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https://epublications.marquette.edu/dissertations_mu/669

EFFECT OF SEQUENCE OF SIMULATED AND CLINICAL PRACTICUM LEARNING EXPERIENCES ON CLINICAL COMPETENCY OF NURSING STUDENTS

by

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A Dissertation submitted to the Faculty of the Graduate School,
Marquette University,
in Partial Fulfillment of the Requirements for
the Degree of Doctor of Philosophy

Milwaukee, Wisconsin

December 2016

ABSTRACT
EFFECT OF SEQUENCE OF SIMULATED AND CLINICAL PRACTICUM LEARNING EXPERIENCES ON CLINICAL COMPETENCY OF NURSING STUDENTS

Jamie Hansen MSN, RN, CNE

Marquette University, 2016

Delivery of clinical education using the traditional model involving faculty supervision of students in a hospital setting has become increasingly difficult for schools of nursing due to factors such as increased student enrollment and decreased clinical site availability. Simulated learning experiences (SLE) have increasingly been used as a supplement or replacement for a portion of nursing students' traditional clinical learning experiences (CLE). There has been a call for research to ensure that new models for delivery of clinical education are built on a foundation of research. Although SLE have been increasingly used as a supplement to CLE, it is unknown if the sequence in which these learning experiences occur affects nursing students' clinical competency development.

This study was guided by the NLN/Jeffries' Simulation Framework and employed a crossover design to explore the effects of age and sequence of blocks of SLE and CLE on clinical competency development. Forty-eight nursing students in their first medical surgical practicum rotation participated. Participants were randomly assigned to one of two group sequences of simulated and clinical practicum learning experiences over the course of one semester. Clinical competency assessment using the Creighton Competency Evaluation Instrument (CCEI) occurred at three time periods: (1) During a designated simulation vignette at the end of participants' SLE rotation; (2) During a preselected clinical day/single patient encounter occurring in the final week of participants' CLE rotation; and (3) After completion of the semester during a follow up simulation vignette. Repeated measures analysis of variance was used to determine if CCEI total scores or subscale scores differed over the three measurement time points within or between the two groups.

Results demonstrated no significant differences in CCEI total or subscale scores between the two groups across the three data collection points. There was also no significant effect of age and group on CCEI total scores or subscales. The use of sequences of blocks of SLE and CLE may help address barriers in delivery of traditional clinical education faced by schools of nursing such as increased student enrollment and lack of clinical site availability, but further study is needed.

ACKNOWLEDGMENTS

Jamie Hansen, MSN, RN, CNE

There are several people that I would like to take the opportunity to thank for their support throughout my doctoral program journey. First, I would like to thank my academic advisor and dissertation chair Dr. Marilyn Bratt for guiding and supporting me throughout the challenging dissertation process. I would also like to thank my dissertation committee members Dr. Marilyn Frenn and Dr. Donna McCarthy for their time, feedback and support during the dissertation process. I would also like to acknowledge Dr. Aimee Woda for her mentorship and assistance with data collection. In addition, I would like to recognize all of my professors at Marquette University for challenging and inspiring me to learn more and to accomplish feats I never thought possible. Without the strong foundation of coursework this dissertation project would not have been possible.

I would like to thank Sigma Theta Tau International for funding this dissertation project. I am also appreciative for the support and encouragement of my peers at Marquette and co-workers at Carroll University throughout this journey.

I am thankful to all my family and friends for their love, support and understanding during this time in my life. I am grateful for my great-grandmother Katherine who instilled a love of nursing in me from a very young age. I am sure she is smiling down on me. I would especially like to acknowledge my husband Jason who has encouraged me to always follow my dreams. Without his patience and never-ending love, I would not be where I am today. Finally, I would like to thank my two children Jared and Evan for always believing in me and thinking that their mom is a superhero.

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CHAPTER 1

Problem/Significance to Nursing

Providing quality clinical learning experiences (CLE) that foster the development of competency in nursing students prior to entry into practice is a vital role of nurse educators. The Institute of Medicine's (IOM, 2003) report, *Health Professions Education: A Bridge to Quality* defined five core areas of competency for all nursing students and professional nurses: patient centered care, interdisciplinary teamwork, use of evidence based practice, quality improvement, and use of information technology. An additional core competency of patient safety was later added. Nursing students are expected to graduate with the knowledge, skills, and attitudes related to each area of competency (Cronenwett et al., 2007). However, nursing care "continues to grow more complex, and nurses must make critical decisions associated with caring for sicker, frailer patients" (IOM, 2011, p. 177). Thus, it has become increasingly difficult for nurse educators to ensure students are meeting these six core areas of competency using a traditional model of clinical education.

Nurse educators today are being faced with several challenges to providing quality CLE that lead to the development of competency core areas that prepare nursing students to enter the nursing workforce. These challenges include increasing student enrollment numbers, a shortage of nursing faculty, increasing patient acuity, and decreasing clinical site availability (Bensfield, Olech, & Horsley, 2012; Ironside, Jeffries, & Martin, 2009; Jeffries, 2005).

The Bureau of Labor Statistics (2013) has projected that the need for professional nurses will grow by 19% (526,800) and that there will be an additional 1.05 million job openings due to growth in the health care industry and workforce replacement needs by 2022. The nursing shortage is expected to be intensified as the health care needs of the aging Baby Boomer population grows (AACN, 2015). Schools of nursing have increased enrollment numbers to address the projected nursing shortage. According to a 2015 report by the American Association of Colleges of Nursing (AACN), enrollment in Baccalaureate nursing programs increased by 2.6% between 2012 and 2013.

Increases in nursing student enrollment numbers have led to an increase in the number of nursing faculty needed to educate students. According to the AACN, more than 78,000 qualified student applicants were turned away in 2013 by baccalaureate schools of nursing in the United States; two-thirds of schools cited faculty shortages as a main factor in determining acceptance rates (2015). Faculty shortages are the result of factors such as inadequate numbers of doctoral-prepared nurses and non-competitive faculty salaries compared to those earned in practice settings; schools of nursing reported nearly 1,400 faculty vacancies across the United States in 2013 (AACN, 2015).

The traditional model of clinical education in nursing involves faculty supervision of students who provide direct patient care in a hospital or other clinical setting (Richardson, Goldsamt, Simmons, Gilmartin, & Jeffries, 2014); students have the opportunity to plan, implement, and evaluate nursing care for their assigned patients. Under this model, clinical instructors supervise between eight and ten students per clinical day (Chappy & Stewart, 2004). While most state boards of nursing regulate clinical instructor to student ratios, patient acuity levels are often not considered in this

calculation, which has put added strains on clinical instructors to ensure they provide quality clinical education. In hospital settings CLE can be fast-paced and a high-pressure environment for students. Direct observation of student performance by clinical instructors is the primary method used in the evaluation of student competency in the clinical setting (Oermann et al., 2009). However, evaluation in the clinical setting has become increasingly difficult as clinical instructors report that more than 50 percent of clinical time is spent supervising student skill performance (e.g., dressing changes, intravenous therapy) as opposed to working with students to analyze assessment data and make clinical decisions (Ironside & McNelis, 2010). According to the National League for Nursing's (NLN) report, *Clinical Education in Prelicensure Nursing Programs: Results from an NLN National Survey*, 44.5% of respondents reported clinical instructor to student ratios in the clinical setting as a barrier in providing quality clinical education (Ironside & McNelis, 2010). These findings suggest that the traditional model of clinical education needs to be reexamined to account for factors such as patient acuity levels.

A final challenge faced by nurse educators to providing quality CLE is the decreased availability of quality clinical sites. With increased enrollment in pre-licensure programs, schools of nursing often compete with each other for quality CLE for students. A shortage of clinical sites that provide quality patient care experiences can impede the development of clinical competency in nursing students. According to the NLN's national survey, 51% of respondents reported a lack of quality clinical sites as a major barrier to providing student learning in the clinical setting (Ironside & McNelis, 2010).

Nurse educators are challenged to find alternative methods to provide students sufficient opportunities to gain the nursing knowledge and skills required to meet

complex patient needs when entering the workforce as new graduate nurses. The IOM's report, *The Future of Nursing: Leading Change, Advancing Health* (2011), has called for an examination of clinical education models and specifically for research exploring simulated learning experiences (SLE) as an alternative method to provide quality clinical education in nursing.

The use of SLE as a supplement or replacement for a portion of traditional CLE has gained acceptance in nursing programs over the past decade (Gates, Parr, & Hughen, 2012). According to the International Nursing Association for Clinical Simulation and Learning (INACSL), SLE are defined as:

> An array of structured activities that represent actual or potential situations in education and practice and allow participants to develop or enhance knowledge, skills, and attitudes or analyze and respond to realistic situations in a simulated environment or through an unfolding case study (Meakim et al., 2013).

A national survey conducted by the National Council of State Boards of Nursing (NCSBN) revealed that 87% of the nursing school respondents use simulation to supplement or replace a portion of students' CLE in their nursing program (Hayden, 2010). Simulated learning experiences are designed to authentically mimic real clinical scenarios in a safe and controlled environment (Bland, Topping, & Wood, 2011; Jeffries, 2005). Simulation is a teaching method that can provide students opportunities to engage in a variety of patient care situations and activities, some of which students may not be exposed to in the traditional clinical setting (Sportsman, Schumacker, & Hamilton, 2011). SLE are different from CLE in that SLE provide students an interactive environment that is a representation of real-world experiences (Gaba, 2004). In addition, students in a simulated clinical setting are to able make decisions, practice skills, and learn from

mistakes without the risk of harming actual patients, thus providing students some degree of psychological safety (Meakim et al., 2013). As a result, SLE have been incorporated into nursing programs to support the development of patient safety and clinical competency (Jeffries, 2012).

The ultimate goal of nurse educators is to use a clinical education model that addresses the challenges of providing quality CLE while ensuring the development of clinical competency in students prior to entry into practice. While new models of clinical education to address the challenges being faced by nurse educators have been described in the literature (Richardson et al., 2014), there is limited research on the effect of these models on student outcomes and the development of clinical competency. Therefore, there is a continued need for research to determine whether new models of clinical education effectively circumvent challenges to providing quality CLE without compromising student outcomes and development of clinical competency.

SLE have been shown to promote clinical reasoning, clinical judgment, critical thinking, problem solving, and psychomotor skill development, all of which contribute to the development of clinical competency (Meakim et al., 2013). It is recognized that the integration of SLE into nursing curricula should be done in a manner that best promotes student development of clinical competency (Masters, 2013). However, standards of best practice for simulation have yet to address the optimal ratio and sequence of SLE and CLE (INACSL, 2011). Currently, in the United States, each state board of nursing specifies the amount of simulation hours that can be designated as clinical hours (Gore, Van Gele, Ravert, & Mabire, 2012) leading to a great deal of variability across nursing programs (Hayden, 2010). The NCSBN recently conducted a National Simulation Study

exploring student outcomes when traditional CLE were replaced with SLE 25% or 50% of the time (Hayden, Smiley, Alexander, Kardong-Edgren, & Jeffries, 2014). The findings of this study revealed that up to 50% of traditional clinical time could be replaced with simulation with no change in student outcomes, however researchers did not control for the sequence of CLE and SLE (Hayden, Smiley et al., 2014). Based on the results of this study, NCSBN has published national simulation guidelines regarding the use of simulation in undergraduate nursing programs (Alexander, et al., 2015).

Research in human learning suggests that the sequence of learning activities may have an effect on student outcomes (Ritter, Nerb, Lehtinen, & O'Shea, 2007; Rohrer & Pashler, 2010). The most basic principle is that one must build upon previous knowledge and that students must possess appropriate background knowledge to be successful in a new learning situation (Ritter et al., 2007). Reports in the literature indicate that SLE promote improved student skill performance (Lynagh, Burton, & Sanson-Fisher, 2007), self-confidence in skill performance (Lamb, 2007), safety in clinical practice, and may increase student demonstration of patient assessment behaviors (Harder, 2010).

