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THE POWER OF REASONING: HOW STUDENT NURSES DEVELOP CONFIDENCE IN REASONING

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THE POWER OF REASONING: HOW STUDENT NURSES DEVELOP CONFIDENCE IN REASONING

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I am submitting a dissertation written by *Michael F. Brown* and entitled *"The Power of Reasoning: How Student Nurses Develop Confidence in Reasoning."* I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Nursing. We have read this dissertation and recommend its acceptance:

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The Power of Reasoning: How Student Nurses Develop Confidence in Reasoning

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Abstract

Background

Clinical Reasoning (CR) is the intellectual capacity to understand the value of patient data related to current knowledge, skills, and experiences within a dynamic domain of patient care with reflective analysis relating the new experience and understanding into new knowledge to be applied in future clinical situations. Poorly developed CR skills inhibit effective problem-solving abilities of nursing students producing levels of unexpected confusion and loss of confidence impeding their adaptability and effectiveness in dynamic healthcare environments. This study explored the effectiveness of human patient simulation (HPS) as an innovative method to facilitate the development of CR in undergraduate nursing students.

Method

A two-group crossover experimental design testing the hypothesis that Baccalaureate Student Nurses (BSN) experiencing patient simulations will have higher Health Sciences Reasoning Test (HSRT) scores as compared to students without these experiences. The 33 item HSRT is a multiple choice test using health science situational mini-case vignettes assessing the takers clinical reasoning capacity. Participants were randomly assigned to treatment groups that received HPS or case studies. Pre and posttest HSRT scores were measured to measure CR of each participant. Data analysis through the Grizzle Model included a mixed linear approach that included fixed effects of treatment, sequence, period, base score, and experience.

Results

The residual effect value was very large signifying the absence of carryover effect ($p=0.840$) indicating further analysis for treatment effects could continue. The best-fit final mixed linear model selected for analysis with the Grizzle Model produced insignificant treatment results with significant ($p<0.05$) covariance that identified both period and random effects impacting the HSRT measure of CR for this research design.

Conclusion

There were no significant treatment effects of HPS on the acquisition of CR yet the outcome illuminated additional considerations to explore with further research adding to the understanding of this complex concept. Additional considerations for future research should include investigating an effective timetable for the development of CR through HPS and consider a more sensitive evaluation tool. New research designs should also consider increasing the realism and designing HPS through best practice methods while respecting the effect of academic, clinical, and external student stressors.

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Summary of Study

Introduction

There are 40,000 projected instances of medical errors occurring daily that cost the United States healthcare system an estimated $17 billion annually (Sherwood & Zomorodi, 2014). Poorly developed clinical reasoning (CR) skills contribute to an increase in the failure to act, decreased confidence, and loss of self-efficacy that increase the potential for adverse patient outcomes (Ashcraft, 2004; Cardoza & Hood, 2012; Ironside, Jefferies, & Martin, 2009; Sharpnack & Madigan, 2012). Nurses encounter a complex, confusing, and uncertain environment that challenges fundamental nursing proficiencies, experience, judgment, and decision-making abilities (Hwang, Yen, Lee, Huang, & Tseng, 2010). Complex clinical situations create a chaotic and dynamic environment frequently resulting in clinical decision errors and increased risk to patients (Cruz, Primenta, & Lunney, 2009). Novice nurses often lack the inductive, deductive, and creative problem solving skills vital in the provision of quality patient care (McAllister, 2003).

The definition of CR is two fold. The initial component of the definition is demonstrating the intellectual capacity to bring together the value of patient data as it relates to current knowledge, skills, and experiences within the dynamic domain of patient care. The second component of reflective analysis combines an understanding of these new experience with development of new knowledge that can be applied to future clinical situations (Meakim et al., 2013). CR skills include the ability to interpret and synthesize both measured and observed patient assessment data resulting in decision-making skills that are fundamental to the nursing process and key to competent nursing care (Cerullo & Cruz, 2010; Cranley & Doran, 2004). The novice student nurse may fail to recognize the complexity of the clinical situation through faulty reasoning resulting in ineffective nursing care and poor patient outcomes (Jones, 2008). Improved CR skills can potentially increase positive patient outcomes through accurate identification of priority nursing diagnoses and related interventions (Cruz, Primenta, & Lunney, 2009).

Nurse educators face the challenge of producing nurse graduates that can effectively exercise CR skills in complex clinical situations. This study investigated the effectiveness of high fidelity human patient simulation (HPS) as a safe, controlled, and innovative *learning method* for the development of CR skills as measured by the Health Sciences Reasoning Test (HSRT) (Insight Assessment, 2016). The use of HPS as a *learning method* for cognitive development is innovative because it diverges from the more common *teaching method* that is focused on psychomotor skill development (Kaakinen & Arwood, 2009).

Specific aim.

The aim of this study is to determine if high fidelity HPS experiences provide undergraduate nursing students the necessary experience to improve CR abilities as measured by the HSRT.

Hypothesis.

Baccalaureate Student Nurses experiencing HPS will have higher HSRT scores compared to students without HPS experiences.

Background

Nursing students typically lack the ability to connect the complexity of reasoning within the clinical situation due to poorly developed critical analysis and problem-solving skills (Jones, 2008). Poorly developed problem-solving skills produce levels of unexpected confusion and loss of confidence that impede the nursing student's ability to adapt and act in this complex and ever-changing clinical environment (Cardoza & Hood, 2012).

