills of nursing students, a preparatory basic mathematics course early in a nursing program is recommended (Grugnetti et al., 2014). However, this should not be the only opportunity offered to nursing students for improving their numeracy skills.

Approaches for Teaching and Assessing

A whole curriculum approach involves the faculty building upon an early preparatory mathematics course by repeatedly providing learning resources and offering medication calculation exams. Math skills, or numeracy, are not acquired once but need to be reinforced over time with constant exercise and application of the math rules and principles throughout the
curriculum (Bagnasco et al., 2016; Fusco et al., 2021; van de Mortel et al., 2014). Throughout the curriculum, the use of the Dimensional Analysis (DA) method for solving problems is appropriate since DA can be used for many problem types and it is easily adopted (Koharchik et al., 2014). Additionally, students need exposure to authentic learning environments to increase their confidence and practice their numeracy skills in a variety of settings. Skills workshops in a simulation center can address contextualization and allow nursing students to apply learning regarding math for safe medication administration (Grugnetti et al., 2014; Ham, 2016; Harris et al., 2014; Mackie et al., 2016; Sanko & Mckay, 2017; Sears et al., 2010; Stolic et al., 2019; Weeks et al., 2012). Furthermore, nursing students prefer a contextualized testing format and develop a higher self-reported confidence in math skills when pictures are added to paper or online tests (Ramjan et al., 2014).

Testing is a common method of assessment used in nursing programs and is an easily implemented assessment for numeracy skills to support student learning and improve teacher effectiveness (NLN, 2020). The benefits of testing for students include motivation, increased confidence, and improved knowledge (Eastridge, 2019). The identified potential negatives of testing include faculty bias, student anxiety, attrition, and financial impact. A need exists within undergraduate nursing programs to balance student testing anxiety with improved patient safety and to mitigate public harm (Dreher et al., 2019). To decrease anxiety, a supportive and positive environment with frequent opportunities for practice, and a flexible teaching approaches that cater to all learning styles are recommended (Williams, et al., 2016). The benefits of high-quality teaching, testing, and remediation are critical to the nursing student’s success with math for safe medication administration.
Faculty roles and responsibilities

The ability of pre-licensure nursing faculty in the development of classroom teaching and assessment may be lacking. The likely cause is a deficiency in the education of nurse faculty who may have little experience with learning theories, and reliable and rigorous test writing and execution (Dreher et al., 2019; Killingsworth et al., 2015; Smith-Glasgow et al., 2019; Stolic, 2014). The development of a testing philosophy or policy within schools of nursing helps to alleviate some of the faculty deficiencies. Such policies for testing of math for medication administration must include clear testing and remediation guidelines such as recommendations for placement of examinations, methods for identification of students at risk, suggestions for development of an individualized learning plan, and implementation of faculty led remediation (Tagher & Robinson, 2016). Faculty should aim to alleviate some of the nursing students’ math test anxiety by allowing more than one attempt to pass, and remediation for those who are unsuccessful (Dreher et al., 2019). Nursing students should be given advanced notice that high-stakes math testing is coming and therefore opportunity to prepare (Dreher et al., 2019).

MMAP Program Evaluation

The issues identified in the literature guided the development of the MMAP program. The strategies implemented within the MMAP program’s processes and policy intended to improve the nursing student’s numeracy skills; coordinate the teaching, assessment, and remediation of
the students’ numeracy skills; and identify the implications for the faculty. Implementation of a formal program evaluation aims to evaluate the achievements of the MMAP program.

Program evaluations are often misunderstood by healthcare professionals and the definition of program evaluation can vary (Adams & Neville, 2020). For this program evaluation, the definition of evaluation as a “value judgement based on defensible criteria” will be used (Rincones-Gómez, 2009, p. 1) Program evaluations answer questions about the quality and value of a program and thus are useful for decision-making and program improvement (Mertens & Wilson, 2019). To ensure a successful program evaluation, a solid foundation in the skills and knowledge of research techniques is required (Adams & Neville, 2020).

Program evaluations associated with improvement and process change are formative evaluations that occur during the development or delivery of a program (Mertens & Wilson, 2019). Formative evaluations allow the key stakeholders make plans and adjustments for change and improvement while the program is progressing toward its goal(s). Stakeholders are those who have a stake, or an interest in the program (Mertens & Wilson, 2019).

For this evaluation of the MMAP program, I will utilize a pragmatic paradigm, focusing on data that will be to be useful to the stakeholders (Mertens & Wilson, 2019). Pragmatism is problem-centered, focusing on what works in real-world practice (Creswell & Creswell, 2018), and has a strong focus on the use of the knowledge gained (Mertens & Wilson, 2019). Program evaluators within a pragmatic paradigm will develop a relationship with the stakeholders with the intent to achieve the purpose of the evaluation. Evaluators will also choose a methodology based on what is right for a particular program (Mertens & Wilson, 2019). For this MMAP program evaluation, I chose a mixed methods approach.
I completed the formal evaluation of the MMAP program in two phases. The purpose of phase 1 of the program evaluation was to establish formal goals in collaboration with stakeholders of the program, to identify the priorities and methods for appraisal of these goals, and to examine any existing data related to the goals (Table 1). The purpose of phase 2 of the program evaluation was to collect and examine additional data related to goals not yet achieved. Specifically, the purpose of phase 2 was to (a) understand how the undergraduate students in this nursing program compare to nursing students in other undergraduate programs with math questions included in national benchmarked testing and (b) examine faculty actions and perceptions regarding the practice of math skills for the safe administration of medications and for the MMAP program.
<table>
<thead>
<tr>
<th>Phase 1 Question</th>
<th>What are the formal goals for the Math and Medication Administration Proficiency (MMAP) program?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1 Sub-</td>
<td>Based on existing data, which goals for the MMAP program have already been achieved?</td>
</tr>
<tr>
<td>Questions</td>
<td>What are the priorities for goal evaluation currently?</td>
</tr>
<tr>
<td></td>
<td>What are the methods for evaluation of the prioritized goals?</td>
</tr>
<tr>
<td>Phase 2 Question 1</td>
<td>Are there differences in the scores on questions regarding math included in the standardized testing (i.e., HESI Exit testing) completed by undergraduate senior nursing students who have participated in the MMAP program when compared to the scores on questions regarding math included in the standardized testing (i.e., HESI Exit testing) completed by undergraduate senior nursing students who did not participate in the MMAP?</td>
</tr>
<tr>
<td>Phase 2 Question 2</td>
<td>What are the perceptions and actions of the undergraduate nursing faculty regarding the MMAP program?</td>
</tr>
</tbody>
</table>
The context for this program evaluation is a pre-licensure, baccalaureate nursing program at a public teaching university in the mid-western United States. Located in a metropolitan area, the student body for this campus is primarily Hispanic and numbers approximately 7500 undergraduate and graduate students. At this institution, most pre-licensure (i.e., undergraduate) nursing students follow a traditional plan of study. The identified stakeholders include pre-licensure baccalaureate nursing students, the advisors for the pre-licensure nursing students, the key nursing faculty members of the MMAP team, and all pre-licensure nursing faculty who teach courses with a clinical component.

**History of the MMAP Program**

The concept for the MMAP program was developed when faculty members within the baccalaureate nursing program bemoaned the lack of transferability of student knowledge regarding numeracy from one semester to another. The inconsistencies in testing math skills for safe medication administration also concerned these faculty. For example, the consequences of not passing, the number of attempts allowed, and the quality of test questions was inconsistent between faculty, courses, and semesters. After approval and creation of an official sub-committee, the interested faculty benchmarked with other midwestern pre-licensure nursing programs regarding processes with math for safe medication administration competency. A great variety of practices and processes for testing math for safe medication administration was
identified. An unfortunate commonality was the students’ lack of retention of math skills within the surveyed pre-licensure nursing programs (Kratovil et al., 2021).

After benchmarking, the sub-committee collected all medication math tests from the evaluand’s pre-licensure faculty members. The MMAP team critiqued and edited the content and format of the questions from these collected tests and created one large pool of math questions housed within the evaluand’s Learning Management System (LMS). For the two semesters the MMAP team piloted the program with revised test questions, clearly stated consequences for not passing, remediation requirements, and a draft of a policy. Results of the pilot were presented to the undergraduate nursing faculty and unanimous faculty approval was given for permanent adoption of the MMAP policy and program. A permanent sub-committee was created under the auspices of the evaluand’s undergraduate faculty testing committee.

The MMAP Program Structure

The components of the MMAP program include preparatory courses and resources, a standardized pool of test questions, a policy that delineates the consequences for not passing, and mandatory remediation. During their sophomore year, the pre-licensure nursing students at this institution complete a mandatory two-credit hour course regarding the essentials of safe medication administration. This course is taught by a nursing faculty member and includes basic numeracy skills, two methods for calculating medication dosages (e.g., dimensional analysis and ratio/proportion methodology), and the appropriate techniques for preparing and administering medications to patients. Additionally, a 300-level statistics course is required during the pre-
licensure nursing students’ sophomore year. In addition to reinforcement of numeracy skills, these courses provide early identification of the pre-licensure nursing students numeracy strengths and weaknesses.

Beginning in their junior year, the pre-licensure nursing students enrolled in a course with a clinical (i.e., practicum) component must attain 90% or greater on the MMAP test before they can attend their practicum experiences. Since clinical experiences during the students’ junior year involve supervised medication administration, accuracy in numeracy for medication dosage calculation is essential. Students are allowed three attempts to pass the MMAP test each semester, with different questions drawn from the question pool for each attempt. Consequences for students who are not successful after their second attempt include mandatory remediation with MMAP faculty member prior to completing their third and final attempt for that semester. If a student is not successful after their third attempt, they are not allowed to attend their clinical or practicum experiences and must withdraw from all courses with a clinical component.