Students have reported that participation in SLE prior to CLE was beneficial in clarifying basic principles before direct patient care and developing their critical thinking skills (Schlairet and Fenster, 2012). According to Harder, the purpose of SLE is to "prepare students for clinical situations they may encounter" (2010, p. 23). The thought that SLE should be used to prepare students for CLE has led schools of nursing to believe that placing SLE prior to CLE will allow for greater knowledge gains and transfer of knowledge to the clinical setting compared to the placement of SLE following traditional CLE. However, research has indicated that SLE may produce equivalent student

competency outcomes when compared to traditional lecture and CLE alone (Alliner, Hunt, Gordon, & Harwood 2006; Blum, Borglund, & Parcells, 2010; Brannan, White, & Brezanson, 2008; Gates et al., 2012; Ironside et al., 2009; McKeon, Norris, Cardell, & Britt, 2009; Mould, White & Gallagher, 2011; Radhakrishnan, Roche, & Cunningham, 2007; Tubaishat & Tawalbeh, 2015). It is possible that student outcomes and the development of clinical competency may be equivalent whether SLE precede or follow CLE. What is not known is whether providing SLE prior to or following CLE affects the development of clinical competency.

To date, few studies in the nursing literature address student outcomes and development of competency using different sequences of traditional CLE and SLE (Curl, Smith, Chisholm, McGee, & Das, 2016; Meyer, Connors, Hou, & Gajewski, 2011; Schlairet & Fenster, 2012; Schlairet & Pollack, 2010). In addition, the majority of these studies have examined student outcomes and clinical competencies following intermittent participation in SLE during a semester rather than replacement of a large block of students SLE with CLE. Substituting a portion of students traditional CLE with SLE has the potential to decrease the number of clinical units needed in a given semester by up to 50 percent (Richardson et al., 2014). For example, one group could participate in CLE on a given clinical unit for the first portion of the semester and then participate in SLE, while another group would participate in SLE during the first half of the semester followed by CLE on the same clinical unit for the second half of the semester. However, research is needed to determine if a sequence of blocks of SLE and CLE impacts the development of clinical competency.

The manner in which clinical competency is evaluated should be done by trained instructors using tools with established reliability and validity (Bensfield et al., 2012; Hansen & Bratt, 2014). However, to date there is no consensus regarding a specific tool or method to evaluate competency in the simulation or clinical environments. The method to evaluate clinical competency should be consistent in SLE and CLE if SLE are being used as a supplement or replacement for a portion of students' CLE. Availability of tools with established reliability and validity for evaluation of clinical competency in CLE and SLE may aid in determining if the sequence of SLE and CLE impacts student outcomes.

Learner characteristics may impact the development of competency. There are some data that suggest that age may impact learner outcomes associated with SLE (Jeffries, 2012). However, evidence to date on the influence of age on student outcomes of SLE has provided conflicting results (Ironside et al., 2009; Lasater, 2005; Mould et al., 2011).

In summary, there is a need to transform the traditional clinical educational model to address the challenges faced by nursing educators in providing quality CLE. Incorporation of SLE as a supplement or replacement for a portion of students' traditional CLE is one approach that may address these challenges. The sequence in which students participate in SLE and CLE may impact learner outcomes. The examination of how alternative models of clinical education affect student outcomes is needed to ensure students receive quality learning experiences that foster the development of clinical competencies needed for professional nursing practice.

Study Purpose and Aims

The purpose of this study was to determine if a sequence of blocks of SLE and CLE in a clinical course affected the development of clinical competencies in nursing students. The specific aim was to compare the effect of two different sequences of blocks of SLE and CLE, and student age, on students' competency scores at the end of a course. Competency scores of students who participated in SLE over the course of a seven-week period followed by a seven-week period of CLE (Group S-C) were compared to those in CLE followed by SLE (Group C-S).

CHAPTER 2

Review of the Literature

This chapter will present the theoretical framework used to guide the study, the relevant philosophical underpinnings, and will provide a comprehensive and critical analysis of the current state of the science pertinent to the study. The assumptions for the study, research questions, and study hypotheses will be presented. Finally, this chapter will highlight the gaps found in the literature and how this study addresses the identified gaps.

Theoretical Framework

According to Fawcett (1999) a conceptual model/framework is "a set of relatively abstract and general concepts and the propositions that describe or link those concepts" (p. 3). Investigation using existing theoretical knowledge allows for expansion or modification of current knowledge, thus moving the science forward (Fawcett, 1999). This study was guided by the NLN/Jeffries Simulation Framework (Jeffries, 2012), which served as the conceptual model for studying the selected variables (Jeffries, 2012).

NLN/Jeffries simulation framework. The NLN/Jeffries Simulation framework was developed based on theoretical and empirical work in the area of simulation as a means of defining the major constructs for the design, implementation, and evaluation of student learning outcomes (Jeffries, 2005). The framework includes five conceptual components: participant, facilitator, educational practices, simulation design characteristics, and outcomes; the framework specifies pertinent variables and their

relationships for assessing learner outcomes (Jeffries, 2005). Relationships and variables chosen from the framework that were examined in this study include the participant, simulation design characteristics, and outcomes.

Within this framework, participant refers to the student or students given an assigned role in a simulation scenario. Expectations of participants in their assigned roles should be clearly outlined in course objectives and shared with students. Learner characteristics, such as age, have the potential to impact learner outcomes and are measured using a demographic survey (Jeffries, 2005).

Simulation design characteristics describe the features that should be incorporated into SLE (Jeffries, 2012). "Objectives, fidelity, problem solving, student support, and reflective thinking (debriefing)" are major features of simulation design, which should be included to some degree depending on the outcomes intended for the SLE (Jeffries, 2012, p. 32). These simulation design characteristics guided the development of the SLE included in the study. Research has reported positive correlations between student perception of simulation design and simulation outcomes (Ahn & Kim, 2015).

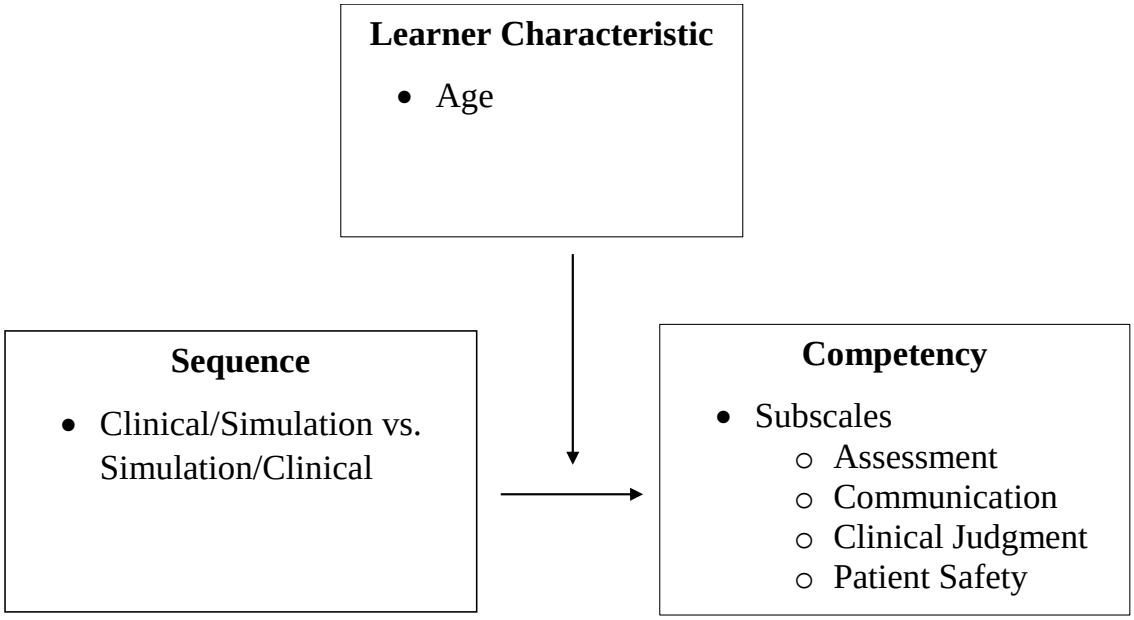
Within the NLN/Jeffries Simulation framework, the concept of design does not include the sequence of SLE in relationship to CLE within a course or program curriculum as a variable. For the proposed study, the sequence of SLE in relationship to CLE in a clinical practicum course was the independent variable. The concept of *simulation design characteristics* was represented by the study concept of *sequence*. In the study, the effects of sequence of SLE and CLE on clinical competency were measured using the Creighton Competency Evaluation Instrument (CCEI).

Outcomes are defined as measurable effects of a simulated learning experience (O'Donnell, Decker, Howard, Levett-Jones, & Miller, 2014). Learning outcomes may include self-confidence or self-efficacy, critical thinking or clinical judgment, learner satisfaction, and skills performance (Jeffries, 2012; O'Donnell, et al., 2014). The concept of *outcomes* was represented by the study concept *competency*, which was measured using the CCEI. The associations between the NLN/Jeffries Simulation framework concepts, study variables, and study measures are seen in Table 1 and the relationships between study variables are presented in Figure 1.

Table 1
Conceptual-Theoretical-Empirical Structure

NLN/Jeffries Simulation Framework Concepts	Theoretical Study Variable	Study Measures
Participant	Learner Characteristics	Age
Outcomes	Competency	Creighton Competency Evaluation Instrument (CCEI)
Simulation Design Characteristics	Sequence	Groups (C-S, S-C)

Figure 1
Conceptual Framework



***** Based on NLN/Jeffries Simulation Framework (2012)

Philosophical Underpinnings

Research is driven by philosophical underpinnings. Post-positivism served as the philosophical basis for this study. Post-positivism is considered a contemporary empirical viewpoint that focuses on observations and scientific strategies (Racher, & Robinson, 2003). In the post-positivist paradigm, knowledge is built by adding new knowledge to the existing evidence base (Lincoln & Guba, 2000). The ontology, epistemology, and methodological assumptions of post-positivism will be described, and justification of post-positivism as the philosophical underpinning for this study will be provided.

Ontology is described as the nature of reality. Within the post-positivist paradigm multiple realities are said to exist. Reality is constantly changing and developing, such

that reality can never be fully understood or explained. Human factors are thought to greatly influence individual perceptions of reality (Crossan, 2003).

Epistemology refers to the relationship of the researcher and participant in the research process. Modified objectivist is the epistemology within the post-positivist paradigm (Guba, 1990). The researcher shapes the research process, but must remain neutral to not influence the study results (Crossan, 2003; Guba, 1990). Additionally, the researcher should state the research assumptions to disclose any subjectivity that may impact the conduct of the study and interpretation of findings (Guba, 1990).

Methodology is the procedures used and how the researcher collects data during the research process. The methodology of post-positivism is referred to as modified experimental/manipulative with a focus on critical multiplism, which recognizes a need for rigor, precision, and control throughout the research process (Crossan, 2003; Guba & Lincoln, 1994). Natural settings are used to obtain data using the modified experimental methodology. Alternative settings may be used in the modified manipulative methodology to reduce confounding variables and biases.

This study aligned with the post-positivist philosophical assumptions presented. The existing evidence base surrounding the concepts of simulation, sequence of learning activities, and development of competency were used to inform the study design, hypotheses, and selection of instruments. The existing knowledge base served as the basis upon which new knowledge was generated. Data collection methods were consistent with the post-positivist paradigm in that multiple methods of observation were used to obtain data from multiple perspectives (Guba, 1990). Participants for this study

were observed and evaluated in both the traditional clinical setting as well as the simulation laboratory setting. In addition, the study explored clinical development of competency over time which aligns with the methodology of post-positivism. The presented philosophical perspective informed the study purpose and design in exploring the effect of sequence of SLE and CLE on development of clinical competency.

Review of the Literature Overview

A review of the literature was conducted to critically examine the concepts explored in this study and to summarize the relevant research on the concepts of age as a learner characteristics, competency, and sequence. All concepts were explored in relationship to SLE and CLE.