The CR process combines experience, judgment, and decision-making skills within a complex environment of uncertainty and confusion (Hwang, Yen, Lee, Huang, & Tseng, 2010). Nursing professionals critically evaluate interventions and manage complex patient situations through the key problem solving approach of noticing, interpreting, responding, and reflecting as they process complex clinical situations (Tanner, 2006).

The outcome-based focus of clinical nursing requires the application of CR to understand complex patient care situations that are contextually variable and dynamic in nature (Bland et al., 2009; Pesut & Herman, 1998). The dynamic clinical nursing environment is filled with uncertainty where new protocols, treatment plans, advances in technology, and an ever-increasing patient acuity level result in levels of ambiguity, uncertainty, and complexity (Clancy, Effken, & Pesut, 2008). Utilizing clinical reasoning to notice changes and implement nursing interventions demonstrates competent care that directly impacts patient morbidity and mortality (Friese & Aiken, 2008; Simpson, 2004). Competent clinical reasoning is a cognitive process where current knowledge and skills are applied to the healthcare environment in an attempt to maintain situational awareness, improve nursing care effectiveness, maintain patient safety, and effect the expected patient outcome (Cardoza & Hood, 2012; Cooper et al., 2010; Fowler, 1997; Radhakrishnan, Roche, & Cunningham, 2007; Sears, Goldsworthy, & Goodman, 2010). The ability to consistently apply CR to complex clinical situations is pertinent to competent nursing care and positive patient outcomes (Nielsen, 2009).

The nursing profession faces several complex issues impacting clinical success, including (1) the shortage of qualified nurses and nurse faculty, (2) increased complexity of nursing care within the healthcare system, (3) recognizing and reducing human error, and (4) improving patient safety (Ebright, Carter Kooken, Moody, & Latif Hassan Al-Ishaq, 2008). The continued nursing shortage has produced an increase in the demand for nursing graduates resulting in increased student enrollment (American Association Of Colleges Of Nursing, 2014). Local clinical resources are limited in the ability to support the increased clinical demands of nursing schools. This threat of uneven exposure to valuable clinical experiences contributes to greater risks associated with decision errors and lower quality of care (Cruz, Primenta, & Lunney, 2009). Current literature indicates a shortage of research testing HPS as an effective *learning method* for BSN students while a few authors point out that experiences in HPS create only a short-term positive effect to the acquisition of new knowledge and skill (Lapkin, Levett-Jones, Bellchambers, & Fernandez, 2010; Strickland & March, 2015). Researchers have utilized multiple theoretical approaches that include educational theory, theory of self-efficacy, social cognitive theory, situational awareness, expert-performance approach, and constructivist theory to investigate the effects of clinical simulation on baccalaureate nurse education (Bambini, Washburn, & Perkins, 2009; Cardoza & Hood, 2012; Cooper et al., 2010; Hauber, Cormier, & Whyte IV, 2010; Kaplan, Holmes, Mott, & Atallah, 2011; Spinello & Fischbach, 2008). Researchers have found that clinical simulations using HPS improve student skill and knowledge acquisition with improved competence and confidence prompting cognitive growth in critical thinking and CR resulting in improved performance levels that are as effective as traditional clinical experiences (Oligie; Yeun et al., 2014). Students that engage in HPS in a simulated clinical environment show improved academic performance with significantly improved standardized test scores (Howard, Ross, Mitchell, & Nelson, 2010). There is a lack of evidence supporting utilization of performance-based evaluation as a valid and reliable method in evaluating clinical reasoning therefore, this study utilized the HSRT as the valid measure of clinical reasoning and judgment (Kreiter & Bergus, 2009).

Hands-on practical clinical experience has been the foundation in traditional nursing education challenging nurse educators to provide consistent and appropriate experiences (Gierach & Evenson, 2010). This study addressed this challenge by providing HPS in a safe and controlled environment where students have the opportunity to experience the consequences of clinical actions and decisions without posing a threat to patients. This HPS experience is thought to encourage the development of critical thinking, clinical reasoning, and reflective learning translating into wiser decisions and safer nursing care.

Design

This study was a two-group crossover experimental design testing the hypothesis that BSN students experiencing patient simulations will have higher HSRT scores as compared to students without HPS experiences. Each student participant completed simulation session and case study assignment as part of the standard nursing curriculum. Data collection was conducted during the pre- and posttest measures and included a demographic questionnaire (see table A1). Data analysis included descriptive statistics as well as treatment effect analysis through the Grizzle Model (Grizzle, 1965).

Grizzle developed a statistical model to analyze quantitative data collected from cross-over study designs where subjects are assigned to 2 or more specified treatment periods separated by a time period that allows the subject to return to a prior disease state (Grizzle, 1965). The Grizzle Model increases the power of the statistical analysis for treatment effects by eliminating the variability between subjects as compared to a fully randomized test (Grizzle, 1965). The model estimates both the *direct* and *residual* effects to determine the *error term* applied to an equality test of treatment effects (Grizzle, 1965). The model variables include the general mean, effect of the patient within the sequence (sequence effect), period effect, treatment effect, residual effect, and the random error (Grizzle, 1965).

The model assumes an absence of residual effect due to the return time described above and validates the assumption when the significance value of the residual effect is $p>0.05$ (Grizzle, 1965). The two-phased Grizzle Model initially tests for significance of the residual or carryover effect with significant findings restricting data analysis to only period one data and insignificant results allowing for complete analysis of both treatment periods (Chen & Huang, n.d.). The sequence effect does not affect the treatment effect and can mask as carryover producing a false alarm for positive carryover effect therefore, sequence effect will represent the carryover effect in this analysis (Chen & Huang, n.d.). The fixed effects for this model are the treatment and period effects (Chen & Huang, n.d.).