Intentionally, all MMAP testing is completed during the first week of the semester thus allowing unsuccessful students to withdraw from the course without penalty. Early withdrawal ensures a failure or withdrawal is not part of the unsuccessful student’s permanent academic record and tuition is fully reimbursed. During the subsequent semester, unsuccessful students are entitled to re-enroll in the course(s) and re-take the MMAP testing.

The MMAP test consists of 20 short answer questions randomly selected from a pool of questions divided into seven categories. To increase the realism of the test questions, pictures of medication labels and/or equipment for measuring as well as realistic medication names and dosages are incorporated into questions within the pool. During the completion of the MMAP test, students are provided paper on which they show their work as they calculate their answers.
These show your work papers are later referenced during any remediation processes. The MMAP policy stipulates the division of the undergraduate students into two levels. Students assigned to Level 2 include students who are soon to graduate and who receive questions with increased difficulty. The required pass rate for these on-line MMAP tests is 90% for juniors and first semester seniors (considered Level 1), while 100% is required for senior students in their final semester of the nursing program (Level 2). The number of questions from the most complex of the categories is also higher for the second semester senior students (Level 2). Early in the MMAP program pilot phase, the faculty stakeholders identified some common errors committed by students. Learning resources were developed and used a variety of formats to meet the students preferred learning style (e.g., tutorial videos with embedded questions, tip sheets with rounding rules and unit conversions, practice tests, live and web-based review sessions).

Historically, the suggested objectives for the MMAP program have included the improvement of the numeracy skills of the pre-licensure students, the consistency of teaching and assessment, and the maintenance of the students’ numeracy skills over time. As part of this program evaluation, the key nursing faculty stakeholders for the MMAP program will now be involved in the development of formal program goals. Further, the prioritization and the methods for evaluation for these goals will be a joint effort with this evaluator and the key faculty stakeholders.
Method

Logic Model

This pragmatic evaluation of a Math and Medication Administration Proficiency (MMAP) program followed the template for a theory-based logic model introduced by the W. W. Kellogg Foundation (WKKF, 2004). A logic model is fundamental since it represents a snapshot view of the stakeholders’ belief of how and why a program will work, sets the boundaries of the project, and identifies expected outcomes (Adams & Neville, 2020; Rincones-Gomez, 2009). The WKKF logic model provides greater detail and complexity than other logic models while explaining what the program hopes to accomplish and how (Mertens & Wilson, 2019). The six identified steps of the WKKF theory-based logic model provided guidance throughout the evaluation of the MMAP program (Figure 2). The first step of the model identified the problem or issue that led to the MMAP program development. Errors with dosage calculations during the administration of medications continues to be an issue in healthcare despite decades of attention given to the training of pre-licensure nursing students.

Within this logic model, step two requires a list of the community’s needs and assets. At this pre-licensure program, assets include the required statistics course and the required didactic nursing course that reviews necessary numeracy skills and introduces math concepts for safe medication administration. A dedicated nursing faculty member who incorporates multiple methods of calculating dosages (e.g., dimensional analysis, and ratio/proportion methodology) teaches this class. Classroom teaching methods go beyond the talk-and-chalk teaching technique
and frequently include active learning with realistic medication problems with pictures and hands-on manipulatives. Additional assets include the full support of the Dean and the undergraduate faculty who affirmed the process through a unanimous vote upon initial implementation. More recently, however, the undergraduate faculty seems to have taken a hands-off approach to teaching math for safe medication administration thus creating a need within the evaluand (step 3). The lack of time slots and faculty to supervise student practice sessions for medication administration has also resulted in a need. And despite the listed community assets, a pressing need concerns the lack of numeracy skills within the undergraduate nursing students. These needs within the MMAP program will be considered during this program evaluation through both the qualitative and quantitative phases.

Step three specifies the desired results in terms of outputs, outcomes, and impacts. Within the WKKF logic model, outputs are the direct results or products generated by the completion of activities (Rincones-Gómez, 2009). In the MMAP program direct results include the development of preparatory materials for the student review, consistent testing practices, and established consequences for unsuccessful students. The MMAP policy approved by the undergraduate nursing faculty also constitutes an output. Outcomes, or short-term goals, include the number of students successful with MMAP testing each semester, improved trends in standardized testing scores, and revised faculty perceptions. Longer term impacts of the MMAP program will be realized when less errors occur with medication administration in healthcare due to improved numeracy skills of nursing students.
Step four of the theory-based logic model requires the identification of influential factors, both internal and external to the evaluand. Influential factors may be a barrier or a facilitator to the success of the MMAP program. Barriers to the success of the MMAP program include a lack of simulation faculty and time slots for student practice sessions. Student constraints include a general lack of time for MMAP preparation and limited time for students to practice medication...
calculations and administration in a simulation or skills lab. Influential factors, identified as facilitators, will contribute to the success of the MMAP program. Motivated key faculty stakeholders and recommendations from the literature contribute to the success of the MMAP program. Another facilitator is the office of instructional technology who assisted faculty with the development of question pools within the LMS. A learning management system upgrade allowed the addition of pictures of medication labels and the syringes and equipment used to administer medications.

The fifth step determines the strategies or activities required to achieve the desired results. The MMAP team developed many student training materials while providing both live and virtual review sessions. Policy approval by the undergraduate nursing faculty solidified the MMAP process and consequences for those students who are not successful.

The sixth and final step in the logic model states the assumptions underlying the project. The assumption underlying this MMAP program was that the coordination and standardization of teaching, assessment, and consequences for testing of math for safe medication administration would result in less errors committed by the student nurses at this evaluan. In the long term, it is also assumed that registered nurses who have graduated from this institution will have strong numeracy skills for the accurate calculation of medication dosages when at the bedside.

The logic model provides a “picture-in-time” (Rincones-Gómez, 2009, p. 4) of the MMAP program at this institution. Consideration of the information inserted within each step of the logic model created the foundation for the purposes of the formal MMAP program evaluation. As I completed the logic model, I had to prioritize what to evaluate of the MMAP program. Many iterations of the logic model were created, and I did not finalize the model until after discussion with the key stakeholders in the focus group. As this is a formative evaluation of
the MMAP program, in the future, the logic model will change as evaluation of the MMAP program continues for the long term (Rincones-Gómez, 2009).

Exploratory Sequential Mixed Methods Approach

A pragmatic approach for the formal MMAP program evaluation aims to provide data useful to the evaluand. The value of a pragmatic approach lies in the knowledge gained from the program evaluation as the program pursues its end goals (Mertens & Wilson, 2019). In addition to using the scientific method to determine truth, the findings sought by the pragmatic evaluator will demonstrate that the results of the program work (Mertens & Wilson, 2019). For this pragmatic program evaluation, I selected an exploratory sequential mixed method design (Creswell & Creswell, 2018). The collection and analysis of qualitative data in Phase 1 of the program evaluation guided the gathering and interpretation of the quantitative data in Phase 2.

It should be noted I am the MMAP program evaluator and I have a vested interest in the success of the MMAP program. I am one of the faculty involved in the development of the MMAP program since its inception. Also, I am a faculty member responsible for the didactic component for a course requiring students to successfully complete the MMAP testing prior to their clinical experiences associated. Therefore, if a first semester junior student does not successfully complete the MMAP testing within three attempts, I am the lead faculty member of the course from which they must withdraw. Additionally, I am one of the authors responsible for the MMAP poster presentations delivered during international nursing conferences in 2021 and 2023 (Kratovil et al., 2021; Kratovil & Hoekstra, 2023). My positionality as the program
evaluator, faculty member, and key stakeholder offered access and prolonged contact with the evaluand and helped to establish my credibility (Mertens and Wilson, 2019). On the other hand, my proximity to the MMAP program may have jeopardized my ability to collect accurate information. “Backyard research” involves a study within the researcher’s work setting and/or with friends (Creswell & Creswell, 2018, p. 184). To combat this potential issue, the use of multiple strategies for validation is recommended (Creswell & Creswell, 2018). Since I completed a program evaluation within my backyard, and I strove to demonstrate the accuracy of the information obtained through more than one measure of validity. I also utilized several recommended strategies including the use of member checking, clarifying the evaluator’s bias, prolonged contact with the evaluand (Creswell & Creswell, 2018), and transparency with the evaluation processes (Cohen et al., 2018).

Participants and Recruitment for Phase 1 and Phase 2

Stakeholders are people who have a stake in a program and include those who receive services, those who provide services, and those who administer the program (Mertens & Wilson, 2019). Within the MMAP program, stakeholders included undergraduate nursing students, all undergraduate nursing faculty, and nursing advisors. Furthermore, there are three key faculty stakeholders who were identified as the nursing faculty who developed and currently implement the MMAP program. The evaluator for this MMAP program evaluation is one of the three key faculty stakeholders.
During Phase 1 of the MMAP evaluation, the evaluator verbally invited the key faculty stakeholders to participate in a focus group to discuss the MMAP program. All three key faculty stakeholders are white women. We have been teaching nursing full-time at this institution for 5-7 years each. One member is a tenure track faculty with a PhD in nursing. The remaining two key faculty stakeholders are currently seeking a terminal degree, one in nursing and the other in higher education. A formal invitation emailed to the key faculty stakeholders involved in Phase 1 also included an informed consent form. During the Phase 1 focus group, the key faculty stakeholders identified the participants to be included in Phase 2 of the MMAP program evaluation. Phase 2 participants included full-time faculty who currently taught pre-licensure nursing students in the clinical setting and/or those who currently taught pre-licensure nursing students in the institution’s simulation laboratory. Full-time faculty who had been teaching for two or more semesters at this institution were selected since they were most likely to be familiar with the policies of the nursing program. A list of participants meeting the prerequisites was verified by the associate dean for the undergraduate nursing program. During Phase 2, an email was sent to the 21 eligible faculty participants to invite them to participate in the program evaluation. The email included an introduction to the MMAP evaluation program, an informed consent form, and a link to a Qualtrics survey (see Appendix B). Eighteen of the 21 eligible faculty members completed the survey. Demographic information regarding the faculty invited to complete the survey is presented in Table 2.
Table 2 Demographics for Faculty Survey Recipients