Competency

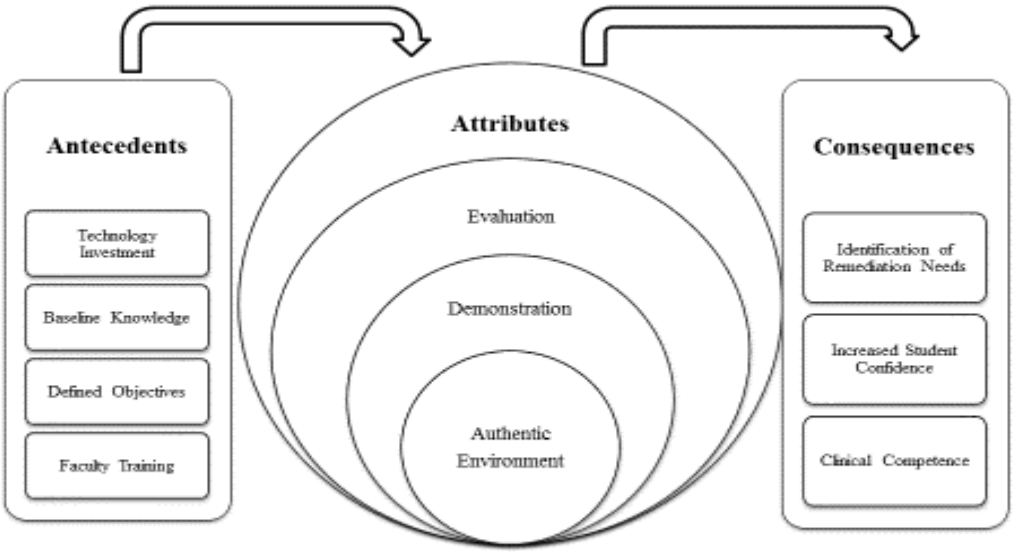
The definitions of competence and competency are very similar and are often used interchangeably in the literature. Competence is defined as demonstration of measurable and expected knowledge, skills, and attitudes (KSAs) (McMullen et al., 2003; Meakim et al., 2013). Competency refers to one's behaviors that underpin competent performance (McMullen et al., 2003). For this study, the American Nurses Association (ANA) definition of competency was used; which is "an expected level of performance that results from an integration of knowledge, skills, abilities, and judgment" (2007, p. 1).

In nursing education expected areas of competency are integrated into curricula based on guidelines established by accrediting bodies and the IOM. Areas of competency include expected KSAs in the areas of patient centered care, interdisciplinary teamwork,

use of evidence based practice, quality improvement, information technology use, and patient safety (Cronenwett et al., 2007; IOM, 2003). A variety of teaching and learning techniques are used by faculty to ensure the development of competency in students related to each area (Hansen & Bratt, 2015). SLE are one strategy frequently used by schools of nursing to aid in the development of student clinical competencies.

Competence acquisition in SLE was previously identified through a concept analysis (Hansen & Bratt, 2015). In this analysis the defining attributes, antecedents, and consequences were identified as found in the manuscript titled "Competence Acquisition Using Simulated Learning Experiences: A Concept Analysis" which is attached in Appendix B. Figure 2 presents the attributes, antecedents, and consequences that emerged as a result of this analysis (Hansen & Bratt, 2015).

Figure 2
Competence Acquisition using Simulated Learning Experiences (SLE) **(Hansen, 2015)**



Competency outcomes in SLE. Significant increases in elements of students' clinical competency following SLE have been reported (Alliner et al., 2006; Blum et al., 2010; Brannan et al., 2008; Gates et al., 2012; Ironside et al., 2009; McKeon et al., 2009; Mould et al., 2011; Radhakrishnan et al., 2007; Tubaishat & Tawalbeh, 2015) suggesting that SLE may produce equivalent student competency outcomes when compared to traditional lecture and CLE alone. In a systematic review of studies published from 2003 to 2007, Harder (2010) found that the majority (83%) of studies reported that students had increased assessment and skill performance, and that 91% of studies indicated students perceived increases in confidence and competence following SLE compared to students not participating in SLE. Additional research findings have evaluated various areas of competency using SLE with several different evaluation methods.

Student self-evaluation of competency. Mould et al. (2011) used a self-report Likert scale survey in a one group pre-test/post-test and reported significant increases (p <0.001), in competence over the course of one semester when students participated in SLE. In qualitative study, Partin, Payne, and Slemmons (2011) found that students perceived that participation in obstetric related SLE prior to CLE contributed to their perceived competency and critical thinking. Similarly, Kaddoura (2010) conducted a qualitative study and found that students' participation in SLE improved perceived clinical decision making skills related to care of critical care patients.

Instructor evaluation of competency. Alliner et al. (2006) found that students participating in SLE, compared to a control group had significantly higher ($p < 0.001$) competency gains when evaluated using an Objective Structured Clinical Examination (OSCE) that tested a variety of expected study clinical competencies. Ironside et al. (2009) reported significant increases ($p < .0002$) in student demonstration of patient safety competencies following multiple simulations over the course of a semester using an instructor evaluation tool. Radhakrishnan et al. (2007) used a Clinical Simulation Evaluation Tool to evaluate student demonstration of clinical competencies during simulation vignettes in the areas of patient safety, communication, critical thinking, and implementation of elements of the nursing process. Outcomes were compared between students having SLE practice sessions over the course of the semester to those in traditional clinical and lecture experiences (Radhakrishnan et al., 2007). Findings indicated that students in the experimental group demonstrated significantly higher scores in the areas of patient identification ($p = .001$) and assessment of vital signs ($p = .009$) (Radhakrishnan et al., 2007). Conversely, Blum et al. (2010) used the Lasater Clinical

Judgment Rubric (LCJR) to evaluate competency and reported that an increase in student competency was not related to SLE, as student competency increased equally in both the simulation and control group.

Written tests assessing knowledge gains. Brannan et al. (2008) compared cognitive skills of students participating in SLE to those in traditional lecture alone using a 20-item written inventory examination and reported significantly higher ($p = 0.05$) scores in students who participated in SLE compared to those in the traditional lecture setting. Similarly, Gates et al. (2012), used a 10-item written inventory examination to evaluate knowledge scores between students who participated in SLE during the course of the semester compared to a control group who did not participate in SLE; scores for students participating in SLE were 8% higher than the control group. Tubaishat and Tawalbeh (2015) conducted a pre-test/post-test using a 20-item multiple choice written inventory to evaluate differences in student knowledge of cardiac arrhythmias. Students who participated in SLE were compared to those in a control group and it was found that students in the simulation group demonstrated significantly higher knowledge gains than those in the control group ($p < 0.001$).

Competency evaluation tools in SLE. Though expected areas of clinical competency for nursing students are delineated, the evaluation of such competencies has been an evolving process in nursing education. Nurse educators have recognized that competencies demonstrated during SLE should not be assumed, and should be periodically formally evaluated (Bensfield et al., 2012). Additionally, it has been suggested that in order to evaluate competency in an objective manner nurse educators should use tools that evaluate elements of the cognitive, affective, and psychomotor

domains (Hayden, Keegan et al., 2014). Reports also highlight the need for evaluation tools with established reliability and validity, and proper training mechanisms to be in place for instructors prior to the use of such evaluation tools (Hansen & Bratt, 2014; O'Donnell et al., 2014). These recommendations have led to the development of several new tools to be used in the evaluation of clinical competencies following SLE (Kardong-Edgren, Adamson, & Fitzgerald, 2010). However, there is still little consensus in the nursing literature about how to best evaluate competency following SLE.

Written tests. Written examinations to evaluate student knowledge gains or cognitive growth following SLE are one of the main methods of competency evaluation cited in the literature (Brannan et al., 2008; Endacott et al., 2010; Gates et al., 2012; McKeon et al., 2009; Secomb, McKenna, & Smith, 2012). However, there is a lack of consistency in the instruments used in these studies and few studies reported using tools with previously established validity and reliability (Fero et al., 2010; Secomb et al., 2012).

Instructor evaluation of competency. Direct instructor evaluation of students in simulation vignettes using a specified evaluation tool has also been cited as an evaluation method within the literature (Alinier et al., 2006; Blum et al., 2010; Ironside, et al., 2009; Lasater, 2007; Todd et al., 2008). Similar to the studies that used written examinations to evaluate student knowledge gains, studies exploring direct instructor evaluation of student performance utilizing several different evaluation tools. Tools completed by instructors during observation of student performance during a simulation vignette that had been video recorded have also been used in competency evaluation (Endacott et al., 2010; Fero et al., 2010). Assessment of clinical competency has also been evaluated

using an Objective Structured Clinical Examination. This method includes student rotation through a given number of stations that require demonstration of clinical competency and are rated by an instructor using a specified checklist (Alinier, et al., 2006). Inconsistencies in evaluation methods have led nurse educators to question the use of SLE as a valid teaching and learning method as a supplement or replacement for students traditional CLE.

Competency evaluation in CLE. Competency of nursing students is also evaluated in the traditional clinical setting. Similar to evaluation of clinical competency in SLE, objectivity in evaluation of clinical performance is a concern discussed in the literature. When evaluation is conducted by means of direct observation, subjectivity of the evaluator can impact the determination of clinical competency (McCarthy & Murphy, 2008). Methods used in the evaluation of competency need to be objective to ensure fairness and reliability (Dolan, 2003; Oermann et al., 2009; McCarthy & Murphy, 2008). Structured clinical evaluation tools that specify observed behaviors and measurable criteria for evaluators have been suggested to be used to determine student clinical competency since they increase objectivity of the evaluation (Bonnel, 2012; Dolan, 2003). However, clinical evaluation processes in nursing programs vary, and to date there are no agreed upon evaluation practices used in clinical settings (Heaslip & Scammell, 2012) or adequate research evidence to aid in developing consensus on clinical evaluation methods or tools.

Instructor evaluation of competency. Direct observation of student performance in the clinical setting was cited as the primary evaluation method (93%) in a survey of nursing faculty conducted by Oermann et al. (2009), a theme also discussed by Dolan

(2003). Clinical faculty typically use a pass/fail scale as the primary grading method in clinical courses (Heaslip & Scammell, 2012; Oermann et al., 2009). A study by Oermann et al. (2009), surveyed 1,573 nursing faculty members from various types of nursing programs and reported that 83% of respondents used a pass/fail grading system in their nursing programs to grade clinical courses.

Heaslip and Scammell (2012), conducted a study to determine clinical faculty and student perceptions of a clinical practicum course that changed from a pass/fail grading system to a graded system aimed to help better identify failing students. While the new criteria-based graded evaluation tool to evaluate students was helpful to faculty in the evaluation process, a large number of faculty (40.2%) still reported a lack of confidence in assigning students a failing grade. Similar to SLE evaluation, Heaslip and Scammell (2012) concluded that faculty need to have training on proper use of evaluation tools to feel confident in using them and being able to assign appropriate grades to students in clinical courses.

Oermann et al. (2009) reported that of the 1,534 respondents to their survey, 98% of respondents used an evaluation tool for clinical evaluation of student performance. Several studies evaluated newly developed clinical evaluation tools (Dolan, 2003; Gill, Leslie, & Southerland, 2006; Karayurt, Mert, & Beser, 2008; O'Connor et al., 2009; Ulfvarson & Oxelmark, 2012). Tools used in the clinical environment to evaluate clinical competency have a goal of aiding instructors in determining whether student performance is congruent with the expected competency standards and performance criteria (Dolan, 2003; Gill et al., 2006; O'Connor, 2008). These standards are based on professional organization recommendations (Gill et al, 2006; Ulfvarson & Oxelmark, 2012), goals of

the nursing curriculum (Karayurt et al., 2008), and established course objectives (Ulfvarson & Oxelmar, 2012).

Results of studies examining tools to evaluate clinical competency in traditional clinical settings vary. Gill et al. (2006) concluded that their newly developed clinical evaluation tool was useful in evaluating students' clinical performance, but modification of the tool was needed to increase objectivity. The results from a study conducted by O'Connor et al. (2009) found that both students and instructors were satisfied with a newly developed tool's usability, structure, and process; however reliability and validity of the tool was not identified. Karayurt et al. (2008) determined that their newly developed clinical evaluation scale was a valid and reliable evaluation tool, but suggested that the results would need to be replicated. Validity of a tool developed by Ulfvarson and Oxelmark, (2012) was determined by an expert panel; however the reliability of the tool was not yet established which necessitated recommendations for further research.