Research activities were conducted during the 15-week fall academic calendar coinciding with the curriculum requirements of the Child and Adolescent Healthcare course. All simulation activities were conducted in the Skills and Clinical Performance Lab (SCPL) of a major university located in the Gulf Coast Region of Texas. The SCPL provided the clinical setting, HPS manikin, and medical equipment required for the research study. Participants of this research study encountered minimal risk as they were exposed to normal physical and mental demands experienced in BSN curriculum.

Sample

Sample recruitment began after Institutional Review Board approval and included all senior level students enrolled in a BSN program located in the Gulf Coast Region of Texas. Recruitment was conducted through open forum discussion sessions prior to academic course activities in the fall semester. Additional recruitment discussion sessions took place prior to the informed consent session. Subjects received details of the research objectives and expectations during the informed consent process. Subjects underwent screening for the following *inclusion criteria:* ≥18 years of age, fluent in the English language, and in good academic standing with the university. *Exclusion criteria* screening prohibited subject participation for those with a valid learning disability or academic failure of any nursing course. The final sample of participants (n=114) received informed consent prior to group assignment. Group assignment was conducted randomly through the use of a random numbers generator resulting in near equal sized treatment groups (A=58, B=56).

Utilizing a crossover design had a distinct advantage in calculating and recruiting participants. There is a 4 to 1 ratio reducing the necessary sample size when conducting a crossover as compared to a parallel design (Chen & Huang, n.d). This effectively reduces the sample size necessary to fully power crossover studies. Initial sample size calculation (n=102) for a parallel pre- and posttest design included a medium effect size (d=0.50), α error probability of 0.05, and power of 0.70 (GraphPad Software, 2015). Considering the sample size reduction ratio in comparison to the final sample size of n=114, this study was fully powered.

Intervention

The use of clinical simulations in nursing education has gained increased support as researchers explore the effects of simulation on nursing students. Clinical simulation incorporates curriculum, theory, and clinical experiences within a safe environment encouraging development of psychomotor skills and higher cognitive processes (Wotton, Davis, Button, & Kelton, 2010). This study utilized clinical scenarios with computerized manikin patient simulators to provide high fidelity clinical situations with formative assessment and feedback to promote the development of CR with specific learning objectives (see table A2). The clinical scenarios and simulation design utilized established standards developed by the International Nursing Association for Clinical Simulation and Learning (INACSL) (see table A3) (Borum et al., 2013). Based on the literary support, this study used manikin based HPS as a *learning method* to explore the effects on the acquisition and development of CR.

The intervention period (*treatment A*) was structured using Jefferies simulation framework and the INACSL Standards of Best Practice: Simulation[SM] providing 10 hours of HPS experiences that included specific objectives, fidelity, problem solving, student support, and debriefing sessions (Borum et al., 2013; Groom, Henderson, & Sitter, 2014). The attention control period (*treatment B*) provided equivalent 10 contact hours of patient care and problem solving experiences in case study content (figure A1). The crossover design provided a two period two-sequence structure providing each group with both *treatment A* and *treatment B*. During period 1, group A participated in sequence 1 where *treatment A* is followed by *treatment B* after a 2-week period. Group B followed a reciprocal sequencing of *treatment B* followed by *treatment A* (see table A1).

Faculty performing the simulations received vendor training specific to the simulation equipment utilized. The primary investigator completed six credit hours of graduate level education towards a certificate in Leadership in Simulation Instruction and Management acquainting the researcher with the INACSL Standards of Best Practice: Simulation (see table A3) (Borum et al., 2013). The one additional faculty participating in the study received National League of Nursing continuing education courses (9 hours) in the use of simulation as a learning method and was introduced to the INACSL Standards of Best Practice: Simulation by the primary researcher.

The components of the intervention period included a pre-simulation assignment that provided detailed patient information, physician orders, and a series of short answer questions to prepare the student for the simulation lab. The participants divided each study group into subgroups of 10 through self-assignment. Each group was further divided into two groups of 5 participants that would rotate between the 2 rooms until all students had completed the four simulation scenarios. Each simulation room contained a high fidelity simulation environment, computerized patient manikin, and faculty facilitator. The facilitator conducted individual 10-minute simulation sessions for each participant while the remaining participants quietly observed. This process was repeated for each of the 2 simulation scenarios assigned to each room for a total of 4 simulation scenarios. Each 10-hour simulation intervention began with a pre-lab briefing containing an orientation session that detailed the clinical environment and equipment utilized in each simulation scenario (Meakim et al., 2013).