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>18/21</th>
<th>86%</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>18/21</td>
<td>86%</td>
</tr>
<tr>
<td>Black, Hispanic, or Asian</td>
<td>3</td>
<td>14%</td>
</tr>
</tbody>
</table>

| Gender - Woman                   | 21    | 100% |

<table>
<thead>
<tr>
<th>Rank</th>
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<tbody>
<tr>
<td>Associate Professor</td>
<td>2</td>
<td>9.5%</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>2</td>
<td>9.5%</td>
</tr>
<tr>
<td>Clinical Associate Professor</td>
<td>2</td>
<td>9.5%</td>
</tr>
<tr>
<td>Clinical Assistant Professor</td>
<td>10</td>
<td>47%</td>
</tr>
<tr>
<td>Visiting status</td>
<td>4</td>
<td>19%</td>
</tr>
<tr>
<td>Clinical Instructor</td>
<td>1</td>
<td>5%</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Years at Institution</th>
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<tr>
<td>Less than 5 years</td>
<td>11</td>
<td>52%</td>
</tr>
<tr>
<td>5 to 8 years</td>
<td>6</td>
<td>29%</td>
</tr>
<tr>
<td>Greater than 8 years</td>
<td>4</td>
<td>19%</td>
</tr>
</tbody>
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<table>
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<tr>
<th>Highest degree attained by Faculty</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal degree (i.e., PhD or DNP)</td>
<td>6</td>
<td>29%</td>
</tr>
<tr>
<td>Seeking a terminal degree</td>
<td>3</td>
<td>14%</td>
</tr>
<tr>
<td>Master’s degree in nursing</td>
<td>12</td>
<td>57%</td>
</tr>
</tbody>
</table>

| Employed full time at institution | 21    | 100% |

Phase 1 Qualitative Data Collection and Analysis

Qualitative data collection began with a semi-structured focus group including the key nursing faculty stakeholders. This flexible format for the collection of Phase 1 data used pre-established and open-ended questions which allowed the interview facilitator to ask clarifying questions (Jones et al., 2014). More specifically, the semi-structured interview format allowed the evaluator control over the line of questioning while still allowing the two key faculty stakeholders to openly share their views and opinions (Creswell & Creswell, 2018). See Appendix A for the interview questions. The 57-minute focus group was conducted face-to-face with audiovisual recording for later data analysis.

During the focus group discussion, the stakeholders created a list of formal MMAP program goals with method of data collection and prioritization. The goals were typed into an Excel document and projected onto a large screen for ease of discussion. All participants verbally shared ideas for edits and agreed upon the version documented within the Excel file. Later I transcribed the recording of the Phase 1 interview aligning with the first step of the data analysis process identified by Creswell and Creswell (2018). Second, I read the transcription and the field notes recorded in the excel document during the interview in their entirety (Creswell & Creswell, 2018). I analyzed small sections of the transcription (i.e., a line-by-line analysis) together with the field notes recorded in the excel file which led to the identification of two themes (Creswell & Creswell, 2018). The first theme related to the question of how the undergraduate nursing students at our facility compared to students around the country who complete the same national benchmarked standardized testing during their final semester. The second theme related to the
apparent lack of faculty involvement with math for safe medication administration. These themes impacted the decisions made by the evaluator and the key faculty stakeholders when formal program goals were created, prioritized, and methods for assessment were identified. All these themes, goals, prioritization, and assessment methods were later confirmed by the evaluator via a final review of the transcribed interview and excel file. Additionally, after completion of the Phase 1 qualitative data analysis, an email was sent to the key faculty stakeholders for review of the program goals, prioritization, and assessment methods derived from the focus interview. All stakeholders approved of the findings from the Phase 1 and thus member checking and careful review of the data enhanced the credibility and validity of the Phase 1 qualitative data (Mertens & Wilson, 2019). See Table 3.

Table 3 Goals 1, 2, and 3 with Data Sources

<table>
<thead>
<tr>
<th>MMAP Goals</th>
<th>Decision of Focus Group</th>
<th>Data sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To standardize the process for math and medication administration proficiency assessments.</td>
<td>The focus group determined this goal has been sufficiently attained. Logic Model: Step 3 Outcomes regarding consistent testing processes; and Step 5 Strategies regarding the standardization of testing and consequences.</td>
<td>Unanimous approval for the MMAP program (e.g., the process and the policy) by the pre-licensure nursing faculty and Dean.</td>
</tr>
<tr>
<td>2. To share our model with other pre-licensure nursing programs.</td>
<td>The focus group determined this goal has been sufficiently attained.</td>
<td>Several poster presentations and a podium presentation at an international nursing conference have been or will be completed. (Kratovil et al., 2021; Kratovil &amp; Hoekstra, 2023).</td>
</tr>
<tr>
<td>3. Improve our scores for first time pass rates on the MMAP testing, as evidence of the level of competency.</td>
<td>The focus group determined this goal has been sufficiently attained. Logic Model: Step 3 Outcome regarding student success.</td>
<td>More than 99% of the undergraduate nursing students are currently determined to have competency in math calculations for medication administration (Kratovil &amp; Hoekstra, 2023).</td>
</tr>
</tbody>
</table>
Phase 2 Quantitative Data Collection and Analysis

Phase 2 of the MMAP program evaluation focused on the collection and examination of data for the prioritized and unmet goals established by the key faculty stakeholders during the Phase 1 focus group. Specifically, Phase 2 involved (a) understanding how the senior nursing students in this program compare to the senior nursing students in other programs with math questions included in national benchmarked testing and (b) examine faculty actions and perceptions regarding the practice of math skills for safe administration of medications and for the MMAP program. Therefore, multiple sources of data were collected during Phase 2. First, quantitative data was collected from reports of national benchmarked testing completed by all pre-licensure nursing students several weeks prior to their graduation. During phase 2, the scores for questions related to math for safe medication administration on the standardized testing administered to senior nursing students weeks before their graduation were evaluated. Specifically, the senior students’ scores prior to the MMAP program were compared to the scores for students who fully participated in the MMAP program.

Additionally, to collect data on faculty involvement and support, the evaluator created a survey. Two faculty who previously taught clinical and were not targeted participants for the faculty survey were asked to provide feedback on the survey questions. After revisions, the faculty survey consisted of 16 questions. Three questions used an essay text box to allow narrative responses and thirteen questions were multiple choice in format (see Appendix B for the Faculty Survey questions.)

The survey was administered through software employed by the institution (i.e., Qualtrics). Descriptive statistics were collected for each of the 13 multiple-choice questions.
Data included the number of faculty who responded to the question along with the frequencies and percentages for each response option. For the three questions with text boxes allowing responses up to 250 words, I copied and pasted all the feedback for each question into one document. I analyzed all feedback using qualitative data analysis techniques. Specifically, I read through all the responses for each question and then completed a line-by-line analysis looking for themes (Creswell & Creswell, 2018). Once my list of themes was generated for each question, I determined the alignment of the responses with the themes by re-reading all the narrative responses and ensuring each response could be matched to a theme. See Table 4.
Table 4 Goals 4, 5, and 6 with Data Sources and Summary of Responses

<table>
<thead>
<tr>
<th>MMAP Goals</th>
<th>Data sources</th>
<th>Summary of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Students will remain competent from semester to semester.</td>
<td>Results of standardized HESI testing pre and post MMAP implementation.</td>
<td>Questions answered correctly that met or beat the National average on standardized testing increased by 9.7% from pre-MMAP to post-MMAP.</td>
</tr>
<tr>
<td></td>
<td>Question 3 &amp; 13 of Faculty Survey.</td>
<td>The number of questions identified as “math” that were answered correctly by 100% of our students increased from 6.3% to 25.3%. A 19% increase from pre MMAP to post MMAP.</td>
</tr>
<tr>
<td></td>
<td>Logic Model Step 2 Community needs. Step 3 Outcome student success.</td>
<td>Question 3: 6/18 faculty respondents are the primary lecturer and all of them include math calculations over didactic content.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Question 13: Faculty respondents require students to complete the calculations required for medication dosing and show or discuss with the faculty.</td>
</tr>
<tr>
<td>5. Ensure students have the resources and adequate time to prepare</td>
<td>Clinical nursing faculty survey. Question 10, 11, 12, 14, 16</td>
<td>Question 10: 41.18% (7/17) are confident students will answer correctly 50-74% of the time. 52.94% (9/17) are confident a student will answer correctly 75-99% of the time. 5.88% (1/17) of faculty state 100% of the time.</td>
</tr>
<tr>
<td>for the core calculations required in clinical.</td>
<td>Logic Model Step 4: Influential factors regarding lack of faculty time and expertise.</td>
<td>Question 11: 100% (18/18) faculty agree. Question 12: 100% (18/18) faculty agree. Question 14: 72.22% (13/18) value as “very important”. 27.7% (5/18) value as “important”. Question 16: • 88.89% (16/18) agree. • 5.56% (1/18) state perhaps. • 5.56% (1/18) state not at all.</td>
</tr>
<tr>
<td></td>
<td>Logic Model Step 3: Outcomes and Step 5: Strategies regarding faculty perceptions.</td>
<td></td>
</tr>
</tbody>
</table>