Competency evaluation tools for SLE and CLE. There is a lack of consistency in the literature regarding tools and methods for clinical competency evaluation in the simulation and traditional clinical environments. If SLE are to be used as a replacement or supplement to traditional CLE evaluation practices should be consistent across settings. To date there has been only one publicized tool in the literature that has been tested and used in both settings, the Creighton Competency Evaluation Instrument (CCEI) (Hayden, Smiley et al., 2014). The CCEI tool provides scalable criteria for specific competency behaviors that students must demonstrate in either the simulation or the traditional clinical setting.

The CCEI is a refinement of the Simulation Evaluation Instrument (SEI), which was initially developed as a tool to evaluate students exclusively in the simulation setting (Todd, et al., 2008). The initial instrument included 22 expected student behaviors in the areas of assessment, communication, critical thinking, and technical skills reflecting the American Association of Colleges of Nursing core competencies (Todd et al., 2008). Content validity of the initial instrument was established by 7 faculty members with simulation experience using a four-point Likert scale (1=*strongly disagree,* 4=*strongly agree)* to rate the expected student behaviors as well as rate the overall usefulness of the instrument. All 22 of the expected student behaviors were rated as necessary items on the instrument (M = 3.84, SD = 0.12), and the overall instrument evaluation was positive (M = 3.84, SD = 0.10) (Todd et al., 2008). Reliability of the instrument was tested using a sample of 72 students evaluated by six trained faculty members. Inter-rater reliability using percent agreement demonstrated an overall agreement of 84.4% to 89.1% for the subscales of assessment, communication, critical thinking, and technical skills (Todd et al., 2008).

Following the initial reliability testing of the instrument the name of the tool changed from the Simulation Evaluation Instrument to the Creighton Simulation Evaluation Instrument (C-SEI). Further testing of interrater reliability and internal consistency of the instrument was conducted using a sample of 38 nurse educators with simulation and clinical teaching experience from across the United States (Adamson et al., 2011). Following training on use of the instrument participants viewed and scored three video-archived simulation scenarios using the C-SEI. Interrater reliability of the

instrument using intraclass correlation was 0.952, and internal consistency using Cronbach's alpha was $\alpha = 0.979$ (Adamson et al., 2011).

The C-SEI underwent further refinement to be established as a valid and reliable tool to evaluate competency of students in both simulation and traditional clinical environments. The name to the refined instrument was changed to the Creighton Competency Evaluation Instrument (CCEI). The CCEI was chosen for use in the current study since student performance in both simulation and clinical settings were measured. Use of tools with established reliability and validity in a variety of settings is critical to determining if the sequence of SLE and CLE affects the development of clinical competency in a clinical nursing practicum course. To date the CCEI is the only published tool that can be used in both settings.

Sequence

Sequence is another critical concept relevant to this study. The term sequence is defined as "the order in which things happen or should happen" (Merriam-Webster Inc., 2015). The sequence of learning activities has been most often explored in the field of education (Ritter, Nerb, Lehtinen, & O'Shea, 2007). The most basic principal regarding sequence of educational content is that material should be presented in a simple to complex manner so that learners can integrate new knowledge with previously gained knowledge (Ritter et al., 2007). Sequence or order effects occur when there are different learner outcomes that result when the same information is given to learners in alternate orders (Langley, 1995; Ritter et. al., 2007). Learning activities may be sequenced in blocked patterns (i.e. aaaabbbb) or interleaved patterns (i.e. ababab) (Rohrer & Pashler, 2010).

Only a few studies were found in the nursing literature that addressed student outcomes using different sequences of traditional CLE and SLE. Curl et al. (2016) conducted a multisite study comparing knowledge based outcomes among two groups of associate degree nursing students following their obstetrics, pediatrics, critical care, and mental health nursing courses. Group one had 50% of their traditional CLE replaced with SLE, and alternated each week throughout the specified courses between their SLE and CLE. Group two served as the control group and they had only traditional CLE during the designated courses. Knowledge based outcomes were assessed using the standardized testing system HESI and NCLEX pass rates. Results of this study showed that students in group one scored significantly higher on the post medical-surgical HESI exam ($p = .05$) and the HESI exit exam ($p = .01$) than the control group, but scores were not significantly different when comparing the two groups' HESI specialty exam scores and NCLEX pass rates (Curl, et al., 2016).

Meyer et al. (2011) randomly replaced two weeks (25%) of students' traditional clinical time with SLE during an 8-week pediatric clinical course. Evaluation of students' clinical performance was conducted by instructors every two weeks throughout the rotation using a Likert-style tool. Results of the study reported significantly higher clinical evaluation scores ($p = 0.02$) for students who attended the simulation experience compared to students who had not yet attended their simulation experience (Meyer et al., 2011).

Jensen (2011) measured self-perceptions of clinical reasoning abilities among students who had a mid-semester versus end-of-semester SLE. Results demonstrated no

significant effect of the sequence of the simulation experiences on students' self-perceptions of clinical reasoning abilities at the end of the semester (Jensen, 2011).

Schlairet and Pollock (2010) used a pretest/posttest in a 2x2 crossover design to determine if student knowledge scores on a 25-question multiple choice test in a fundamentals of nursing course differed when students participated in a 2 week block of SLE followed by a 2 week block of CLE or the reverse sequence. Findings showed that students in both sequences demonstrated significant gains in knowledge scores from the pretest to the posttest, suggesting that the sequence of SLE and CLE did not impact knowledge acquisition in a fundamentals of nursing course (Schlairet & Pollock, 2010).

A similar study by Schlairet and Fenster (2012) explored the relationship of blocked and interleaved sequences of SLE and CLE on student outcomes. In this study, a pretest/posttest mixed-methods design was used to determine what dose and sequence of SLE and CLE was most efficacious in promoting the development of competency in the areas of clinical judgment, critical thinking, and knowledge gains for students in a fundamentals of nursing course. Students were randomly assigned to one of eight combinations of dose and sequence of SLE and CLE for their six-week clinical experience including only CLE, alternating weeks of SLE and CLE, and a range of blocks of SLE and CLE. Results of the study demonstrated that students in the 70% CLE followed by 30% SLE were scored significantly lower by instructors in clinical judgment using the Lasater Clinical Judgment Rubric (LCJR) than students in the 50% alternating SLE and CLE group that started in simulation (Schlairet & Fenster, 2012). No other differences in clinical judgment were noted between the remaining doses and

sequences of SLE and CLE. There were no significant differences in critical thinking or knowledge based scores between any of the groups.

Learner Characteristics

There is some evidence that learner characteristics may impact student outcomes following SLE (Jeffries, 2012), though evidence is inconclusive. The majority of nursing students in prelicensure baccalaureate nursing programs today are millennial learners, born from 1980 to 2000 (McCurry & Martins, 2010). This generation of learners are thought to be technologically savvy, and to prefer structure, teamwork, and experiential learning situations (Earle & Myrick, 2009; McCurry & Martins, 2010). Simulation is a learning activity that may be appealing to this generation of learners. While traditional students in baccalaureate nursing programs are 18-22 years of age, reports indicate that there is an increase in the number of students entering nursing programs who hold a prior academic degree (HRSA, 2010). Students holding a prior degree are generally older (>23 years of age) than traditional nursing students. Older students may not have the same perceptions of gains in competency or outcomes following SLE as traditional students do, and to date it is not known if the combination of sequence and age impacts student outcomes of SLE.

In 2009, Ironside et al. conducted a multisite study to determine the relationship between specific learner characteristics and patient safety competency outcomes following SLE during students' final semester in the nursing program. Results of this multisite study indicated that there was no correlation between age and student patient safety competency outcomes (Ironside et al., 2009). Likewise, Mould et al. (2011) found

that age did not affect students' self-reported confidence and competence levels prior to and following a critical care SLE.

Lasater (2005) explored the effect of SLE on development of clinical judgment and reported that age was not correlated with students' perception of their competency as reflected in the Lasater Clinical Judgment in Practice Survey (LCJPS). In contrast, Jensen (2011) found that age was positively correlated with students' scores on the LCJPS (rho = .209, p = .019) (Jensen, 2011). Older students (>23 years old) reported larger perceived gains in clinical reasoning over the course of one semester than younger students. However, these findings were not based on the sequence of SLE and CLE in the semester.

While age in relationship to a variety of student outcomes following SLE has been explored in prior studies, none of the studies have specifically examined the relationship of sequence of SLE and CLE and age on student clinical competency. Given the increasing number of students completing nursing degrees later in life, examination of the influence of students' age on competency outcomes may provide additional information for development of new models for delivery of clinical education.

Gaps in the Literature

An extensive review of the literature identified that there are inconsistencies in methods and tools being used by schools of nursing to evaluate student competency in both the simulation and traditional clinical setting. Although evaluation of nursing students in the traditional clinical environment is commonplace, the review of literature revealed that there is a limited amount of research on the topic. The scarce amount of

research that is published on this topic does not offer a consistent perspective on the best methods to achieve a valid and reliable clinical evaluation.

Nurse educators agreed that evaluation of student competency should be based on established guidelines such as competency standards (Dolan, 2003; Gill et al., 2006; McCarthy & Murphy, 2007; O'Connor, 2008; Ulfvarson & Oxelmark, 2012), and current research (Karayurt et al., 2008). Competency standards may vary from program to program, which may be the reason for inconsistencies in evaluation tools described in the literature. However, there is still a need to establish reliable and valid evaluation tools. Likewise, the literature supports the need for education and training prior to the evaluation processes (Dolan, 2003; Heaslip & Scammell, 2012; McCarthy & Murphy, 2007; O'Connor et al., 2009; Oerman et al., 2009).

If SLE are used as a supplement or replacement for traditional CLE, the manner in which student evaluation takes place should be consistent across both environments. To date there is only one tool reported in the literature that can be used in evaluation of student competency in both environments. This study used the Creighton Competency Evaluation Instrument, which is an extension of the tool initially developed by Todd et al. (2008) which has been developed to evaluate student development of competency in both the simulation and traditional clinical environments.

Simulation is being used more and more as a substitute for a portion of traditional CLE. Currently the literature does not provide enough information to determine the optimal ratio or sequence of SLE and CLE to promote clinical competency for nursing students. The few studies exploring possible effects of sequence of SLE in courses in medical and nursing education were limited by small sample sizes which limits their

generalizability. No studies to date have evaluated whether the sequence of a seven-week block of traditional CLE followed by a block of SLE over the course of 7 weeks, or the reverse sequence affects student clinical competency, as proposed in this study. It is also not known if student age along with sequence of SLE and CLE impacts student outcomes.

The results of this study provide information on the impact of sequences of blocks of SLE and CLE on development of clinical competency. This study makes an original contribution to the nursing literature because to date there are no studies exploring whether age of students along with the sequence of blocks of SLE and CLE in a semester affects student development of clinical competency. The results of this study may provide a framework for nurse educators using SLE as a substitute for the more traditional CLE and guide development of appropriate curriculum structures.

Assumptions

1. Nursing student clinical competency can be measured using the Creighton Competency Evaluation Instrument, which is a valid and reliable tool.
2. Trained instructors are able to accurately evaluate student clinical competency.

Research Aims, Questions, and Hypotheses

The aims of this study address the following research questions and hypotheses:
Aim 1: Evaluate the effect of sequence of blocks of SLE and CLE on students' clinical competency outcomes using the CCEI.

Aim 2: Determine if age influences the effects of sequence of SLE and CLE on student clinical competency outcomes.

RQ1: Does the sequence of blocks of SLE and CLE have an effect on clinical competency development of nursing students when evaluated over three time points using the CCEI tool?

RQ2: Does the age of the student have an effect on clinical competency development in the two different sequences of blocks of SLE and CLE when evaluated over three time points using the CCEI tool?

Hypothesis 1: There will be a significant difference ($p < 0.05$) in clinical competency scores based on the sequence of simulated and traditional clinical experiences.

Hypothesis 2: There will be a significant difference ($p < 0.05$) in clinical competency scores based on the age and sequence of simulated and traditional clinical experiences.

CHAPTER 3

Introduction

The purpose of this study was to determine if the sequence of SLE and traditional CLE in a clinical practicum course impacts development of clinical competency in nursing students. This chapter will first discuss a pilot study conducted in preparation for the study. It will then describe the research design, study methods, description of the sample, procedures for data collection and statistical analysis, and limitations of the study.