Each participant engaged in four different 10-minute simulation scenarios that implemented specific objectives, fidelity, problem solving, student support, and debriefing. *Objectives* are defined as the directions provided to students in order to prepare them for the simulation (Groom et al., 2014). Each scenario and pre-simulation prep assignment came from the *Clinical Simulations for Nursing Education* text (Gasper & Dillon, 2012). The case studies provided detailed mini vignettes and instructions to complete the individual questions posed throughout the problem solving exercise (Preusser, 2008). *Fidelity* is defined as the low, moderate, or high levels of technical ability that mimic reality, immersing the participant in a realistic clinical environment

(Groom et al., 2014). The simulation intervention included both high and moderate levels of fidelity based upon the availability of adequate computerized patient simulators. *Problem solving* is defined as either high or low levels of situational complexity that provides opportunities for clinical reasoning (Groom et al., 2014). This study implemented both low (asthma and fracture/suspect abuse) and high (head injury and meningitis) complexity simulation scenarios as well as beginning to advanced levels of case studies to stimulate the application of nursing knowledge and problem solving. *Student support* is defined as operational cues during the simulation that include observations, patient assessment and diagnostic test data, verbal and physiological responses provided by either the facilitator or the HPS (Groom et al., 2014). The simulation design incorporated both objectives and simulation fidelity to provide the student support. Additional limited instructor facilitation was utilized during the simulation experience to provide prompts or cues when subjects became confused or unsure during the simulation. *Debriefing* is defined as the post simulation reflective examination of each participant's application of nursing knowledge exploring the thoughts, feelings, and outcomes of their problem solving actions (Groom et al., 2014). The Debriefing for Meaningful Learning (DML) tool was used to encouraging reflective thinking through discussions focusing on performance, nursing knowledge, and nursing skill (Dreifuerst, 2010).

Simulation design included branching scenarios with low to high levels of situational complexity that provided adequate opportunities for clinical reasoning in the following content areas: traumatic brain injury, asthma, meningitis, and suspect abuse/fracture. Simulations included operational cues such as observations, patient assessment, diagnostic test data, and verbal or physiological responses. The composition of each simulation day included two 3-hour simulation sessions immediately followed by two additional 2-hour reflective debriefing sessions.

Four separate pediatric case study assignments provided equivalent attention control for the *treatment B*/attention control group. Maintaining the same spirit of collaboration as the simulation activity, participants worked together to complete the case study assignment. Controlling for any between group collaboration required utilization of eight separate case studies (four per group).

The intervention and attention control activities are components of the regular course requirements for baccalaureate nursing students and added no additional educational component. The research component included informed consent, collection of demographic information, and the pre- and posttest HSRT measures.

Measures

Demographic data were collected during the informed consent process and included gender, age, prior healthcare provider experience (PHPE), and ethnicity. The informed consent process included a detailed explanation of the proposed research, risks and benefits as well as voluntary consent. Research participation was not part of the academic grade. Participation in the research was completely voluntary with no academic advantage or disadvantage. Course faculty with appropriate grade rubrics conducted all academic evaluations of the simulation and case studies. Evaluation of the simulation activity for academic purposes was conducted with the *Modified Lasater Rubric* and is not included in this research (Lasater, 2011).

Each research participant completed three HSRT measures (1 pretest and 2 posttests) as outlined in the study design (table A1). The HSRT is a 33 item multiple choice test that uses health science situational mini-case vignettes assessing the clinical reasoning capacity of the test taker (Huhn et al., 2011; Panns, Sermeus, Nieweg, & Van Der Schans, 2010). The questions are designed to evaluate the test taker's analytical skill, ability to make and interpret inferences and to rationalize the inference resulting in a overall score of clinical reasoning with an additional set of subscale scores from 5 domains that include analysis, evaluation, inference, deductive, and inductive measures (Huhn et al., 2011). The analysis domain evaluates the significance and understanding of context where situations, relationships, procedures, and experiences are measured to understand how individuals draw inferences directing them towards the appropriate conclusion (Insight Assessment, 2016). Evaluation domain measures the credibility of these contextual experiences and allows for reflective thought and analysis resulting in rationales for the proposed conclusions while the inference domain measures the ability to formulate the connection between both the context and experience allowing for identification of pertinent information (Insight Assessment, 2016). The deductive domain measures the ability to determine the validity of the proposed conclusion while inductive domain assesses the ability to derive the proper conclusion based on specific contextual observations (Insight Assessment, 2016). Through the measurement of these domains, the HSRT produces a weak, average, or strong score indicating the level of CR achieved (Insight Assessment, 2016).

Scoring the items is either correct or incorrect resulting in combined additive score where results >24 indicate strong CR, scores <15 indicate weak CR, and scores falling between these marks indicate average CR. The HSRT reliability using Cronbach's α is high reinforcing the instrument's usage in measuring critical thinking and judgment (α=0.835) (Scarbrough, 2012).

Procedures Quality Control

Consistent presentation of each scenario and avoidance of deviations or "on-the – fly" changes to the simulation scenario and script prevented any simulation case variance. Further quality control included utilization of branching scenario templates allowing the simulation to progress according to the decisions made by the participant during care activities.

Statistical Analysis

Data analysis explored for the possibility of carry-over effects prior to analysis for measurable significance of the treatment effect. The primary data analysis method of the HSRT results of the two-group crossover design included both descriptive statistics and the Grizzle Method (Grizzle, 1965). The study focus was on the broad concept of CR and therefore no subscale analysis was conducted. All statistical analysis was conducted with Statistical Package for the Social Sciences (IBM, SPSS version 22).

Results

Sample

The recruitment and random group assignment process produced no exclusions with nearly equal groups (A=58, B=56) of participants. Detailed group characteristics will be discussed later. General characteristics of the total sample (n=114) include a diverse representation of ethnic groups with ages ranging between 20 to 47 years. All participants were at the senior level of a BSN nursing program with 20% of the sample responding positive to having some level of PHPE.