Continued on the following page.
Table 4 continued

<table>
<thead>
<tr>
<th>MMAP Goals</th>
<th>Data sources</th>
<th>Summary of responses</th>
</tr>
</thead>
</table>
| 6. Increase faculty support and collaboration for continued student success through practical application. | Clinical nursing faculty survey. Questions 4, 5, 6, 7, 8, 9, and 17. | **Question 4:**  
77.78% (14/18) incorporate.  
22.22% (4/18) do not.  
| Logic Model Step 4: Influential factors regarding lack of faculty time and expertise. | **Question 5:**  
81.82% (9/11) incorporate.  
18.18% (2/11) do not.  
| Logic Model Step 6: Assumptions regarding clinical faculty reinforcing and monitoring med dose calculations. | **Question 6:**  
50% (9/18) use dimensional analysis.  
44.44% use Ratio/Proportion method.  
5.56% (1/18) uses both.  
**Question 7:**  
8/18 (44.44%) are confident.  
6/18 (33.33%) state “maybe” they are confident.  
4/18 (22.22%) state they are not confident.  
**Question 8:** Resources included:  
- MMAP videos  
- Brightspace clinical section  
- 3-Online resources  
- Clinical conversion resources  
- Math faculty at PNW  
- 4-Textbook purchased for sophomore nursing course  
- 2-Calculator  
Ask course lead.  
Refer to my old nursing school notes.  
Coworker  
Answer sheets  
Notes from previous course  
PowerPoint resource posted in course with both methods.  
**Question 9:**  
72.22% (13/18) are interested.  
27.78% (5/18) are not interested.  
**Question 17:**  
- Example problems  
- Additional practice for students in classes  
- Make it more consistent…other instructors did not use dimensional analysis and were not checking students’ math comprehension.  
- Not sure. Continue to do this excellent and important work.  
- Possibly teach alternative ways to calculate other than dimensional analysis.  
- Weight based medications with safe ranges rate calculations of minutes.  
- Maybe seminars, brown bags.  
- Videos, handouts, or sessions (as a group or individually) connecting other calculation methods to DA. Consistent and clear expectations for what faculty are expected to do related to meds and math during clinical/sim.  
- Share the resources the students have been given, so we can reinforce those methods and avoid confusion.  |
Findings

Exploratory mixed methods design was used to guide the collection of qualitative data during the initial phase of this MMAP program evaluation which led to the quantitative data collected during the second phase. Through the evaluation of the MMAP program, I discovered the nursing students who participated in the program showed improved numeracy skills. However, the undergraduate nursing faculty showed varied support and implementation of the MMAP program.

Evaluation of the Math and Medication Administration Proficiency (MMAP) program has shown the nursing students abilities to successfully compete the MMAP testing have improved since the implementation of the MMAP program. When the key stakeholders reviewed previously published data an increase in the number of first-time pass rates improved for all students was determined. For those students in Level 1 the second time pass rates also improved (Kratovil & Hoekstra, 2023). Additionally, the MMAP faculty team previously published that 99% of the undergraduate nursing students are currently determined to have competency in math calculations for medication administration each semester because of the MMAP program (previously published data by Kratovil & Hoekstra, 2023).

The focus group posed the question of how the numeracy skills of the undergraduate nursing students who have completed the MMAP program compared to nursing students who are not enrolled at this institution regarding the math questions on national benchmarked testing. Data collected included students’ success on the questions identified as “math” on national benchmarked testing (i.e., HESI Exit testing) during their senior year. Table 4 includes data obtained from the five semesters prior to MMAP implementation in comparison with the five
semesters post MMAP implementation. The percent of questions our students answered correctly when compared to National averages increased by 9.7% (from 82.2 to 91.9%) from pre-MMAP to post-MMAP (Table 5).

<table>
<thead>
<tr>
<th></th>
<th># questions identified as “math”</th>
<th># Questions Greater than or Equal to National Results</th>
<th>% Questions Greater or equal to National Results</th>
<th># Questions Less than National Results</th>
<th>% of Questions Less than National Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before MMAP</td>
<td>90</td>
<td>74</td>
<td>82.2%</td>
<td>16</td>
<td>17.8%</td>
</tr>
<tr>
<td>After MMAP</td>
<td>74</td>
<td>68</td>
<td>91.9%</td>
<td>6</td>
<td>8.1%</td>
</tr>
</tbody>
</table>

Further comparison of the standardized testing for these same students and semesters concluded the number of questions identified as “math” that were answered correctly by all our students increased by 19.08% from pre MMAP to post MMAP (Table 6). These findings show the undergraduate nursing students who participated in the MMAP program at this evaluand correctly answered more math questions than students who completed the same standardized testing and who were enrolled at other undergraduate nursing programs. Through the evaluation of the MMAP program, MMAP goal 4 pertaining to the nursing students’ ability to remain competent from semester to semester with their math skills for safe medication administration.
Table 6 Number of questions answered correctly by all MMAP students:

<table>
<thead>
<tr>
<th></th>
<th># questions identified as “math”</th>
<th># questions all our students answered correctly</th>
<th>% questions all our students answered correctly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before MMAP</td>
<td>96</td>
<td>6</td>
<td>6.25%</td>
</tr>
<tr>
<td>After MMAP</td>
<td>75</td>
<td>19</td>
<td>25.33%</td>
</tr>
</tbody>
</table>

The focus group identified a second theme which revealed the lack of involvement by the pre-licensure nursing faculty. A stakeholder stated, “We have the resources available for the students, we do not have the faculty backing them up”. Another stakeholder shared the pre-licensure faculty “thinks they do not have to worry about math because the MMAP team does it”. After discussion, the focus group identified this theme of faculty indifference as a high priority for further evaluation of the MMAP program and recommended using an anonymous survey. Since the evaluator is also a member of the faculty, it was decided an anonymous survey would result in more honest answers versus focus groups with undergraduate faculty participants. A Qualtrics survey was emailed to 21 full-time undergraduate nursing faculty who teach in the clinical and/or simulation setting, eighteen (85.7%) responded. A summary of the responses is included in Table 4. Additionally, Table 7 contains descriptive data for the faculty survey respondents.
Results of the faculty survey showed none of the respondents taught in the simulation lab exclusively, and more than half of the respondents (55.5%) have taught at the CON at PNW for more than 6 semesters. The majority (86.7%) of the faculty respondents were not the primary lecturer for the course content that complements the students’ clinical and simulation lab activities.

Early in the MMAP program development, the MMAP team determined Dimensional Analysis (DA) to be the preferred method for teaching students about calculations for safe medication administration. Of the faculty surveyed, half (9/18) use the DA method, while one faculty member uses both DA and the ratio/proportion method. Thus, a disappointing 44.4% (8/18) of the faculty do not use the DA method preferred by the MMAP team. More than half of the faculty feel they are “maybe confident” or “not confident” (12/18, 55.5%) to coach a student through solving a problem using dimensional analysis. One faculty commented the MMAP team should “Make it more consistent…other instructors did not use dimensional analysis and were
not checking students’ math comprehension”. Another faculty member encouraged the team to teach methods other than DA. This faculty respondent likely did not realize that other methods are taught during the students’ sophomore year.

In the undergraduate nursing program, all faculty surveyed (18/18) agree that it is imperative for both nursing students and registered nurses to check for accuracy of the medication dose calculations provided on the patient’s medication administration record. And most value the nursing student’s demonstration of math competency as very important or important (72.22%, 27.7%). When asked if it was their role as the clinical or simulation faculty to assess the nursing students’ demonstration of math competency, 88.9% (16/18) felt it was. Some faculty reported they do not incorporate any math calculations during hospital experiences or simulation lab experiences (22.2% and 18.2% respectively).

When asked to share their techniques for assessing the students’ competency in the clinical or simulation lab, most faculty (11/14, 78.6%) have students complete the math calculation, compare their findings to the electronic patient medication record, and share their findings with their instructor prior to administering the medication. One instructor also has the whole group of students individually complete and then discuss the medication dose calculations in a group setting at the end of the clinical day.

Conclusions associated with the second theme indicate that not all the MMAP goals determined by the key faculty stakeholders have been accomplished. Through the evaluation of the MMAP program, MMAP goal 5 pertaining to the nursing students having the resources needed for the core calculations required for clinical practices was not achieved. Additionally, MMAP goal 6 pertaining to faculty support and collaboration for continued student success through practical application was not achieved.
This formal evaluation of the MMAP program was conducted to appraise the outcomes, the outputs, and the impact of the program. Previous edits and revisions to the MMAP program seemed reactionary and often occurred in response to faculty and/or student complaints. By following a systematic evaluation plan as presented in the WKKF logic model, the effectiveness MMAP program was formally assessed. Several of the six program goals established by the key faculty stakeholders have been accomplished.

The first goal for the MMAP program related to the standardization of the MMAP process, in particular the assessment of the math skills of the undergraduate nursing students. A whole curriculum approach was implemented (Bagnasco et al., 2016; Fusco et al., 2021; van de Mortel et al., 2014). The math skills taught in the numeracy courses completed by the students in their sophomore year, as recommended by Grugnetti et al. (2014), were built upon with materials available for review of numeracy skills prior to the MMAP testing each semester. Additionally, the MMAP team developed a policy to ensure consistency in testing experiences. For example, the policy ensures all students complete their attempts on the MMAP testing during the first week of classes to avoid the financial costs of a late withdrawal and the negative impact on their transcript. Finally, the MMAP team development a pool of questions with similar formatting to further standardized the process of MMAP testing.

The second goal for the MMAP program involves sharing our model for the MMAP program with other undergraduate nursing programs. As noted, this goal has been accomplished through poster presentations at a variety of regional and national conferences. Additionally, two of the key faculty stakeholders will be sharing the MMAP model at an international nursing
conference in the coming months. This second goal has been achieved, but I anticipate further publications regarding our MMAP program.