Pilot Study

A pilot study was conducted to establish the feasibility of the design and methods used in the current study and to obtain preliminary data on the effects of sequence of SLE and CLE on nursing student development of clinical competency. A secondary purpose of the pilot study was to determine interrater reliability using the CCEI.

The sample for the pilot study consisted of 24 undergraduate nursing students who were enrolled in one of two blocked sequences of SLE and CLE in a clinical practicum course at a large Midwestern University. The sample size for this pilot study was based on the power analysis for the subsequent larger study in which an anticipated medium effect size (d = 0.35) would yield .80 statistical power (1-β) of a repeated measures ANOVA to detect a difference in student clinical competency between the two groups at the .05 level (α) of significance. For pilot studies, a sample size of 10% of the projected sample needed for the larger study is generally acceptable (Hertzog, 2008).

Planning for potential attrition of students during the semester, a sample size 20% of what was calculated for the larger study was used for the pilot study.

Prior to the start of the semester students in the course were randomly assigned to one of two clinical practicum sequence groups by the course coordinator. The Simulation-Clinical Group (S-C group) participated in SLE in a high-fidelity simulation laboratory setting over the course of a seven-week period followed by CLE over the course of a seven-week period in a hospital setting. The Clinical-Simulation Group (C-S group) participated in the reverse sequence of learning experiences. Following Institutional Review Board approval, participants were recruited during the first week of classes by the researcher, who was not associated with the course. After obtaining informed consent, participants completed a demographic information form.

During the SLE portion of the semester students participated in three, four-hour simulation sessions over the course of a seven-week period. Data collection occurred at two time-points for each participant (See Table 2.). Time one was during participants' first SLE, during each group's first week of the simulation experience. Time two data collection occurred during participants' final simulation scenario, during each group's final week in the simulation laboratory. Participants' simulation and debriefing sessions were video-recorded and stored on a secure server. At the end of the semester the researcher and another trained researcher viewed participant's first and final simulation and debriefing sessions and scored participants clinical competency using the Creighton Competency Evaluation Instruments (CCEI) (Hayden, Keegan et al., 2014).

Table 2
Pilot Study Measurements

Week 1	**Week 2**	**Week 8**	**Week 10**	**Week 16**
Demographic Information	Group S-C CCEI (Time 1)	Group S-C CCEI (Time 2)	Group C-S CCEI (Time 1)	Group C-S CCEI (Time 2)

Following data entry and cleaning, CCEI scores were analyzed using SPSS version 21.0. Descriptive statistics summarized the characteristics of participants (See Table 3). Repeated measures ANOVA was used to determine if scores on the CCEI and the subscales at time 1 and time 2 were statistically different between groups. Significant main effects of group, time or interaction were explored further using Fisher's LSD post hoc comparison to disclose between group differences at each time point.

To ensure that the two groups were equivalent at baseline, demographic information for the two groups was compared using chi square analysis for categorical variables and independent *t* tests for continuous variables. The majority of the participants were female ($n = 21$) and identified as Caucasian ($n = 21$). The mean age of the S-C group was significantly lower ($t = -2.18$, $p = 0.04$) than the C-S group. One subject in Group C-S was significantly older than the other participants, which may have skewed the data. There were no other significant demographic differences noted between the two groups.

Table 3
Pilot Study Sample Characteristics

Characteristic	All Participants (*n* = 24)	Group S-C (*n* = 12)	Group C-S (*n* = 12)
Age: Mean (*SD*)	21.6 (2.0)	20.8 (1.4)	22.4 (2.1)
Female Gender: % (*N*)	87.5 (21)	91.7(11)	83.3(10)
Caucasian: % (*N*)	87.5 (21)	100 (12)	75 (9)

To evaluate interrater reliability of the CCEI for the pilot study Kappa statistics and percent agreement were calculated. The researcher and another trained researcher independently viewed and scored student clinical competency in designated simulation scenarios using the CCEI. Overall agreement between the two raters was 85%. The subscales revealed the percent of agreement: 83% for assessment, 92.5% for communication, 81.4% for clinical judgment, and 84.7% for patient safety. Kappa statistics were then calculated to account for the amount of agreement expected due to chance (Waltz, Strickland, & Lenz, 2010). Kappa statistics for the subscales revealed a moderate reliability for the subscales of assessment ($k = 0.41$) and clinical judgment ($k = 0.43$), and substantial reliability to the subscales of patient safety ($k = 0.64$) and communication ($k = 0.72$) (Landis & Koch, 1977).

Repeated measures ANOVA was used to determine if scores on the total CCEI or any of the subscales were statistically different between or within the two groups over the two data collection points. These analyses indicated that the total CCEI total scores and the subscales of assessment and clinical judgment were no different within or between

the two groups. The communication subscale exhibited a significant time effect [F (1, 22) = 7.21, p = 0.013]. Post-hoc analysis testing revealed that group S-C experienced a significant decline in communication from time 1 to time 2 in the simulation laboratory, while scores of group C-S remained unchanged. A significant interaction effect of time and group on scores on the patient safety subscale was found [F (1, 22) = 4.71, p = 0.041]. Post-hoc analysis indicated that the S-C group exhibited significantly lower scores in the patient safety subscale at the initial data collection point compared with the C-S group, and that at the second data collection point the two groups exhibited similar patient safety scores. Significant findings from the subscales are presented in figures 3 and 4.

Figure 3
Pilot Study Communication Subscale

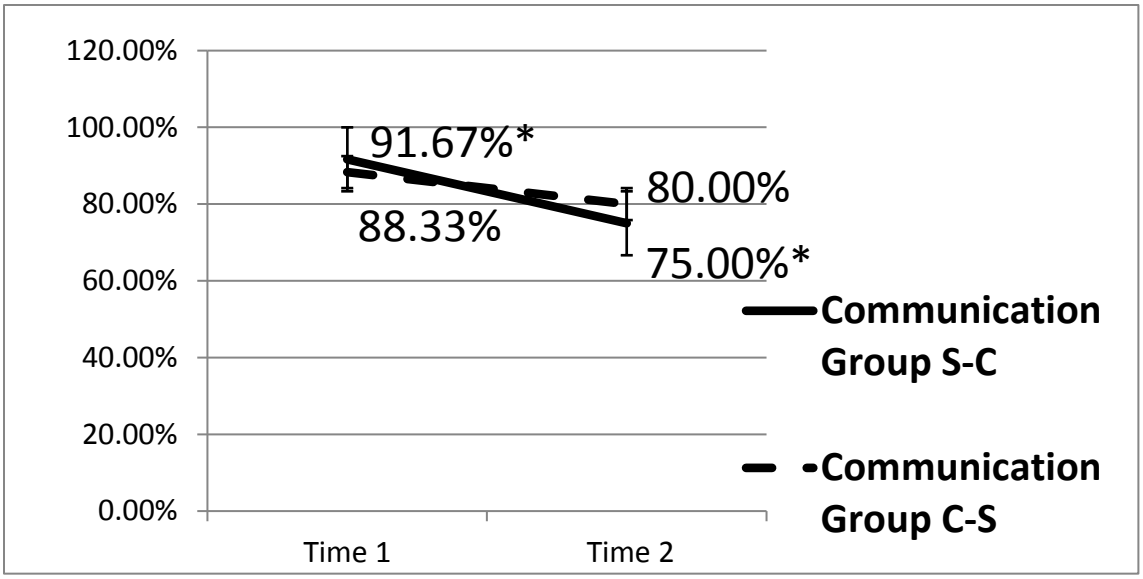
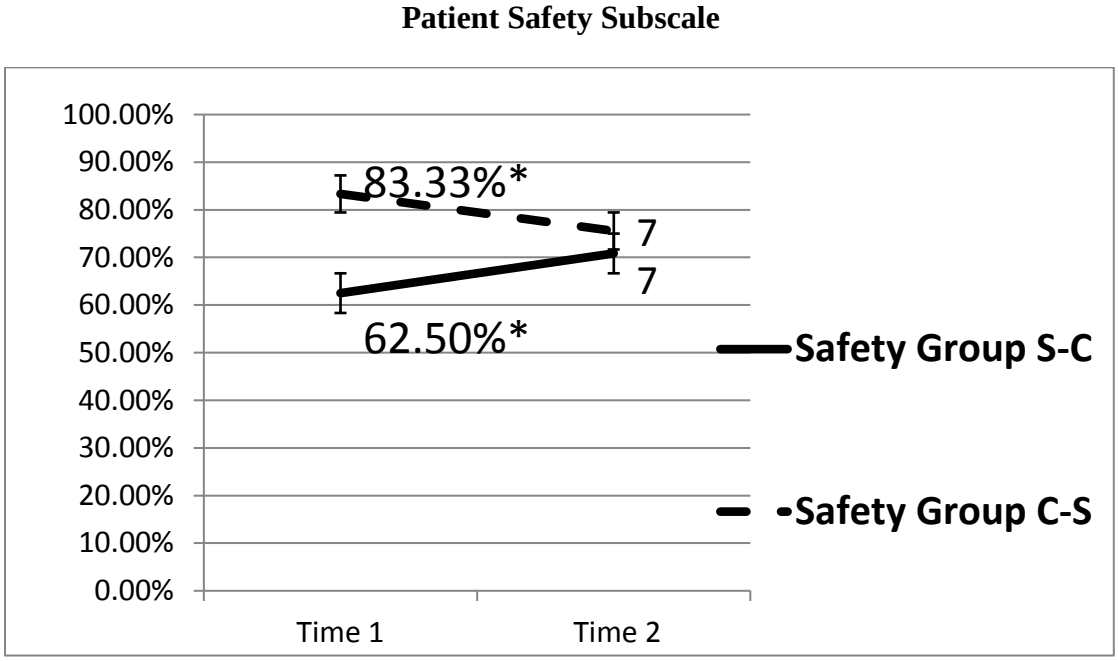


Figure 4
Pilot Study Patient Safety Subscale



The results of this pilot study demonstrate the feasibility of the proposed methods for the proposed study. The plan for subject recruitment yielded the target sample size with no refusals or dropouts. To address any differences noted in the subscales ratings, simulation scenarios were discussed and additional details were added to the CCEI tool directions to clarify expected student behaviors during the simulation scenarios, which should increase inter-rater reliability.

These preliminary findings suggest that a block sequence of SLE and CLE may not affect development of student competency across the semester. However, preliminary findings are limited by a small non-diverse sample, with differences in age between the two groups. The findings of this pilot study support the feasibility of the methods to be used in the proposed study with a larger sample.

Research Design

A randomized crossover design was used to determine if the sequence of blocks of SLE and CLE affected development of clinical competency in a sample of nursing students over time. Crossover designs are useful when analyzing data on subjects that have been randomly assigned to more than one condition over a period of time (Polit, 2010). Study participants were randomly assigned by the course coordinator prior to the start of the semester to one of two group sequences: SLE over the course of a seven-week period followed by CLE for seven-weeks (Group S-C) or CLE for 7 weeks followed by SLE over the course of a seven-week period (Group C-S). The dependent variable for the study was clinical competency scores as measured by the CCEI. The independent variable was sequence of SLE and CLE. The demographic variable of age was treated as a covariate.

Procedure

Over the course of the 16-week semester all participants attended CLE and SLE; each taking place over the course of a seven-week period. The week prior to the start of each seven-week block of SLE and CLE was used for orientation to each setting.

Clinical Learning Experiences. The CLE consisted of two-eight hour clinical days/week in which participants provided direct patient for one patient under the supervision of a nursing faculty member. Participants attended CLE in the same clinical group of 7-8 students as they were in for their SLE. The CLE took place on patient care units in various hospitals in a large metropolitan area. During CLE participants provided direct patient care and planned, implemented, and evaluated nursing care for one patient.

Participants also attended a post conference discussion and debriefing of clinical experiences following each clinical day using a version of the debriefing tool used in the simulation setting adapted for the clinical environment.