Group Characteristics

The specific group demographic information includes the gender, age, PHPE, and ethnicity. The demographic makeup of both groups was homogeneous with relatively equal distribution of participant characteristics between groups (see table A4). Gender representation was as expected with 82.5% of the sample population being female. Gender breakdown by group included an equal number of male participants in each group (A=10, B=10) with the remaining participants being female (A=48, B=46). Ages had an overall sample mean of 25.5 and a range of 20 to 47 years. There is an assumed equal variance (t= -0.894) with no significant difference (Sig 2 tailed= 0.372) in the group mean age (A= 25.16, B= 25.84). Distribution of participants with PHPE was nearly equal (A=11, B=12) (see table 4). Ethnicity by group was also similar with African-American (A=5, B=7), Anglo-American/Caucasian (A=20,B=24), Asian-American/Pacific Islander (A=13, B=15), Hispanic/Mexican-American (A=12, B=8), Native American (A=1, B=0), and Mixed/Other (A=7, B=2) (see table A4).

Data Analysis

The examination for carryover effects produced a large value lacking statistical significance ($p=0.840$) indicating no measurable carryover effect allowing for continued analysis for treatment effects. Data analysis included a mixed linear approach utilizing the Grizzle Model to detect treatment effects as measured with the HSRT overall score with no analysis of HSRT subscales (Grizzle, 1965).

The mixed linear model development process included comparison of fixed and random effects. Utilization of the Schwarz's Bayesian Criterion (BIC) to determine goodness of fit for each different model explored produced a final model that included fixed effects of treatment, sequence, period, base score, and experience (Pallant, 2007).

Treatment effects of HPS were not significant ($p>0.05$) while the analysis of covariance estimates produced significance in both period effect and intercept ($p<0.05$) (see table A5). Examination of the repeated measure HSRT score when adjusting for both baseline score and PHPE, produced insignificant results that indicated a positive shift in group A of period 1= +0.19 and period 2= +0.17 and a negative shift in group B of period 1= -0.17 and period 2= -0.61 (see table A6). The combined group mean scores of both the HPS and case study groups per period show a variation in overall scores where the outcome of HSRT measures experienced statistically insignificant changes over time as evidenced by the baseline mean score of 23.228 and period results of 23.396 and 22.951 (see table A7).

Discussion

Overall examination of the treatment effects showed no significant differences in treatment groups based on the period mean scores ($p>0.05$) (see table A7). These results do not support the current trend in literature where improved BSN education is attributed to the integration of HPS through best practice methods that promote improvement of clinical performance and decision-making (Hayden, Smiley, Alexander, Kardong-Edgren, & Jeffries, 2014). Furthermore, the negative finding of this study contradicts additional research where significant improvement in student performance ($p=0.03$) was measured when clinical simulations were implemented as compared to traditional clinical experiences of community based patient care experiences (Spinello & Fischbach, 2008).

Although this study failed to support the anticipated significant improvement in CR, there are possible alternative explanations to consider. One major consideration may involve the limited time allocation for the critical components required to develop CR such as knowledge, experience, and reflection (Rigby et al., 2011). The combined influence of the simulated clinical experience with external cognitive artifacts, such as test results and electronic monitoring, during clinical situations prompts the application of factual, procedural, and conceptual domains of formal and informal knowledge to make clinical judgments and decisions (Considine, Botti, & Thomas, 2007; McLane et al., 2010). The idea that tacit knowledge is gained through application of nursing skills while engaged in clinical experiences is thought to be the keystone in developing reasoning skills (Offredy, Kendall, & Goodman, 2008). The combination of knowledge, external cognitive artifacts, and experience are ultimately simplified into the singular term of reasoning and is generally accepted as the necessary process in which nurses develop this skill (Offredy et al., 2008). The inquisitive act of thinking through experiences and knowledge while trying to clarify and understand complex clinical situations can be achieved through purposeful reflection (Kuiper & Pesut, 2003). This current research experience in HPS may not have been of sufficient duration to elicit the expected subject response of active cognitive processing of knowledge application combined with simulated clinical experiences that included periods of reflective exploration of the situation to develop CR (Rigby et al., 2011).

One must also consider the strength of the HSRT to accurately measure the small magnitude of change in score over the short research period. The low magnitude of change in the group mean scores may be an indication of the inability of the HSRT to adequately measure this change in CR (table A6). This inability of the HSRT to capture the change in CR may partially explain why treatment effect significance was not achieved. This postulation is supported by current research by Scarbrough (2012) and his conclusion that the HSRT may be best suited as an indicator for trait-based critical thinking rather than a discriminator for changes in CR.

Additional consideration must examine the effects of stress as a psychosocial influence on both the student's well being and academic performance (Jimenez, Navia-Osorio, & Diaz, 2010). The affect of academic stressors such as assignments, course workload, and grade performance along with clinical stressors of lack of knowledge, lack of skills, and caring for patients are combined with external stressors of daily life events and financial issues that can ultimately affect the health and academic performance of the student population (Jimenez et al., 2010). The significant period effects of this study indicate that the timing of the treatment during the academic calendar has a significant effect on the acquisition of CR. The period effects may be attributed to the variable impact of academic, clinical, or external stressors each subject encountered throughout the study period ultimately affecting the acquisition and development of CR. The significant random effects are not defined and are unpredictable. The significant variance effects of this study stress the importance of utilizing theoretical and methodological best practices to minimize the impact of variance while improving the preparation of nursing students and their readiness to practice (Hayden et al., 2014). Smith and Roehrs (2009) also found that simulation design characteristics (objectives, support, problem solving, guided reflection, and fidelity) explained 46.9% of total variance when measuring student satisfaction and self-confidence in simulation thus supporting the importance of simulation design.