Goal three of the MMAP program evaluation referenced the undergraduate nursing students’ improved scores on their first attempt at the MMAP testing. Test questions that are contextual i.e., include pictures and real medication names and dosing, was a recommendation taken from the literature (Ramjan et al., 2014). Additional recommendations taken from the literature during the development of the MMAP program included the use of authentic examples and active learning during the sophomore level numeracy course with follow-up practice in the clinical and simulation lab (Grugnetti et al., 2014; Ham, 2016; Harris et al., 2014; Mackie et al., 2016; Sanko & Mckay, 2017; Sears et al., 2010; Stolic et al., 2019; Weeks et al., 2012). In fact, many pre-licensure nursing schools also have implemented these recommendations from the literature supporting nursing simulation labs for the practice of safe medication administration and dose calculations. However limited availability of simulation faculty and a lack of time slots in the simulation lab prohibit the use of this hands-on approach to learning at this evaluand. This limitation was identified as a community need in step 2 of the logic model. It is conceivable that other pre-licensure programs also struggle with faculty and time slot availability in the simulation lab.

Not only did the quality of the teaching and testing receive attention during the initial stages of the MMAP program but also the remediation efforts improved. Individualized remediation (i.e., using the student’s show your work document) provided by caring and supportive MMAP faculty built upon recommendations from the literature (Williams et al., 2016) and led to the achievement of goal 3 of the MMAP program. The remediation processes adopted within the MMAP program could be considered a facilitator in step 4 of the logic model.
The results collected confirm the effectiveness of the program in relation to the fourth MMAP goal for retention of the numeracy skills required for the math calculations for medication administration by the nursing students from semester to semester. The percentage of senior students scoring better on benchmarked HESI Exit testing support the MMAP program effectiveness. These findings also support the research indicating that safe medication administration teaching and learning techniques should be incorporated throughout the curriculum (Bagnasco et al., 2016; Fusco et al., 2021; van de Mortel et al., 2014). Notably the improvement in the scores on math questions within the HESI Exit testing was small. Future evaluations of the MMAP program should consider setting minimal improvements required i.e., benchmarks, before determining MMAP goals have been met.

Also related to the fourth MMAP goal, the key faculty stakeholders who developed and implemented the MMAP program assumed the coordination and standardization of teaching and assessment within the MMAP program would result in, the students’ improved numeracy skills at the bedside. However, the results of the faculty survey revealed not all faculty teaching in the simulation lab and/or the clinical setting ensure the students correctly complete calculations to ensure medication dose accuracy. In fact, some clinical and simulation faculty believe this is not their role, which seemingly contradicts the survey results revealing 100% of the faculty believe all nurses and nursing students should calculate the medication dosages to ensure accuracy of dosing. Regardless of the efforts of the MMAP program over the past several years, not all faculty have required students to calculate medication dosages in the hospital or simulation lab setting, despite the recommendations for the use of DA (Koharchik et al., 2014) and frequent contextual practice in the literature (Grugnetti et al., 2014; Ham, 2016; Harris et al., 2014; Mackie et al., 2016; Sanko & Mckay, 2017; Sears et al., 2010; Stolic et al., 2019; Weeks et al.,
2012). This constitutes a missed opportunity to provide the students a real-life opportunity to use their math skills and then to administer the medication safely to a patient. Fortunately, all the clinical faculty who also provide the didactic/lecture experiences for the students include questions regarding medication dose calculations on their exams and quizzes. Despite these more negative findings from the faculty survey, the fourth goal of the MMAP program was considered to be achieved related to the increase in the senior nursing students HESI Exit testing scores.

In light of the current recommendations for nursing programs to move to a competency-based curriculum (AACN, 2021), the missed opportunity for real-life practice of math skills when providing care to patients in the hospital or simulation lab must be addressed. It is no longer acceptable to teach nursing students how to score well on a test. Hands-on practice with demonstration of competence is required (AACN, 2021). Future MMAP program evaluations will hopefully show even greater student competence with medication dosage calculations after the students are encouraged to fully take advantage of all practice opportunities.

The fifth goal of the MMAP program was to ensure the undergraduate nursing students have the resources and the time to prepare for the core calculations required in clinical. Through the phase 2 faculty survey, it was discovered that while at the clinical facility and/or patient bedside not all faculty dedicate time for completing calculations for safe medication administration using DA. While disappointing, these results were not surprising considering the struggle clinical and simulation faculty reported with the Dimensional Analysis (DA) method for medication dosage calculations. Most faculty were likely taught the ratio/proportion method during their pre-licensure nursing programs and have not used dimensional analysis. Only 44% of the faculty surveyed felt confident in their ability to coach a student with a medication dose calculation using DA. Future efforts by the MMAP team should include a discussion with the
faculty regarding the methods taught during the sophomore class and the reason for reliance on the DA method in the MMAP program. DA can be applied to all types of medication calculations.

As noted in step six of the logic model, it was assumed the faculty teaching in the simulation lab and/or the clinical setting would reinforce and monitor medication dose calculations. This assumption was in error. The faculty survey responses indicated that not all faculty are encouraging the undergraduate nursing students to calculate and compare the medication doses all the time.

The sixth and final goal for the MMAP program involves an increase in faculty support and collaboration for continued student success through practical application. This goal was not achieved. As noted in step two of the logic model, a community asset included the full support of the Dean and the faculty who unanimously approved the MMAP program. What become evident through this program evaluation was that the faculty support has waned. Responses to the faculty survey revealed that not all faculty are using DA, nor are they confident with DA. While many faculty identified resources they have available for coaching a student with a medication dose calculation problem, a large number (72.22%) also indicated an interest in a faculty development activity. Additionally, when asked how the MMAP team can provide support, faculty respondents suggested example problems, access to the same resources the students have for numeracy review, and a seminar. Since some faculty recommended teaching students other methods for calculating medication dosages, some of the information provided to the faculty should include the reasoning for teaching DA to the students. This goal was determined not to have been met when more than half of the faculty requested additional resources and training for DA. Future
program evaluations should consider a pre-determined benchmark to determine achievement of this and other MMAP program goals.

**Limitations**

Upon reflection of this formal evaluation of the MMAP program, I identified several limitations. First, many of the pre-licensure nursing students are instructed by limited-term-lecturers (LTL) in the clinical and simulation setting at this institution. Despite having a limited knowledge of the evaluand’s policies, these LTL faculty likely should have been included in phase 2 and received the faculty survey. It would be interesting to determine how many LTL faculty encourage their pre-licensure students to complete medication dosage calculations and if they encourage the use of DA.

A second limitation of this MMAP program evaluation is no financial considerations were included. During the first two weeks of every semester, the MMAP faculty time spend many hours coordinating the testing, providing live training sessions, and remediating unsuccessful students. This distracts the faculty from activities required to prepare and launch their assigned courses. Further evaluation regarding feasibility, in particular costs and time for the key faculty, should be considered.

Third, as both the evaluator and a key faculty member of the MMAP program I am strongly vested in the program. In fact, much of this MMAP program evaluation was dependent on the input of the three key faculty stakeholders. This MMAP program evaluation has potential bias inherent in its processes. Attempts were made to seek the opinion of previous clinical
instructors when developing the faculty survey. However, the opinion of evaluators outside of the evaluand would be helpful and should be incorporated in future MMAP program evaluations.

A fourth limitation of this MMAP program evaluation centers around the statistics I used during the qualitative portion. When evaluating the students’ successes with the MMAP testing and the national benchmarked exams I used descriptive statistics. A suggestion for future evaluation of the MMAP program should include following a cohort of the same students as they progress through the both the undergraduate curriculum and the MMAP program. More long-term research and evaluation might even include following a cohort after graduation as they transition to the role of a registered nurse. This would address the original problem (step 1) and assumptions (step 6) identified in the Logic model.

As noted in the discussion, the goals related to the faculty and clinical experiences, goals 5 and 6, were not achieved. A future evaluation of the MMAP program should follow a MMAP intervention for the faculty. This intervention should probably be in the form of a workshop and include a review of the MMAP policy and processes, as well as justification and review for the use of Dimensional Analysis (DA).

Conclusions and Significance of the Program Evaluation

The findings of the MMAP program evaluation clearly support a curriculum wide and structured approach to the required numeracy skills for safe medication administration by nursing students. The format of the MMAP program improved retention in the students’ abilities with the math calculations required for safe medication administration. This evaluand was able to
show these improvements without extra student and/or faculty time spent in the simulation lab or skills lab. With the nation-wide recommendations for implementation of a more competency-based nursing curriculum (AACN, 2021) both simulation lab time slots and faculty are in high demand.

Even though the MMAP program shows successes of the pre-licensure students and their math skills, there are ways the MMAP program could be improved. In the future, the MMAP program should incorporate the needs of the pre-licensure clinical and simulation faculty, perhaps through DA workshops and resource materials for faculty reference. If these are not sufficient to earn faculty buy-in, other measures will need to be considered. Overall, the MMAP program has shown positive results for the pre-licensure nursing students. Some work will need to be done to improve faculty buy-in.
CHAPTER 3

SCHOLARLY REFLECTIONS

Introduction

For years I struggled with the decision whether to pursue a terminal degree or not. I already had my dream job as a faculty member in an undergraduate nursing program. I received a teaching award and was also nominated for teacher of the year, so I was not sure needed to go back to school and I was not sure I wanted to. I had looked at a few doctoral programs in nursing but never felt the urge to apply. Besides, our three children were all in college and I was in my early 50’s, why would I want to start a program now? However, in 2018 the faculty development office at my institution hosted a course from the Association of College and University Educators (ACUE) for the improvement of faculty members’ skills with teaching and learning. I enrolled and completed the ACUE course. The information presented was exactly what I wanted to learn. I quickly realized that I did not want another nursing degree. I wanted to learn how to become a better teacher, so I enrolled in the Doctorate in Education (Ed.D.) program at Northern Illinois University (NIU).