Simulation Learning Experiences. The SLE consisted of three high-fidelity simulation days, each lasting four hours over the course of a 7 week period. Participants also completed a medium-fidelity virtual simulation. Participants attended high-fidelity simulation days in a clinical group of 7-8 students. Each high-fidelity simulation day followed the NLN/Jeffries' framework for simulation (2012) and included four vignettes on specific topics including pain management, heart failure, and COPD/pneumonia. The medium-fidelity virtual simulation on the topic of diabetes mellitus was completed independently by students using a computer program and included preselected debriefing questions. To ensure information from the simulation vignettes was not shared with other students, which could inflate performances, all students in the course were asked to sign a confidentiality agreement at the start of the semester to protect simulation scenarios. Each vignette was designed to include expected behaviors that can be associated with items on the CCEI. Simulation instructors received training prior to the start of the semester and a step-by-step manual with instructions to ensure all SLE and debriefing sessions were run as similarly as possible. A standardized debriefing tool was developed using the SimTRACT model for debriefing (Gum, Greenhill, & Dix, 2011) and was used following each high-fidelity simulation vignette.

For each high-fidelity simulation day students were assigned pre-work including readings, a quiz to prepare for the simulation day topic, development of a tentative plan of care, and review of scenario objectives, patient chart, laboratory results, and

medication administration record. Pre-briefing sessions and orientation to the high-fidelity simulation room and manikin occurred prior to the start of each simulation vignette. Two active participants were in the simulation room for each vignette and were assigned the role of lead RN or new RN. For the purpose of assessing clinical competency using the CCEI the lead RN in the simulation vignette was evaluated. The remaining 5-6 students in clinical group were active observers of simulation vignettes and watched a live video feed of vignettes in a debriefing room adjacent to high-fidelity simulation rooms. The two active participants in the high-fidelity simulation room during the vignettes worked through patient assessments and nursing interventions. Once all vignettes assessments and expected interventions were completed or after 30 minutes had elapsed the vignettes were stopped.

Active participants then returned to the debriefing room with the simulation instructor and active observers for a debriefing session. Active participants were asked to reflect on their performance in the simulation vignettes and had an opportunity to identify what went well during the vignette and areas that they could improve upon in the future. Active observers were given an opportunity to provide feedback on areas that went well and suggestions for improvement to the active participants based upon their observations. Simulation instructors used a standardized debriefing guide to ask any follow up questions and answer any questions or clarify any areas of concern related to the vignette. Following debriefing the next vignette was presented, and two new active participants entered the high-fidelity simulation room. This sequence of events continued until the four vignettes and debriefing sessions occurred.

Following completion of their SLE and CLE sequence participants were evaluated during a final high-fidelity simulation vignette approximately five weeks after the completion of the semester, but prior to the start of the subsequent semester. A unique type II diabetes mellitus vignette using the same format and with a similar level of complexity as the previous high-fidelity simulation vignettes was used for the final evaluation time point. For the final evaluation time point participants were assigned to an evaluator who was not their SLE or CLE instructor during the course of the semester.

Setting

The setting for this study was the simulation center at a large mid-western school of nursing and clinical units in hospitals in the surrounding metropolitan area. This school of nursing recently redesigned the students' first hospital based clinical practicum course to include SLE over the course of a seven-week period and seven-weeks of CLE in a hospital setting. One half of the class began with the SLE, and one with the CLE. The groups then switched learning settings after seven weeks until completion of the semester. Because there is a large amount of variability in how SLE are used among schools of nursing in the area, only one school of nursing was included in the study to ensure consistency in design, frequency, and setting of SLE across the semester.

The SLE used two intensive care and two medical-surgical hospital suites in the school's simulation laboratory. The four debriefing rooms were utilized by simulation instructors and active observers to view a live video stream of simulation vignettes and to hold pre-briefing and debriefing sessions with participants. High fidelity manikins, along with medical and nursing equipment and supplies were incorporated into simulation scenarios to facilitate realistic practice.

Sample

The sample was recruited from junior level undergraduate baccalaureate nursing students and generalist entry masters nursing (GEM) students enrolled in a 16-week nursing practicum course and the associated 16-week theory course. GEM students are direct entry masters of science in nursing students who enter the program with a baccalaureate degree in a field other than nursing. All participants providing consent were 18 years of age or older and were enrolled in the associated medical-surgical nursing theory course. Exclusion criteria included students not enrolled in the specified courses, refused consent, or less than 18 years of age.

Power Analysis

The software program G*Power version 3.0.10 was used to estimate the sample size for the study *a priori*. A power analysis determined the minimum sample size for between groups repeated measures ANOVA with two groups, one covariate, and three measurement time points to be 48 subjects, 24 subjects in Group S-C and 24 subjects in Group C-S, with an α level of .05, a minimal statistical power of 0.8, and what is considered between a small to medium effect size, $d = 0.35$ (Cohen, 1988). This effect size was chosen based on effect sizes reported in the NCSBN study using the C-CEI (Hayden, Smiley et al., 2014). Oversampling to account for a potential 30% drop out rate brought the target sample to 62 subjects. Past class sizes for the medical-surgical nursing course have averaged 120 students per semester, and the course is offered during both fall and spring semesters, making participant recruitment goals achievable.

Recruitment

Participant recruitment occurred in a face-to-face meeting during the first week of the medical-surgical nursing theory course by the investigator who was not associated with teaching the course. The course instructor was not present at the time of recruitment. The PI introduced self and explained the purpose of the research study and what involvement in the study would consist of. The PI then provided potential participants the opportunity to ask any questions regarding the study. Those agreeing to be involved in the study were given an information sheet (Appendix C) outlining the study and were asked to sign it. The PI retained a copy of the signed form. Participants were assured that their involvement in the study was confidential, voluntary, and would in no way affect their final course grade.

Instruments

There were two instruments used in this study: the Creighton Competency Evaluation Instrument (CCEI) and student demographic information sheet (Appendix B). The demographic information sheet was created by the researcher and included information obtained by student self-report on age, gender, ethnicity, student employment in healthcare, and prior degrees.

Creighton Competency Evaluation Instrument

The 23-item CCEI incorporates QSEN competencies as well as components of the *Essentials of Baccalaureate Education for Professional Nursing Practice* (AACN, 2008; Hayden, Keegan et al., 2014). The instrument includes four subscales of expected student behaviors: assessment, communication, clinical judgment (formerly critical

thinking), and patient safety (formerly technical skills). Reliability and validity testing was conducted by Hayden, Keegan et al. (2014). Thirty-one faculty members scored three simulation videos using the CCEI. Internal consistency assessed using Cronbach's alpha demonstrated highly acceptable levels ranging from .97-.98, a 79.4 % agreement between expert raters, and fair to moderate Kappa scores (*K*=.316-.453) (Hayden, Keegan et al., 2014). Content validity of the CCEI was established using a 4-point Likert scale (1=*strongly disagree,* 4=*strongly agree)* by 35 faculty members, in which all 23 items of the CCEI were thought of as a necessary part of the tool (*M* = 3.89, *SD* 0.19) which was similar to the findings from Todd et al. (2008) following the initial tool development (Hayden, Keegan et al., 2014).

To determine CCEI scores students are rated by instructors, receiving a score of zero when a specified competency behavior is not demonstrated by a student, and a score of one when the specific behavior was demonstrated. Any behaviors not observed are scored as NA. Total scores are summed and divided by total points possible. For the purpose of this study all behaviors listed on the tool were assessed during a given clinical experience or simulation vignette.

Instructors received training on the use of the CCEI tool prior to the start of data collection. During training session, instructors viewed a series of training videos that provided an orientation to the tool, and discussion of how to properly score participants expected behaviors for each item on the instrument. Interrater reliability using the tool to determine clinical competency was subsequently established. Prior to the start of the semester each trained instructor was asked to view and score an archived simulation vignette using the CCEI. The investigator previously scored the same simulation vignette.

If scores differed by more than four points (<80% consensus) additional instructor training would be conducted by the researcher. Following additional training, if the scores continue to differ by more than four points, a third party trained researcher would have been brought in to arrive at greater consensus. This level of difference was chosen as pilot study findings revealed moderate to substantial reliability in Kappa statistics with similar levels of percent agreement. Likewise, the study by Hayden, Keegan et al. (2014) reported a 79.4 % agreement between expert raters, and fair to moderate Kappa scores when establishing reliability and validity for the CCEI. To ensure consistency in the use of the tool during data collection all instructors assisting with data collection were provided with a specific guide of competency behaviors based on individual simulation vignettes or clinical practicum objectives.

Data Collection

Following Institutional Review Board Approval by the University and after participants agreed to participate in the study and signed the research information sheet, they filled out a paper demographic information survey (Appendix B). Completed demographic information sheets and research information sheets were placed in a sealed envelope and placed in the researcher's locked file cabinet.

Competency evaluation occurred using the CCEI at three time points as outlined in Table 4: (1) During a designated simulation vignette at the end of participants' SLE rotation; (2) During a preselected clinical day/single patient encounter occurring in the final week of participants' CLE rotation; and (3) After completion of the semester during a follow-up simulation vignette. For study purposes participants were evaluated when they were assigned to the lead RN role in a simulation vignette.

Table 4
Measurement Times and Instruments

Week 1	**Week 8**	**Week 16**	**Week 20**
Demographic Survey-All participants	CCEI-Group S-C (Simulation) CCEI-Group C-S (Clinical)	CCEI-Group S-C (Clinical) CCEI-Group C-S (Simulation)	CCEI- All Participants (Simulation)

Simulation and clinical instructors teaching in the medical-surgical nursing practicum course were recruited as research personnel to assist in data collection. Instructors were not blinded to the treatment condition of participants during weeks 8 (time 1) and 16 (time 2) time points as data collection was done by participants' course instructors. However, evaluators were blinded to the treatment condition of participants at week 20 (time 3) during the final simulation/data collection time point.

Participant confidentiality of data was maintained over the three time points by providing participants a four digit non-identifiable number using their mother's two-digit birth month and two-digit day of birth. Following each data collection time point instructors placed the instrument in a sealed envelope and participants wrote their participant number on the exterior of the envelope. Once in the sealed envelope instructors returned the instruments to the researcher who placed envelopes in a locked filed cabinet until the data collection was completed.

Data Cleaning

Following the data collection period all data were entered into SPSS version 21.0 for data cleaning and analysis. After the data were entered the researcher performed data cleaning. Demographic survey data were checked for missing data and analyzed for outliers. When outliers existed, the paper copy of the demographic survey was checked. Any items entered incorrectly were then corrected. For the CCEI data, the researcher randomly selected 10% of participants and checked each paper item against the data entered into SPSS. Any errors found were corrected and an additional 10% of participants' data were examined for data entry errors. This process continued until no errors were found.

Data Analysis

Demographic characteristics of the sample were summarized using descriptive statistics. To examine whether or not the two groups were equivalent at baseline, demographic information for the two groups were analyzed using chi square analysis for categorical variables and a *t* test for continuous variables.

To determine if clinical competency using the CCEI differed over three measurement time points between the two groups repeated-measures analysis of variance (RM-ANOVA) were calculated. This test is used to detect differences between two independent groups over three time points while controlling for the effects of age (Polit, 2010). Significant main effects of group, time or interaction were explored further through post hoc comparison using Fisher's LSD between group means at the various data collection time points.

Limitations

Several limitations of this study are recognized. First, drawing a sample from only one mid-western university reduces the generalizability of the study results. However, using one site ensured intervention fidelity and allowed for control of other confounding variables. In addition, since the study was conducted using the unique sequence of blocks SLE and CLE in only one medical surgical practicum course the results of the study are not generalizable to other courses, student levels, or nursing curricula.

Since the revised CCEI has been used in only one study to date, this may be seen as a limitation. There is a potential for differences in participant scoring by instructors since they were not blinded to participant treatment condition during the first two data collection time points. This makes it possible for instructors to score participants differently based on individual beliefs related to expected student performance following a specific treatment condition. However, instructor training did take place prior to the start of the study and interrater reliability for use of the CCEI was established. Also, since the CLE took place in a variety of hospital settings and participants were not guaranteed to provide care for patients with specific conditions. Since patient acuity and conditions varied across clinical settings participants who cared for specific patient conditions may have scored higher in specific simulation vignettes than participants who did not have such experiences. Additional limitations of this study included the lack of a control group and no baseline measurement of participants to compare findings to. Finally, while all students were required to sign a waiver indicating they would not share simulation vignette details with other students, it cannot be guaranteed that students did the performance for some participants.