The absence of carryover effect is important for statistical analysis when utilizing a crossover research design but does cause pause when measuring cognitive abilities. There is the assumption that students should gain and retain knowledge as they progress through a rigorous academic program such as nursing curriculum. The insignificant carryover effect of this study indicates a lack of knowledge retention thus supporting the current findings in literature where poor knowledge retention occurs over time, specifically within HPS experiences (Strickland & March, 2015). This lack of new knowledge retention confounds the intuitive assumption that students should retain new knowledge when exposed to HPS. In contrast to previous research, this study does not support the current findings that clinical simulations through HPS improve the intellectual performance, CR, and clinical judgment while improving the acquisition of new knowledge through translating nurse theory to practice (Gonzol & Newby, 2013; Hauber, Cormier, & Whyte IV, 2010; Lindsey & Jenkins, 2013).

Additional research should be conducted to explore the use of HPS as a *learning method* to develop CR in nursing students. This approach is in contrast to the current trend in nursing literature where clinical simulations have been shown to be an effective adjunct to traditional clinical experiences allowing nursing programs to substitute up to 50% of required clinical experiences with clinical simulation if the simulation design includes 1) trained facilitators, 2) utilization of INASCL Standards of Best Practice: Simulation, and 3) use of evidence based simulation scenarios (Hayden et al., 2014). This trend includes measuring simulation effectiveness by assessing nursing student performance on standardized tests (HESI and NCLEX), and use of metrics designed to measure clinical performance, critical thinking, student satisfaction, and self-confidence (Gates, Parr, & Hughen, 2012; Hayden et al., 2014; Ironside et al., 2009; Kaplan, Connor, Ferranti, Holmes, & Spencer, 2012; Liaw, Scherpbier, Rethans, & Klainin-Yobas, 2012; Mould, White, & Gallagher, 2011; Schlairet, 2011; Sears et al., 2010). Although these trends are well established in nursing research, poorly developed CR skills continue to contribute to an increase in the failure to act, decreased confidence, and loss of self-efficacy increasing the potential for adverse patient outcomes (Ashcraft, 2004; Cardoza & Hood, 2012; Ironside, Jefferies, & Martin, 2009; Sharpnack & Madigan, 2012). Suggested revisions to improve the effectiveness of the current research design and improve the learning process are (1) increase the time students engage in simulation experiences, (2) use of an evaluation measure that can discriminate the expected low level change in CR that occur over short periods of time when evaluating the effect of HPS on CR (3) improve the simulation design with increased fidelity and realism while implementing best practices, and (4) consider the effect of academic, clinical, and external stressors when designing HPS.

Limitations of this research include a relatively short research period (15 weeks) with limited exposure to HPS experiences (10 hours). Bias may have been introduced because the researchers were not blinded to which group was assigned to the HPS or case study groups. Additional limitations could include the timing within the academic calendar of the HSRT evaluations. Participant performance may have experienced bias where the need to prioritize preparation and participation in other academic courses or employment may have had an adverse effect on the readiness for research activities.

Conclusion

This study utilized the recommended best practice methods of 1) trained facilitators, 2) utilization of INASCL Standards of Best Practice: Simulation, and 3) use of evidence based simulation scenarios to determine if computerized patient manikin HPS experiences would effect the CR abilities of BSN students (Hayden et al., 2014). The results conflict with current trends and findings in nursing research on HPS in nursing education indicating a need for further research while implementing best practice methods. A possibility of the conflict could be related to the research focus on CR and the utilization of HPS as a *learning method* rather than a *teaching method.* Although there were no significant treatment effects of HPS on the acquisition of CR, the outcome illuminated additional considerations to explore with further research. Additional considerations for future research should include investigating the most effective timetable required for the development of CR through HPS. New research designs should include INACSL Standards of Best Practice: Simulation and increased fidelity/realism while incorporating improved understanding of academic, clinical, and external stressors affecting the student population. Finally, consider an evaluation tool with improved sensitivity to measure changes in CR. The future exploration of how to improve the acquisition of CR through HPS will continue to add to nursing science and improve the use of HPS in nursing curriculum.

Strengths of the study include a large sample size and the use of theoretical methodologies of best practice for the design and application of HPS. Theoretically based simulation design, application, and debriefing techniques provided strength and stability to the study contributing to future repeatability of this study. Continued research testing and developing HPS models for practice and education are critical for continued success in nurse education and the advancement of nursing science. Understanding how to utilize HPS as a *learning method* to increase the CR abilities of BSN students will ultimately translate to improved clinical decisions, reduced nursing error, and safer competent nursing care.

Proposal

Specific Aim

There are 40,000 projected instances of medical errors occurring each day costing the United States healthcare system an estimated $17 billion annually (Sherwood & Zomorodi, 2014). Poorly developed clinical reasoning (CR) skills contribute to an increase in the failure to act resulting in increased undesirable patient complications and poor outcomes (Ashcraft, 2004). Nurses face a complex, confusing, and uncertain environment challenging their fundamental nursing proficiencies, experience, judgment, and decision-making abilities (Hwang, Yen, Lee, Huang, & Tseng, 2010). Complex clinical situations create a chaotic and dynamic environment that frequently results in clinical decision errors increasing the risks to patients (Cruz, Primenta, & Lunney, 2009). In many cases, nurses lack the reasoning and problem solving approach where creativity, inductive, and deductive thinking skills provide a solution vital for effective nursing care (McAllister, 2003). CR is the ability to interpret and synthesize observed and measured patient data culminating in appropriate nursing actions (Cerullo & Cruz, 2010). Improved CR skills produce positive patient outcomes through identification of priority nursing diagnoses and related interventions (Cruz, Primenta, & Lunney, 2009). Nursing educators face the challenge of producing graduates with effective critical thinking and CR abilities. This study will examine the effectiveness of high fidelity human patient simulation (HPS) scenarios as a safe and controlled learning method for the development of CR skills in undergraduate nursing students.