As I am now finishing up my doctoral program, I want to reflect on my experiences during the program, focusing in particular on the dissertation process. In this scholarly reflection,
I will first reflect upon my experiences with selecting a topic and approach for my dissertation project. I have considered the process required for the completion of my dissertation, as well as application of this experience to my practice and I will share these considerations. Finally, I will reflect upon the completion of my dissertation and how this applies to my scholarly inquiry.

Selecting a Dissertation Topic and Inquiry Approach

Before reflecting on the dissertation process and what I gained from the experience, I would like to share how I decided to complete a program evaluation for my dissertation. It should be noted that when I began my Ed.D. program, no student had ever completed a program evaluation, and it was not listed as an option. Our choices were qualitative, quantitative, or maybe a mixed methods research project for our dissertation. Also at that time, my colleagues told me to stay away from mixed methods since it was too much work. So how did I select a program evaluation using a mixed methods approach for my dissertation project?

During our first class in August 2019, I was not the student who knew their dissertation topic. I had way too many ideas, thoughts, and possibilities rolling around in my head. As I progressed through those first semesters, I could not find a topic with which I wanted to establish an intimate relationship spanning many months. These were my thoughts until I completed a course concerning program evaluations in the Spring of 2021. My enjoyment of this program evaluation course led to my selection of the formal evaluation of the MMAP program as my dissertation topic.
To be honest, I believe that my fear and self-perceived weaknesses in research design also influenced my selection of a program evaluation. Even though I have completed all the required coursework for this practical doctorate, I believe I am still weak with the context of educational research designs and approaches. When I first read about educational research methods (Creswell & Creswell, 2018; Cohen et al., 2018), I discovered, and re-discovered, terms such as inductive versus deductive reasoning. I read about four sets of assumptions known as ontology, epistemology, human nature, or methodology which make up paradigms (Cohen et al., 2018) and so on. It was confusing and perhaps too intellectual for me. However, when our cohort completed the class on program evaluation; terms such as merit, value and worth (Mertens & Wilson, 2019) made sense to me. Yes, there are still have paradigms, theories, models, and approaches in program evaluation (Mertens & Wilson, 2019) but this time I really understood. It is likely the earlier readings and coursework in research and statistics set the stage for my understanding and preferences for program evaluation. It is also likely that my foray into program evaluation has strengthened my understanding of research methods in education. After all, program evaluation also uses qualitative, quantitative, and mixed methods designs; and collects the data, analyzes the data, and interprets findings (Mertens & Wilson, 2019).

Once I had settled on a program evaluation approach, identifying the program to evaluate was easy. I knew I wanted to evaluate the MMAP program at my institution. The MMAP program is very near and dear to me. I was one of the original faculty who bemoaned the undergraduate students’ inability to carry forward their knowledge of math for medication dosage calculations. I was one of the original faculty who threw her arms up with frustration when I learned that a fellow faculty’s second quiz attempt for unsuccessful students was the same practice test provided to the class on their first day. In other words, every student in that
class successfully passed the medication dose calculation test. Yet in my class, one or more student(s) was required to withdraw each semester when they were unsuccessful at my versions of the math for safe medication dosage testing. Situations such as these led to the development of the processes and the policy that became the MMAP program. And this program development led to the partnership I developed with the other two key faculty stakeholders.

After several years of implementation of the MMAP program, there were several factors that led us three key faculty stakeholders to consider the need to evaluate the MMAP program. During the early stages of the MMAP program we saw the success our students were experiencing. Early data analysis showed that our students were more likely to pass the MMAP testing on their first attempt (Kratovil et al., 2021). This was exciting and encouraging. We also witnessed a more consistent process for testing and consequences of failure thanks to the adoption of the MMAP program policy. But we, the MMAP faculty stakeholders also knew how much time and effort this program cost us. Many hours were spent remediating students during the first week of the semester. A time when we needed to be establishing our assigned courses. Also, the key faculty stakeholders heard rumblings from our fellow faculty members that made us question whether we still had their full support and buy-in for the MMAP program. These concerns regarding the time requirements and the negative rumblings of our fellow faculty stimulated discussions among the team of key faculty stakeholders. When I proposed a formal evaluation of the MMAP program for my dissertation project, the key stakeholders fully supported my idea.

Program evaluation, by definition, includes both an empirical or experimental aspect, and a judgement of the value (Mertens & Wilson, 2019). One way to approach this is to determine if the program is meeting its self-established goals. Unfortunately, the MMAP program had no
formally established goals. What followed was a two-part program evaluation using qualitative methods to establish the MMAP program goals, and then quantitative methods to determine if the goals were being met. In other words, I selected a program evaluation using a mixed methods approach for my dissertation.

This was an exciting time for me. I had a dissertation topic and methodology that would be a benefit to my institution. And so, I began the dissertation process.

Reflections on the Dissertation Process

The dissertation process turned out to be a great learning experience. I not only learned more about how to conduct a program evaluation, but I also learned about myself as a writer, reader, a team member, and the skills I will need moving forward in my profession. Through the process of submitting drafts of different sections of my project to my dissertation chair, I have learned to trust my gut regarding my writing. The edited or graded version I received back from my dissertation chair usually did not contain any surprises. I knew some areas were weak and I anticipated the need to review certain sections. What I was not sure about was how. The recommendations from my dissertation chair were invaluable to me. I learned so much from the suggestions for revisions. So, my instincts, or my gut tell me when something is not quite right with my writing. What I still need to work on is how to correct and improve my writing. In the future I should plan to work with another faculty as either a co-author or an editor to improve my writing and build my confidence.
Throughout my dissertation process, I have learned the benefits of being an avid reader. At this moment I am reading four different books and am participating in two book clubs. I believe my love for reading and for words has helped my writing. I enjoy being able to put my thoughts on paper in paragraph format with (hopefully) proper sentence structure. I frequently use my dictionary app with thesaurus to find just the right word. I love this challenge. I also enjoy editing the writing of others.

But while I enjoy writing, I learned through the dissertation process that I am not great at writing survey questions. What I thought were high quality survey questions that would provide me with all the information I needed, did not turn out to be true. After I shared my survey questions with two fellow faculty members, their comments were somewhat distressing. One faculty said, “I really don’t know what you are trying to gain with this question.” I learned that when I ask for the critique and opinion of others, I should be ready for both positive and negative feedback. And I learned that writing survey questions is tough. This is likely another area with which I should reach out to fellow faculty to seek their opinions.

As I further reflect on my dissertation process, I realize that I should ask questions and seek the support of others more quickly. The dissertation process did not always proceed smoothly for me and asking more questions is something I should have done differently. There was a time during my dissertation process when I thought I knew what needed to be done. I am thinking of the process of obtaining Institutional Review Board (IRB) approval from my institution for Phase 2 of my dissertation. Unfortunately for me, this process was mired in delays. Some of them were my fault. This was the point where I should have asked the advice of other faculty at my institution; or asked my faculty stakeholders who previously have escaped the muck of the IRB process. Then I would have heard their messages about the IRB at our
institution and how frustrating and exacting they can be. I would have heard the message that as the primary researcher I needed to go to one additional page on the website to click “confirm” after my submission. This would have saved me weeks of time. So, one of the important lessons I learned was to ask for advice when needed.

While I did not consult other faculty when it came to the IRB process, there were other times when I leaned on the expertise of my team members, something I greatly benefitted from. For example, my team members, also known as the two faculty stakeholders, and myself had a conversation one day concerning our dissertations. We discussed our methodologies, and this led to a rather detailed discussion of statistics. Words like parametric and non-parametric were discussed like they were part of our everyday conversations. Now I need to admit that I had done some review of data and statistics in my textbooks just a few days beforehand. On the other hand, one of my team members is brilliant and remembers impressive amount of information concerning research methodologies and statistics. That conversation reminded me that I did not need to do this alone and will not need to manage future evaluations or research on my own.

This lesson will also be important after I finish my doctorate degree and strive to publish my dissertation. Unknowingly, I selected one of the toughest journals for having an article accepted. Conversations with fellow faculty led to good suggestions for selecting a journal for publication. I also was not aware of the wide variety in the requirements for article publication. Some journals use APA formatting, while other journals use another formatting style. My selected journal does not want tables. There is such a wide variety in journal requirements that I must pay careful attention to the guidelines for the journal I selected. Seeking the advice of a faculty member with more publishing experience is my plan, and some of them are even the editors or reviewers for some journals.
I also learned the importance of being flexible during the research or program evaluation process. As I completed the formal evaluation of the MMAP program, I made extensive changes to the evaluation process I had included in my dissertation proposal. This is how it should be when one is working with key stakeholders to complete a program evaluation. During phase 1 of my dissertation, I collected the opinions of two key faculty stakeholders when we developed the goals for the MMAP program. The goals of the MMAP program served as the criteria for evaluation of the program (Mertens & Wilson, 2019). Until I completed the focus group with my two key faculty stakeholders, I did not know the goals for the MMAP program. By developing the goals with the key faculty stakeholders as part of the dissertation process, we all had input into the purpose of the MMAP program and the subsequent evaluation. Thus, it was reasonable and expected that my proposal did not match my formal MMAP program evaluation.

The changes required between my proposal and the implementation of my dissertation project likely slowed my progress. Honestly, I was not stressed and overwhelmed with this process or the delays. As I wrote my proposal, I used forms of the word proposed since I expected to make changes. Perhaps I was not upset because I am a rookie researcher, and this is the first time I have completed a dissertation. However, I also know that I am quite flexible and can change my plans quickly when indicated. Interestingly, I teach undergraduate nursing students to expect change and I often use the phrase, “We are nurses, we punt!” Not only do I teach the nursing students to expect change, when in the classroom I also role model the ability to move to a back-up plan. Since the changes and delay between my proposal and implementation of the program evaluation were expected this was not a frustrating time for me, which leads to me another lesson I learned about myself: Expected change is something I can
deal with easily. However, when I encountered unexpected change, for example the IRB delays, I was not so accommodating. Unexpected change is frustrating for me.