Human Subjects Protection

Intuitional Review Board approval was obtained prior to the start of the study. No more than minimal risk was anticipated for each subject. The potential for distress as a result of participation was anticipated to be no more than what the participants would experience in their daily lives as student nurses. Study participants had the right to withdraw from the study at any time without penalty.

Informed consent was obtained from all participants prior to any data collection. Participants were given a $15 gift card for their time and participation in the research study following the completion of the final simulation vignette. Anonymity and confidentiality were maintained throughout the study. Participants were assigned a non-identifiable identification number which was used on the CCEI and demographic questionnaire. The study database was stored on a password protected laptop. Signed consent forms, demographic information sheets, and completed CCEI tools were stored by the researcher in a locked file cabinet.

CHAPTER FOUR

Results

The results of the study are presented in the manuscript titled “Effect of Sequence of Simulated and Clinical Practicum Learning Experiences on Clinical Competency of Nursing Students” and are not duplicated in this section.

CHAPTER FIVE

Interpretation of Findings

The interpretation of findings and discussion of results are included in the manuscript titled “Effect of Sequence of Simulated and Clinical Practicum Learning Experiences on Clinical Competency of Nursing Students” and are not duplicated in this section.

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Appendix A

Hansen, J. & Bratt, M. (2015). Competence acquisition using simulated learning experiences: A concept analysis. *Nursing Education Perspectives, 36(*2), 102-107. doi: 10.5480/13-1198.

Appendix B: Study Forms and Instruments

Creighton Competency Evaluation Instrument C-CEI©

Copyrighted Tool

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https://www.blueq-surveys.creighton.edu/se.ashx?s=46BEEE7F5D651685

Participant Demographic Information

1) **What is your sex?**
    a. Male_____
    b. Female_____

2) **What is your age?**

    _____

3) **What is your race/ethnicity?**
    a. White_____
    b. Black_____
    c. Hispanic_____
    d. Asian_____
    e. Other_____

4) **Do you have a previous degree?**
    a. Yes_____(if so please list)_____
    b. No_____

5) **Do you currently work in healthcare?**
    a. Where?_____
    b. What is your role/position?_____

Appendix C

MARQUETTE UNIVERSITY RESEARCH INFORMATION SHEET

EFFECT OF SEQUENCING OF SIMULATED AND CLINICAL PRACTICUM LEARNING EXPERIENCES ON CLINICAL COMPETENCY OF NURSING STUDENTS

Jamie Hansen

College of Nursing

You have been asked to participate in a research study. You must be age 18 or older to participate. The purpose of this study is to determine if the order of providing human patient simulation laboratory based experiences and traditional hospital based clinical experiences in a clinical course affects competency development in nursing students. You will be asked to participate in your regularly scheduled simulation and clinical experiences and one additional simulation session prior to the start of the next semester. The study involves participation in normal course activities including simulation and clinical practicum learning experiences and evaluation of performance at three time points: once at the end of your seven-week simulation session, once at the end of your seven-week traditional clinical practicum session, and once during a final simulation at the end of the semester and will take approximately 90 minutes over and above normal course requirements to complete a questionnaire and complete the final simulation at the end of the semester. There are no foreseeable risks associated with this project; however there may be indirect benefits to you in participation in an additional learning experience. For your participation in this study you will be compensated with a $15 Starbucks giftcard, which you will receive following participation in the final simulation session which will take place at the end of the semester. Your responses will be anonymous and will not be associated with your name or other identifying information. Your participation will in no way affect your course grade. Your participation is voluntary and you may withdraw from the study at any time.

If you have any questions about this project you can contact Jamie Hansen at 262-366-1540 or jamie.hansen@marquette.edu.

Thank you for your participation.

I HAVE HAD THE OPPORTUNITY TO READ THIS INFORMATION SHEET, ASK QUESTIONS ABOUT THE RESEARCH PROJECT AND AM PREPARED TO PARTICIPATE IN THIS PROJECT.

_____

(Printed Name of Participant)

_____ _____

(Signature of Participant) Date

_____ _____

(Printed Name of Individual Obtaining Consent) Date

Appendix D: Institutional Review Board

MARQUEITE
UNIVERSITY
Be The Difference.

Office of Research Compliance
Schroeder Complex. 102
P.O. Box 1881
Milwaukee. Wisconsin 53201-1881

P 414.288.7570
F 414.288.6281
W Marquette.edu/researchcompliance

August 4, 2015

Ms. Jamie Hansen
Nursing

Dear Ms. Hansen:

Thank you for submitting your protocol number HR-3027 titled, *"EFFECT OF SEQUENCING OF SIMULATED AND CLINICAL PRACTICUM LEARNING EXPERIENCES ON CLINICAL COMPETENCY OF NURSING STUDENTS"* to the Office of Research Compliance (ORC). On August 4, 2015, a determination of exempt status was made under the following category or categories:

- Category #1: Normal Educational Practices and Settings

Your protocol has been granted exempt status as submitted. Before proceeding with your research, you may be required to adhere to other MU policies, and state and federal laws governing activities you seek to employ. Visit ORC's website (http://www.marquette.edu/orc/irb/policies.shtml) for an inconclusive list of related links which are independent of MU IRB review/approval.

Minor changes to the project may be emailed to orc@mu.edu. Major changes, or changes affecting participant risk, require submission of a Protocol Amendment Form which can be found on the ORC web site. These changes must be reviewed and approved by the IRB before being initiated, except when necessary to eliminate apparent immediate hazards to the human subjects. If there are any adverse events, please notify the Marquette University IRB immediately.

Please submit an IRB Final Report Form once this research project is complete. Submitting this form allows the Office of Research Compliance to close your file.

Contact the IRB office if you have any further questions. Thank you for your cooperation and best wishes for a successful project.

Sincerely,

Benjamin Kennedy
Research Compliance Officer-Human Subjects & Radiation Safety

cc: Dr. Marilyn Bratt, Nursing
Ms. Sherri Lex, Graduate School

BK/tk

Appendix E: Manuscript II

Effect of Sequence of Simulated and Clinical Practicum Learning Experiences on Clinical Competency of Nursing Students

Abstract

This study compared the effects of two different sequences of blocks of simulated and clinical practicum learning experiences on clinical competency development of nursing students. Using a randomized crossover design, competency was measured three times. No significant differences in competency scores between the two groups across the three time points were identified. The use of alternative models of clinical education delivery may help address barriers in delivery of clinical education faced by schools of nursing.

Keywords: clinical competency, nursing education, patient simulation, nursing students

Background

Providing quality clinical learning experiences (CLE) that foster the development of clinical competency in nursing students prior to entry into practice is a critical objective of all nursing education programs. The traditional model for clinical education in nursing involves faculty supervision of students who are providing patient care in a hospital or other clinical settings (1, 2). However, schools of nursing have increasingly faced barriers in delivering clinical education using the traditional model due to factors such as increasing student enrollment numbers, a shortage of nursing faculty, increasing patient acuity, and decreasing clinical site availability (2- 4).

The use of simulated learning experiences (SLE) as a substitute for a portion of traditional CLE has gained interest over the past decade, but nurse educators continue to seek evidence supporting such substitution. The National Council for State Boards of Nursing (NCSBN) recently conducted the National Simulation Study to explore student

outcomes when traditional CLE were replaced 25 or 50% of the time with SLE (2, 5). Results of the study revealed no difference in student outcomes when substituting up to 50% of traditional CLE with SLE. The NCSBN has since challenged state boards of nursing to develop specific guidelines for the use of simulation in undergraduate nursing programs (6). However, there is a need for continued research so such guidelines and new models of clinical education are built on evidence. In particular, since the NCSBN National Simulation Study did not control for the sequence of the CLE and SLE, this warrants further study.

Research in human learning suggests that the sequence of learning activities may have an effect on student outcomes (7, 8). The basic principles surrounding the sequence of learning activities is that knowledge is built on previous learning and possession of appropriate background knowledge is essential for success in new learning situations (7). According to Harder, (9), the purpose of SLE is to "prepare students for clinical situations they may encounter" (2010, p. 23). The belief that SLE should be used to prepare students for CLE has led schools of nursing to place SLE prior to CLE to allow greater knowledge gains and transfer of knowledge to the clinical setting compared to the placement of SLE following traditional CLE. However, research has indicated that SLE may produce equivalent student competency outcomes when compared to traditional lecture and CLE alone (10, 11).

To date, few studies in the nursing literature address student outcomes and development of competency using different sequences of traditional CLE and SLE (12-15). The majority of these studies have examined students' outcomes and clinical competencies following their intermittent participation in SLE during a semester rather

than large blocks of SLE within a semester. Providing blocks of SLE and CLE has the potential to increase student enrollment and decrease the number of clinical units needed in a given semester by up to 50% (1). However, it is unknown if students' development of clinical competency is equivalent when a block of SLE precedes or follows CLE. Therefore, this study explores students' clinical competency outcomes following a unique model of clinical education delivery using two different sequences of blocks of SLE and CLE during students' first medical surgical nursing practicum rotation. The specific research questions were: (1) Does the sequence of blocks of SLE and CLE affect clinical competency development of nursing students? (2) Does the age of the student affect clinical competency development in the two different blocked sequences of SLE and CLE?

Method

Design

This study used a randomized crossover design and was conducted at a large mid-western school of nursing's simulation center for the SLE and clinical units in metropolitan hospitals for the CLE. Prior to the start of the semester students enrolled in their first medical-surgical nursing practicum course were randomly assigned by the course coordinator to one of two sequences: SLE over the course of a seven-week period followed by CLE for seven weeks (Group S-C) or CLE for seven weeks followed by SLE over the course of a seven-week period (Group C-S). Students attended each block of SLE and CLE in the same group of seven to eight students. The ratio of simulation to clinical hours for the semester was 1:4.

Clinical and Simulated Learning Experiences

The CLE consisted of two-eight hour clinical days/week in which participants provided direct patient for one patient under the supervision of a nursing faculty member. Participants planned, implemented, and evaluated nursing care, and participated in a post conference discussion. The SLE consisted of three high-fidelity simulation days, each lasting four hours over the course of a seven-week period and one medium-fidelity virtual simulation. Each high-fidelity simulation day followed the NLN/Jeffries' framework for simulation (2) and included four vignettes on the topics of pain management, heart failure, and COPD/pneumonia. The medium-fidelity virtual simulation on the topic of diabetes mellitus was completed independently by students using a computer program and included preselected debriefing questions. Simulations were run by instructors who received training prior to the start of the semester along with a step-by-step manual with instructions to ensure all SLE and debriefing sessions were run as similarly as possible. A standardized debriefing tool was developed using the SimTRACT model for debriefing, (16), which was used following each high-fidelity simulation vignette.

For each high-fidelity simulation day students were assigned pre-work including readings, a quiz to prepare for the simulation day topic, development of a tentative plan of care, and review of scenario objectives, patient chart, laboratory results, and medication administration record. A pre-briefing session and orientation to the high-fidelity simulation room and manikin was conducted prior to the start of each simulation vignette. Each vignette included two active student roles, the primary RN and the primary RN's preceptor. During vignettes participants worked through patient assessments and nursing interventions followed by a debriefing session conducted by the simulation instructor. The remaining students in the clinical group observed vignettes via a live

video feed in a debriefing room with their instructor and took notes to provide feedback or to take notes to clarify any areas in question during debriefing. The medium-fidelity simulation included prebriefing, working through the patient scenario using the nursing process, and was followed by debriefing. Following completion of their SLE and CLE sequence participants were evaluated during a final high-fidelity simulation vignette approximately five weeks after the completion of the semester, but prior to the start of the subsequent semester. A unique type II diabetes mellitus vignette using the same format and with a similar level of complexity as the previous high-fidelity simulation vignettes was used for the final evaluation time point.