For the purpose of this study, high fidelity HPS is defined as a high level of realism and interactivity that mimic the physiological changes that occurs during illness that fully functional computerized human patient simulators can provide (Meakim et al., 2013).

CR skills and decision-making ability are fundamental to the nursing process and key to competent nursing care (Cranley & Doran, 2004). The novice student nurse may fail to recognize the complexity of the clinical situation through faulty reasoning resulting in ineffective nursing care and poor patient outcomes (Jones, 2008). Expert nurses are able to grasp complex clinical situations by comparing current events to prior experiences. A broader more knowledgeable experience base provides the expert nurse greater understanding of the overall picture of the patient's condition. The study will provide consistent learning experiences through the application of HPS scenarios allowing the student to develop and apply clinical reasoning skills. This innovative use of HPS as a learning approach is divergent from the more common teaching approach of psychomotor skills (Kaakinen & Arwood, 2009).

There is a shortage of research testing if HPS is an effective learning method as opposed the more common application of HPS as a teaching method for the development of psychomotor skills (Lapkin, Levett-Jones, Bellchambers, & Fernandez, 2010). This study will examine if HPS affects the development of CR as measured by the Health Science Reasoning Test (HSRT).

Specific aim.

Determine if high fidelity HPS experiences provide undergraduate nursing students the necessary experience to improve CR abilities.

Hypothesis.

Baccalaureate Nursing Students (BSN) experiencing HPS will have higher HSRT scores as compared to students without these experiences.

Research Strategy

Significance

Nursing students typically lack the ability to connect the complexity of reasoning within the clinical situation due to poorly developed critical analysis and problem-solving skills (Jones, 2008). Poorly developed problem-solving skills produce levels of unexpected confusion and loss of confidence that impede the nursing student's ability to adapt and act in this complex and ever-changing clinical environment. This study will explore if HPS scenarios are an effective innovative method that facilitates the development of CR when added to nursing curriculum.

The CR process combines experience, judgment, and decision-making skills within a complex environment of uncertainty and confusion (Hwang, Yen, Lee, Huang, & Tseng, 2010). Nursing professionals critically evaluate interventions and manage complex patient situations through a crucial process of clinical reasoning. Tanner defines this clinical judgment process as the key problem solving approach where nurses notice, interpret, respond, and reflect as they process complex clinical situations (Tanner, 2006).

The outcome-based focus of nursing requires the application of clinical reasoning to understand patient care situations that are complex, contextually variable and dynamic in nature (Pesut & Herman, 1998). This dynamic environment is filled with uncertainty where new protocols, treatment plans, advances in technology, and an ever-increasing acuity level of the patient population result in levels of ambiguity, uncertainty, and complexity (Clancy, Effken, & Pesut, 2008). Utilizing clinical reasoning to notice changes and implement nursing interventions that demonstrate competent care directly impacts patient morbidity and mortality (Friese & Aiken, 2008; Simpson, 2004). Patient survival and nurse competency are dependent upon the skilled application of clinical reasoning. Competent clinical reasoning includes the cognitive environmental interaction between the patient and the nurse's knowledge while maintaining focus on the situational need for action leading to positive patient outcomes (Fowler, 1997). The ability to consistently apply CR to complex clinical situations is pertinent to competent nursing care and positive patient outcomes (Nielsen, 2009).

The nursing profession faces several complex issues impacting clinical success, including the shortage of qualified nurses and nurse faculty, increased complexity of nursing care within the healthcare system, recognizing and reducing human error, and improving patient safety (Ebright, Carter Kooken, Moody, & Latif Hassan Al-Ishaq, 2008). The continued nursing shortage has produced an increase in the demand for nursing graduates resulting in increased student enrollment (American Association Of Colleges Of Nursing, 2014). Local clinical resources are limited in the ability to support the increased clinical demands of nursing schools. This threat of uneven exposure to valuable clinical experiences contributes to greater risks associated with decision errors and lower quality of care identifying clinical reasoning as a crucial component of the nursing process (Cruz, Primenta, & Lunney, 2009).

Student nurses often lack the experience and problem-solving skills to effectively manage the complexity of patient care indicating a need to improve their learning experiences. Current literature indicates a shortage of research testing human patient simulation as an effective learning method (Lapkin, Levett-Jones, Bellchambers, & Fernandez, 2010). The literature also identifies a lack of evidence supporting utilization of performance-based evaluation as a valid and reliable method in evaluating clinical reasoning therefore, this study will utilize the HSRT as the valid measure of clinical reasoning and judgment (Kreiter & Bergus, 2009). This gap identifies a serious need to develop innovative strategies addressing the increased need for knowledgeable nurses capable of meeting the dynamic changes that typically occur within the provision of nursing care. Furthermore, the gap identifies a need to promote a reliable and valid measurement instruments capable of evaluating clinical reasoning within nursing curriculum. Hands-on clinical practice experience is the foundation to learning clinical reasoning and creates a challenge for educators to provide consistent and appropriate experiences (Gierach & Evenson, 2010). Therefore, educators face the challenge of developing methods that bring clinical reasoning into the classroom environment with valid and reliable evaluation methods.