My reflection upon my dissertation process has taught me several things. I need to trust myself and my ability to write. I need to seek help and support more quickly and to take advantage of the expertise of those around me. If I need to write survey questions again in my future, this dissertation process was a good reminder that writing survey questions is not easy. And finally, while I deal well with expected change, I need to figure out better ways to process and manage unexpected change.

Application to my professional practice

My dissertation provided me with ample opportunities to improve my practice and processes at my institution. An immediate benefit for my practice was the confirmation that the students in our pre-licensure nursing program are performing well. In fact, they are outperforming others in math calculations for safe medication administration. The data collected from the standardized testing completed by all senior nursing students confirmed the entire cohort of our students are correctly answering questions regarding dosage math calculations for safe medication administration. This portion of the program evaluation findings was a clear sign to the MMAP faculty team that our efforts are producing excellent results for our students.

As our team moves forward with our MMAP program there are recommendations we discovered through this MMAP program evaluation to be considered. Most importantly, we need to engage our fellow faculty again. I will be suggesting a faculty development workshop with on-
line faculty resources to provide information about dimensional analysis and using teachable moments at the clinical setting and in the simulation/skills labs. As noted previously, I completed this formative evaluation in my backyard and my positionality as the evaluator, a key faculty stakeholder who created and maintains the MMAP program, and also an author of poster presentations, there is a potential for bias. While my multiple roles provided easy access to the evaluand and the ability to implement the findings of this formative evaluation, future evaluations of the MMAP program should involve an external evaluator to reduce bias. Future evaluations should also consider the financial aspects of the MMAP program. And a goal for the MMAP faculty stakeholders should be to publish an article concerning our MMAP processes. We have developed a successful program and we need to share our findings with other undergraduate nursing faculty.

As I consider the possibility of sharing these findings with other nursing programs through a nursing journal, I wonder how well a program evaluation will be received. As noted by Adams and Neville (2020), healthcare professionals do not understand the benefits of collecting data and then making conclusions that address the merit, worth, and significance of the program being evaluated. Even though standard research techniques are used to collect the data, the valuing included in a program evaluation is not understood. As I learned more about program evaluation while completing my dissertation, I grew to more fully appreciate the judgement that is involved in a program evaluation. I was reminded of a definition of Evidence-Based Nursing Practice (EBNP) which compares EBNP to a three-legged stool that incorporates research, the expertise of the nurse, and the values of the patient and his/her family (Hopp & Rittenmeyer, 2012). Recently I read a description of evidence-based teaching as practice that incorporates research, professional judgement, and student preferences and values (Caputi, 2020). The words
value and judgement used to describe EBNP and evidenced based teaching very much align with the definition of program evaluation (Mertens & Wilson, 2019). Perhaps more schools of nursing should use this approach to support their decision making. My role as a faculty member and my participation in a curriculum revision will benefit from my experience with a program evaluation. Highlighting the benefits of conducting a program evaluation – to the program but also to me, as a professional – will be important in convincing others that evaluating programs is a worthwhile endeavor.

Application to Scholarly Inquiry

The skills I have developed throughout my dissertation process have changed how I engage with and think about scholarly inquiry. I now take a more critical approach when reading journal articles. Previously I would skim through the methods sections of an article. Now I am slowly reading through the entire article and often write notations in the margins about the methodology or statistical tests used. I admit that I must grab my textbooks and refresh my memory sometimes. But I believe this is a valuable learning process and will allow me to continue learning long after I complete this doctorate.

I am also excited to apply what I have learned particularly in relation to research methods and program evaluations. Through my dissertation process, I learned to appreciate the practical nature of a program evaluation, particularly a formative evaluation such as my dissertation. This approach aligns with my reflections while reading about paradigms. I decided that I primarily hold to a pragmatic paradigm (Mertens & Wilson, 2019). The consideration of the usefulness of
the data and the very practical nature of a program evaluation aligns perfectly with my formative MMAP program evaluation. Our MMAP program will continue, and we will need to re-evaluate. Thanks to this experience, I now have ideas to share with my fellow stakeholders for evaluation of the MMAP program, particularly in relation to the clinical and simulation faculty at our facility.

I know that I just dipped my toes into the waters of program evaluations. I completed a small-scale program evaluation in one department at a regional university. Program evaluations that look at a national program, or a government funded initiative are of a much larger scale and have a team of evaluators. I would like to be involved in a project of this size someday, although I should first engage in more research and evaluation opportunities to build both my confidence and my skills even further.

My dissertation process also affirmed my appreciation of mixed methods approaches to scholarly inquiry. As I recall, during my master’s program I understood and enjoyed my statistics course. (Please keep in mind, my master’s degree was completed more than 25 years and three kids ago). And yes, I enjoyed the statistics course in my doctoral program also. However, I did not want to limit myself to a quantitative dissertation project. Even though I appreciate the skills required to complete some detailed quantitative data analysis, I always felt this was only part of the story. In my opinion, a mixed methods approach provides a more complete picture of the program or phenomena being studied.

The decision to use a mixed methods approach not only fit the MMAP program evaluation, but it challenged me to collect and analyze both quantitative and qualitative data. I do not claim to be an expert with either quantitative or qualitative research and data analysis. My experiences are very limited with qualitative research. During my doctoral student experiences at
NIU, an extracurricular opportunity arose where I participated with a NIU faculty member and some fellow students to perform a qualitative study. This was not a formal part of my coursework, but it was an invaluable experience that helped me to trust myself and my ability enough to incorporate both qualitative and quantitative research methods for my dissertation. I am glad I stretched myself and did mixed methods. The skills I developed through my dissertation process have further increased my confidence in utilizing different methodologies.

Conducting this program evaluation also made me realize that I would love to engage in more quantitative research. My MMAP program evaluation included only descriptive statistics. During this dissertation process, it would have been the ideal time to attempt some more complicated statistics, what I like to call mathematical gymnastics. In fact, a part of me was disappointed that my data analyses did not include some complex statistics and the use of SPSS. With my dissertation chair guiding and correcting me, this would have been an excellent time to incorporate more complicated statistics. The decision to use only descriptive statistics was largely based upon the lack of time. My dissertation proposal originally included more data to be collected and analyzed. For example, I proposed an evaluation of the quality of the questions included in the MMAP pool but in conversations with my stakeholders, I decided to home in on more pressing aspects of the program that needed to be evaluated. Additionally, I did not have the ability to follow a cohort of undergraduate nursing students through their final three years of our nursing program. By following a cohort of students, I could have completed comparative statistical analyses such as $t$-tests (Creswell & Creswell, 2018). These possibilities for additional data collection and statistical analyses would have required considerably more effort and time. Perhaps with a future evaluation of the MMAP program, I will include more statistics.
I know that this dissertation will not be the last time I engage in scholarly inquiry, whether through conducting additional program evaluations of the MMAP program or engaging in research. In the past, I have worked with a faculty team to write articles and a very lengthy document for our program certification. I look forward to continuing this practice of writing with a team. I also hope that I can work with some fellow faculty members on a research project. I am curious about so many aspects of my role as an educator in an undergraduate nursing program. I would like to research many topics in the literature and subsequently develop a research project. By completing a mixed methods design, I have dabbled in both quantitative and qualitative research methods. While I am now more comfortable with both types of research, I do not have the confidence to tackle a project on my own. I thus plan to team up with a quantitative researcher to better hone my skills with quantitative research designs. And I should also team up with a qualitative researcher again to gain additional insights into this methodology.

While many of my plans are still up in the air, I have already started to engage in additional research. This Ed.D. program gave me the confidence I needed to apply for, and I received a seed grant for a project concerning holistic admissions for our undergraduate program. This project involves working with academic advisors and other undergraduate nursing faculty, in other words with a team. Working with a team will allow me to continue growing as a researcher and I look forward to all the things I will learn through this new project.
Conclusion

As I write this conclusion, I wonder if I have or will experience imposter syndrome. Do I really know what I claim to know? Am I ready to be considered a nurse educator with a doctorate degree? Most of the time I say yes, I am ready. But recently I received feedback on a section of my dissertation. As I prepared to review the comments and edits, all those doubts and thoughts of imposter syndrome returned. My answer to those thoughts is that I am not alone. This seems to be a common theme for my reflections upon my dissertation process. I am not alone. I have a team. I have fellow faculty members to whom I can pose questions. I have a dissertation chair who is always willing to answer my questions. And I have textbooks and resources to refresh my memory when things are unclear. I know that having these resources and the support of peers and mentors will allow me to continue my journey as a scholar practitioner, a journey I only started with this doctoral program.
REFERENCES


APPENDIX A

CONSENT FOR FOCUS GROUP
APPENDIX A CONSENT FOR FOCUS GROUP

**Evaluation of a Math and Medication Administration Proficiency (MMAP) Program in a Pre-licensure Nursing Program**

**Study Title:** Evaluation of a Math and Medication Administration Proficiency (MMAP) Program in a Pre-licensure Nursing Program

**Investigators**

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<thead>
<tr>
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**Key Information**

- This is a voluntary research study on the success of the Math and Medication Administration Proficiency (MMAP) program in a pre-licensure nursing program.
- This one-year study involves one or two 1.5-hour long group interviews with you and the other key faculty in the MMAP program regarding the goals of the MMAP program and planning for evaluation of the goals.
- The benefits include justification for the continued implementation of the MMAP program; there are no risks anticipated.

**Description of the Study**

The purpose of the study is to develop formal goals for the MMAP program and to plan a program evaluation. If you agree to be in this study, you will be asked to do the following things: participate in at least one, possibly two, virtual and recorded group interviews using Zoom. The first interview will be planned for 1.5 hours in duration. If the goals and program evaluation plans for the MMAP program have not been finalized after 1.5 hours, a second one-hour Zoom interview will be planned. After consideration, the developed goals and the planned evaluation will be shared with you via email for your review. Throughout the academic year (i.e., Fall 2022 through Spring 2023 semesters), clarification questions may be emailed to you.