Sample

Sample size calculation was conducted *a priori* power using the software program G*Power version 3.0.10. The estimated required sample size for a between groups repeated measures ANOVA with two groups, three measurement time points, an α level of .05, a minimal statistical power of 0.8, and what is considered a small to medium effect size, $d = 0.35$ (17)s was 46 participants (23 per group). This effect size was chosen based on those reported in the NCSBN study using the Creighton Competency Evaluation Instrument (5). Oversampling to account for a potential 30% drop out rate brought the target sample to 60 participants.

All students enrolled in the practicum course were invited to participate in the study. A convenience sample of nursing students was recruited using the following inclusion criteria: (1) at least 18 years of age; (2) enrolled in their first medical-surgical nursing course; and (3) enrolled in the associated medical-surgical nursing theory course.

Data Collection and Measurement

Following University Institutional Review Board approval and obtaining participant consent, demographic information was collected. Evaluation of participants' clinical competency was measured using the Creighton Competency Evaluation Instrument (CCEI) three times: (1) During a designated simulation vignette at the end of participants' SLE rotation; (2) During a preselected clinical day/single patient encounter occurring in the final week of participants' CLE rotation; and (3) After completion of the semester during a follow up simulation vignette. For study purposes participants were evaluated when they were assigned to the primary RN role in a simulation vignette.

The CCEI is a 23-item tool with four subscales: assessment, communication, clinical judgment, and patient safety which incorporates the Quality and Safety Education for Nurses (QSEN) competencies and components of the *Essentials of Baccalaureate Education for Professional Nursing Practice* (18, 19). The tool is scored by assigning each item a 0 or 1 depending if a specific behavior is demonstrated (scored as 1), not demonstrated (scored as 0), or not applicable. Prior studies have demonstrated acceptable reliability estimates with Cronbach's alpha ranging from 0.97- 0.98 (18, 20). In this study Cronbach's alpha for total scale was 0.95 and subscales ranged from 0.94- 0.99.

To ensure interrater reliability of the instrument for this study 16 instructors received training on the use of the CCEI tool prior to the start of data collection. During the training session, each instructor viewed a series of videos that provided an orientation to the tool, and discussion of how to properly score participants expected behaviors for each item on the instrument. To establish interrater reliability instructors then viewed and independently scored an archived video scenario using the CCEI. The researcher, who was deemed an expert rater, previously scored the same archived video. If scores differed

by more than four points (<80% consensus) additional instructor training was to be conducted by the researcher, however no additional training was needed. Interrater reliability of the CCEI in this study demonstrated an overall percent agreement with the researcher of 92%. To account for the amount of agreement expected due to chance Kappa statistics were also calculated (22, 23) and suggested moderate to almost perfect agreement (K = .481-1).

Data Analysis

Descriptive and inferential statistical methods were utilized to analyze the data using SPSS version 23.0. To ensure that the two groups were equivalent at baseline, pertinent demographic variables were compared using chi square analysis for categorical variables and independent *t* tests for continuous variables. To determine if clinical competency using the CCEI differed over the three measurement time points within and between the two groups repeated-measures analysis of variance (RM-ANOVA) were calculated. To establish statistical significance an alpha level of .05 was used. Significant main effects of group, time or interaction were explored further through post hoc comparison using simple main effects analysis. All analyses included only those participants who had complete data across all three measurement time points.

Results

Sample Demographic Characteristics

Of the 120 students initially invited to participate in the study 71 enrolled, for a 41% refusal rate. Of the 71 originally enrolled, 48 participated in all three data collection time points, for a 32.3% attrition rate. The final sample consisted primarily of Caucasian females with a mean age of 22.2 years (SD =3) as presented in Table 1. No statistically

significant differences between groups were identified for any of the variables describing the sample characteristics.

Differences between Groups: Group S-C vs. Group C-S

The primary aim of this study was to determine if the sequences of blocks SLE and CLE impacted clinical competency development in nursing students participating in their first medical- surgical practicum course. As summarized in Table 2 results showed that there were no significant differences in CCEI total ($F [1, 46] = .05$, $p = .811$) or subscale scores between the two groups across the three data collection points. Consequently, there was no significant effect on clinical competency based on the sequence participants were assigned to.

Differences within Groups

As illustrated in Table 3 there was a significant time by group interaction for CCEI total scores. Simple main effects analysis revealed that both groups had significantly higher scores following the CLE component of the sequence with Group S-C demonstrating significantly higher CCEI total scores at Time 2 compared to Times 1 and 3, and Group C-S demonstrating significantly higher total CCEI scores at Time 1 compared to Time 3. Of note there were significant time by group interactions among the CCEI subscales. Mauchly's test indicated that the assumption of sphericity for the patient safety subscale was violated, $p = .009$, therefore the degrees of freedom were corrected using Huynh-Feldt ($\varepsilon = .925$). Simple main effects analyses revealed that Group S-C demonstrated significantly higher scores for the assessment and patient safety subscales at Time 2 following CLE compared to Times 1 and 3 and significantly higher scores for the communication and clinical judgment subscales at Time 2 following CLE compared

to Time 1. Group C-S demonstrated significantly higher assessment subscale scores at Time 1 following CLE compared to Time 2, significantly higher clinical judgment subscale scores at Time 3 compared to Time 2, and significantly higher patient safety subscale scores at Time 1 following CLE compared to Times 2 and 3.

Age, Sequence and Clinical Competency Development

The secondary aim of the study was to determine if the age of the learner affected clinical competency development in the different blocked sequences of SLE and CLE. There was no significant effect of age and group on CCEI total scores ($F [2, 88] = .800$, $p = .452$), nor the subscale scores.

Discussion

The results of this study provide evidence regarding the effects of blocked sequences of SLE and CLE on clinical competency development. When using the NLN/Jeffries Simulation Framework it is suggested that researchers consider the impact of student demographic factors such as age on simulation based competency outcomes (4). In this study, regardless of the group participants were assigned to age was found to not have a significant influence on CCEI total scores or subscales. This is similar to previous reports in the simulation literature regarding age and simulation outcomes (4, 24). These insignificant findings may have been due to the fact that there was little variation in the age of participants for this study. Despite these insignificant findings, student demographic factors should continue to be investigated in studies exploring simulation based competency outcomes particularly using a sample compromised of a more diverse student population as suggested by Ironside, et al. (4).

Findings revealed that there were no between group differences noted over the study period in the CCEI total or subscale scores, suggesting that the sequence of SLE and CLE did not impact participant's CCEI scores over time. Of interest, there were several notable within-group differences for this sample. Regardless of group assignment, participants had higher total CCEI scores following the CLE portion of the sequence. Even though the CCEI was initially developed for use exclusively in the simulation environment the current version of the tool has been reported to be reliable and valid in both the clinical and simulation environments (18). However, no studies to date have compared faculty ratings of students in the clinical and simulation environments using the tool. Therefore, it is possible that higher scores following participants CLE for this study are a function of the environment in which they were evaluated. Further study of the CCEI tool is warranted to determine if student scores in the clinical environment are significantly different than those obtained in the simulation environment.

Further examination of clinical competency through analysis of the CCEI subscales revealed significant within group changes over time. Clinical judgment subscale scores were significantly higher for each group post-SLE. Previous reports have suggested that simulation contributes to the development of clinical judgment (25, 26.) A surprising finding was that participants' scored the lowest in demonstration of patient safety subscale behaviors during the final simulation vignette regardless of group assignment. Previous studies have indicated significant improvements in patient safety competencies following simulation (4, 27). Decreased demonstration of these safety behaviors may have been attributed to an approximately five-week gap between the second and final measurement points, during which participants were between semesters

and not attending classes. This gap could have ultimately impacted retention of key behaviors that are included in this subscale such as medication administration, correct performance of procedures, and use of patient identifiers. Prior studies have reported significant decline in skills performance using high-fidelity simulation following a lapse of time between evaluations (28, 29). Based on the findings of this study further study of retention of procedural knowledge comparing alternative models of clinical education delivery is needed.

Limitations

This study explored the influence of two different sequences of SLE and CLE on clinical competency in only one medical-surgical practicum course at one university limiting the generalizability of the results to other courses, curricular levels, or nursing programs. It is also possible that the two groups were not equivalent since no pretest measure of clinical competency was obtained.

Implications for Nursing Education

This study provides evidence that participation in a block of SLE preceding or following a block of CLE may produce similar student outcomes regardless of the sequence of these learning experiences. This unique model of clinical education delivery in nursing programs may aid in addressing the barriers faced by nurse educators such as lack of clinical site availability and increases in student enrollment. There is a need for additional appraisal of the CCEI comparing use in the clinical and simulation environment to determine if differences exist in faculty evaluation of student performance in each environment. Continued evaluation of student outcomes using alternative formats of simulation and clinical hours, in additional courses, and over longer

periods of time is necessary before nurse educators can determine the optimal clinical education delivery model for prelicensure nursing programs.

Acknowledgements

This study was funded by a grant from Sigma Theta Tau International.

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Table 1. Sample Characteristics

Characteristic	All Participants (*N* = 48)	Group S-C (*n* = 22)	Group C-S (*n* = 26)
Age: Mean (*SD*)	22.2 (3.0)	21.9 (1.9)	22.4 (3.7)
Female: % (*n*)	79.2 (3)	72.7 (16)	84.6 (22)
Caucasian: % (*n*)	83.3 (40)	77.3 (17)	88.5 (23)
Prior Degree: % (*n*)	47.9 (23)	50 (11)	46.1 (12)
Work in Healthcare: % (*n*)	27 (13)	22.7 (5)	30.8 (8)

Table 2. Between Groups ANOVA

Source	*F*	*p*
Total CCEI Scores between Groups		
Group	(1, 46) = .058	.811
CCEI Subscales between Groups		
Assessment	(1, 46) = .182	.671
Communication	(1, 46) = 3.132	.084
Clinical Judgment	(1, 46) = .059	.809
Patient Safety	(1, 46) = .298	.588

Table 3. Summary of Time by Group Means, Standard Deviations, and Test Statistics for CCEI Total and Subscale Scores

	Time 1 Mean (*SD*)	Time 2 Mean (*SD*)	Time 3 Mean (*SD*)	Time X Group Test Statistics (Time of Significant Differences)
Total Scale (*N = 48)*	20.17 (3.4)	20.81(3.0)	19.15 (2.6)	F (2, 88) = 6.09 p = .003 Post hoc p = .005 (c)
Assessment	2.31 (.88)	2.31 (.95)	2.00 (.77)	F (2, 88) = 6.71 p = .002 Post hoc NS
Communication	4.46 (.85)	4.75 (.70)	4.65 (.57)	F (2, 88) = 1.12 p = .332
Clinical Judgment	8.13 (1.5)	8.42 (.87)	8.54 (.94)	F (2, 88) = 3.24 p = .044 Post hoc NS
Patient Safety	5.27 (1.1)	5.33 (1.1)	3.96 (1.5)	F (1.85, 81.41) = 9.12* p < .001 Post hoc p < .001(b, c)
Group S-C (*n = 22)* **Total Score**	19.05 (3.3)	21.73 (3.1)	19.14 (2.7)	p = .001(a) p =.005 (c)
Assessment	2.09 (.75)	2.64 (.90)	1.86 (.71)	p = .014(a) p = .003(c)
Communication	4.18 (.91)	4.73 (.70)	4.55 (.67)	p = .033 (a)
Clinical Judgment	8.05 (1.2)	8.73 (.77)	8.36 (1.2)	p = .046 (a)
Patient Safety	4.73 (1.3)	5.64 (1.0)	4.36 (1.4)	p = .001(a) p = .003 (c)
Group C-S (*n* = 26) **Total Score**	21.12 (3.3)	20.01 (2.8)	19.15 (2.6)	p = .018 (b)
Assessment	2.50 (.95)	2.04 (.92)	2.12 (.82)	p = .020 (a)
Communication	4.69 (.74)	4.77 (.71)	4.73 (.45)	NS
Clinical Judgment	8.19 (1.7)	8.15 (.88)	8.69 (.68)	p = .010 (c)
Patient Safety	5.73 (.53)	5.08 (1.2)	3.62 (1.6)	p = .002 (a) p <.001 (b) p = .002 (c)

Post-hoc analysis a = Significant Differences between Time 1 & Time 2; b = Significant Differences between Time 1 & Time 3; c = Significant Differences between Time 2 & Time 3; * = Huynh-Feldt correction