**Risks and Benefits**

There are no direct benefits for participants. There are no reasonably foreseeable or expected risks.

Benefits to the institution and the field of pre-licensure nursing education include the justification for your continued involvement in the MMAP program. If the evaluation of the MMAP program shows value and worth, dissemination of the MMAP program processes to other pre-licensure nursing programs is possible.

**Confidentiality**
The records of this study will be kept strictly confidential. Research records will be kept in a locked file, and all electronic information will be coded and secured using a password protected file. Only the primary researcher will have access to recorded Zoom interviews and word-for-word transcription of the interview. The videos and the transcription will be deleted three years after the interview. We will not include any information in any report we may publish that would make it possible to identify you.

- It should be understood that, when participating in a group interview, confidentiality among the members of the group cannot be guaranteed.

**Your Rights**

The decision to participate in this study is entirely up to you. You may refuse to take part in the study at any time. Your decision will not result in any loss of benefits to which you are otherwise entitled. You have the right to skip any question or research activity, as well as to withdraw completely from participation at any point during the process.

You have the right to ask questions about this research study and to have those questions answered before, during, or after the research. If you have any further questions about the study, at any time feel free to contact the researcher, Dianne Hoekstra at dhoekstr@pnw.edu or by telephone at (708) 309-7167. Contact information for my faculty mentor is: Dr. G. Nyunt, gnyunt@niu.edu, (815) 753-9373. If you have any questions about your rights as a research participant that have not been answered by the investigators or if you have any problems or concerns that occur as a result of your participation, you may contact the Office of Research Compliance, Integrity, and Safety at (815)753-8588.

**Future Use of the Research Data**

Your information collected as a part of this research will not be used or distributed for future research, even if all identifiers are removed.

Your signature below indicates that you have decided to volunteer as a research participant for this study, and that you have read and understood the information provided above. You will be given a signed and dated copy of this form to keep, along with any other printed materials deemed necessary by the study investigators.

________________________________________________  _____________________
Participant’s Signature                          Date

I give my consent to be audio and visually recorded during the virtual interview(s) using Zoom format.

________________________________________________  _____________________
Participant’s Signature                          Date
APPENDIX B

QUESTIONS FOR SEMI-STRUCTURED FOCUS GROUP

WITH 2 KEY FACULTY STAKEHOLDERS
APPENDIX B: QUESTIONS FOR SEMI-STRUCTURED FOCUS GROUP WITH 2 KEY FACULTY STAKEHOLDERS

Prior to the introduction, participants were informed of the AV recording, and both agreed to the recording of the interview.

Introduction:
Thank you for your participation in this interview. You have received a copy of the consent form; do you have any questions concerning your participation in this interview?

Thank you for your questions. Please sign the consent.

Open Ended Questions:
1. In your opinion, what are the goals for the Math and Medication Administration Proficiency Program (MMAP) program?
   a. How can we take our suggestions for the goals of the MMAP program and combine them into one final and formal list of goals?
2. How do you suggest we evaluate whether the MMAP program is meeting each of these goals?
3. Which goal(s) do you feel is a priority for evaluation at this time?
Which goals can wait for a later evaluation?
APPENDIX C

CONSENT FOR CLINICAL AND SIMULATION

FACULTY SURVEY
APPENDIX C CONSENT FOR CLINICAL AND SIMULATION FACULTY SURVEY

Evaluation of a Math and Medication Administration Proficiency (MMAP) Program in a Pre-licensure Nursing Program

Key Information
- This is a voluntary research study on the success of the Math and Medication Administration Proficiency (MMAP) program in a pre-licensure nursing program.
- Participation in this study involves completion of an anonymous survey by pre-licensure full-time nursing faculty whose students complete testing within the MMAP program and who provide care to patients in a simulation laboratory or at a clinical facility.
- The benefits include justification for the continued implementation of the MMAP program; there are no risks anticipated.

Description of the Study
The purpose of the study is to evaluate the MMAP program. If you agree to be in this study, you will be asked to complete an anonymous Qualtrics survey regarding students and their proficiency with math and medication administration proficiency.

Risks and Benefits
There are no direct benefits for participants. There are no reasonably foreseeable or expected risks.

Benefits to the institution and the field of pre-licensure nursing education include the justification for continued involvement in the MMAP program. If the evaluation of the MMAP program shows value and worth, dissemination of the MMAP program processes to other pre-licensure nursing programs is possible.

Anonymity
This study is anonymous. We will not be collecting or retaining any information about your identity.

Your Rights
The decision to participate in this study is entirely up to you. You may refuse to take part in the study at any time. Your decision will not result in any loss of benefits to which you are
otherwise entitled. You have the right to skip any question or research activity, as well as to withdraw completely from participation at any point during the process.

You have the right to ask questions about this research study and to have those questions answered before, during, or after the research. If you have any further questions about the study, at any time feel free to contact the researcher, Dianne Hoekstra at dhoekstr@pnw.edu or by telephone at (708) 309-7167. Contact information for my faculty mentor is: Dr. G. Nyunt, gnyunt@niu.edu, (815) 753-9373. If you have any questions about your rights as a research participant that have not been answered by the investigators or if you have any problems or concerns that occur as a result of your participation, you may contact the Office of Research Compliance, Integrity, and Safety at (815)753-8588.

**Future Use of the Research Data**
Your information collected as a part of this research will not be used or distributed for future research.

By completing the survey using the link provided below, you are indicating that you have decided to volunteer as a research participant for this study, and that you have read and understood the information provided above. Please take a screenshot or picture of this form to keep for your records.

- [ ] I agree to participate in this study.
- [ ] I do not agree to participate in this study.

Link to the anonymous Qualtrics survey:
https://purdue.ca1.qualtrics.com/jfe/form/SV_exhflcJVLv4R9cO
APPENDIX D

CLINICAL AND SIMULATION FACULTY SURVEY QUESTIONS
APPENDIX D CLINICAL AND SIMULATION FACULTY SURVEY QUESTIONS

Introduction and Questions for the Faculty Survey:

Dear Faculty Member,

In 2018, several faculty members in the College of Nursing (CON) at Midwest University (pseudonym) began work to improve the consistency of instruction and assessment of undergraduate nursing student’s math skills for safe medication administration. Working under the auspices of the Testing Committee, the MMAP sub-committee developed a program that was piloted and approved by all faculty members in December 2019. Today, the MMAP program provides standardized testing, preparation, and consequences regarding math for safe medication administration.

I, Dianne Hoekstra, am evaluating whether the goals of the MMAP program are being met. This project is part of the requirements for my doctoral program at Northern Illinois University (i.e., Ed.D. in Higher Education). I am also an original and current member of the Midwest University MMAP team.

As a faculty member who currently teaches in the simulation lab or clinical setting, you are being asked to complete a survey to assist the team with the evaluation of MMAP program. Your responses will remain anonymous. Please see the consent form attached to this email. By completing this survey, you are granting consent for your participation.

Questions:

1. Select the location where you are teaching pre-licensure nursing students this semester:
   a. Hospital setting
   b. Simulation lab
   c. Both the Simulation lab and the hospital setting

2. Indicate how many semesters you have taught clinically in either the Simulation Lab or the hospital setting for the College of Nursing at Midwest University:
   a. 2-3 semesters
   b. 4-6 semesters
   c. More than 6 semesters

3. If you are a primary lecturer for a course with a clinical, do you include math calculations over didactic (lecture) content on your exams and quizzes?
   a. Yes
   b. No
   c. Not applicable

4. Do you incorporate math calculations during the clinical experiences at the hospital?
   a. Yes
   b. No
   c. Not applicable, I do not teach in the hospital setting.
5. Do you incorporate math calculations during the simulation lab experiences?
   a. Yes
   b. No
   c. Not applicable, I do not teach in the Simulation Lab

6. What method for medication calculations do you use, or have you used, as a Registered Nurse at the bedside?
   a. Dimensional analysis
   b. Ratio and Proportion
   c. Other, with blank

7. Are you confident in your ability to coach a student through solving a problem using dimensional analysis?
   a. Yes
   b. Maybe
   c. No

8. What resources do you have available to you for assisting students with math for safe medication administration?

9. Would you be interested in a faculty development activity to reinforce use of dimensional analysis for medication calculations?
   a. Yes
   b. No

10. If a student is presented with a medication administration math calculation, are you confident the students are able to correctly calculate the answer?
    a. 100% of the time
    b. 75-99% of the time
    c. 50-74% of the time
    d. Less than 50% of the time

11. When preparing to administer a medication to a patient, do you agree it is imperative that the nursing student checks the calculations and information provided on the medication administration record (MAR)?
    a. Agree
    b. Somewhat agree
    c. Neither agree or disagree
    d. Somewhat disagree
    e. Disagree

12. When preparing to administer a medication to a patient, do you agree it is imperative that the registered nurses (RN) check the calculations and instructions provided on the MAR?
    a. Agree
    b. Somewhat agree
    c. Neither agree or disagree
d. Somewhat disagree
e. Disagree

13. How do you assess the student’s competency for safe math calculations with medication administration in the clinical or sim lab setting? Please share your techniques in the space below.

14. How much do you value the nursing student’s demonstration of math competency in the clinical or sim lab setting?
   a. Very important
   b. Important
   c. Somewhat important
   d. Not important

(Misnumbering occurred at this point during the faculty survey)

16. Do you feel it is your role as the clinical or simulation faculty to assess the nursing student’s demonstration of math competency?
   a. Definitely
   b. Perhaps
   c. Not at all

17. How can the MMAP faculty team provide further support for faculty regarding calculations for safe medication administration?