Faculty must develop new innovative methods that will bridge the clinical education gap by providing HPS learning experiences that meet the increased clinical complexity of today's patients (Lasater, 2007). Innovative new methods such as HPS provide safe and controlled environments where students have the opportunity to experience the consequences of clinical actions and decisions without posing a threat to human subjects. This experience encourages the development of critical thinking, clinical reasoning, and reflective learning that translates into wiser decisions and safe effective nursing care.

Innovation

The current dynamic and complex environment of today's healthcare system along with the challenges facing nursing education has identified a need for a shift in current educational methods. This study will utilize the innovative approach of HPS as a modality to teach student nurses cognitive skills of clinical reasoning rather than psychomotor skills. The need to shift current nursing education modalities towards higher cognitive skills of clinical reasoning that include multiple problem solving abilities to include critical thinking is needed to adequately prepare new nurses (Gonzol & Newby, 2013). Traditionally, nursing skills are commonly taught by example where students "see-one, do-one, teach-one" (Harder, 2012). The introduction of HPS offers the opportunity to provide educational experiences while addressing current challenges to nursing education while focusing on development of higher cognitive abilities resulting in safer patient care (Norman, 2012). Development of innovative and engaging HPS experiences to promote improved CR, confidence, and competency is essential to baccalaureate nursing academia.

Preliminary Studies

After Institutional Review Board approval and informed consent, we studied three female student subjects who participated in HPS experiences. All participants participated in interventional HPS activities that involved four separate patient care scenarios and completed attention control case scenario assignments after a 2-week washout period. The participants participated in an initial pre-test with post-test HSRT examinations after the intervention and attention control period. The pilot sample lacked sufficient numbers to adequately power the study this limited the ability to detect any significant effects of the intervention therefore data analysis was deferred.

The pilot study identified areas for improvement to include improving the stability of the research environment to allow subjects the opportunity to seamlessly complete both their academic and research requirements at the same time. Improving the seamless incorporation of the data collection periods for the HSRT should improve recruitment and retention. Furthermore, reducing the obstacles that adversely impact the successful participation of research subjects is essential to improving the power of any future study. These obstacles include, clear understanding that the research component is limited to the data collection process and not related to the simulation activity. The simulation and case study experience are mandatory course assignments and not optional for the student/participant. Ensure that the potential participant understands that the HSRT testing sessions/data collection will be utilized as an academic evaluation if the overall simulation experience and must be completed by all students. Participants must also understand that informed consent will allow access to the data for analysis by the PI for the specifics of this study only.

Approach

Design

This study is two-group crossover experimental design testing the hypothesis that BSN students experiencing patient simulations will have higher HSRT scores as compared to students without these experiences. Utilization of a crossover design is supported by current literature indicating that HPS experiences have a short-term positive impact to the acquisition of knowledge in baccalaureate nursing students (Strickland & March, 2015). The use of an adequate two-week washout period is expected to limit the anticipated carryover effects of this design. Additionally, this design will utilize the current curriculum requirements that each participant successfully completes the simulation and case study assignments with addition of the HSRT and data collection as the only research activity.

Sample

Sample recruitment will begin after Institutional Review Board approval and will occur within the undergraduate nursing student population of a major university located in a major medical center. Subjects will be screened for inclusion and exclusion criteria and receive a detailed description of the study procedures and expectations prior to obtaining voluntary consent. Recruitment activities include a brief research seminar during the course orientation day. This brief seminar will include details of the research, expectations of the participants and a brief question and answer period. Additional recruitment will be conducted via online course enrollment where each student will receive a detailed research letter outlining the specifics of the proposed study as well as allowing a forum for private discussion. Recruitment will continue up to the period of group assignment through either face-to-face or online encounters with students. Since this research is closely tied to the course requirements, the PI is in close contact with the sample population and can provide rich recruitment opportunities during the initial weeks of the research period. Informed consent and group assignment will follow the recruitment period of four weeks. Participation is voluntary and the decision to take part in the research has no impact on academic assessment or grading.

Graph Pad software utilizes a random group assignment process that initially assigns each subject a random number then it will determine the final group assignment through a repeated random swapping of subjects between groups until a final random group assignment of subjects is made (GraphPad Software, 2015). A total sample size (n=102- 51 in each group) is calculated with a medium effect size (d=0.50), α error probability of 0.05, and power of 0.70.

Subjects must meet the following *inclusion criteria;* ≥18 years of age, fluent in the English language, and in good academic standing with the university. The *exclusion criteria* include prohibiting any subject with a valid learning disability or failure of any nursing curriculum course. All inclusion and exclusion criteria are obtained during the informed consent process where the participant self-reports the required information.

Research activities are scheduled during the academic calendar coinciding with the curriculum requirements of the Child and Adolescent Healthcare course. All simulation activities will be conducted in the Skills and Clinical Performance Lab (SCPL) of a major university located in a major medical center in the Gulf Coast Region of Texas. The SCPL will provide the clinical setting, HPS, and medical equipment that are required to complete this research.

This study has a minimal amount of risk to the human subject. The subjects will not encounter any physical or mental demands outside of normal student behavior expected when enrolled in an undergraduate nursing program. Subjects will be asked to engage in routine behaviors of sitting and standing while navigating complex nursing situations including but not limited to, cue identification, information processing, problem solving, and application of cognitive and metacognitive processes to implement clinical reasoning. Students may encounter anxiety and stress levels associated with performance and evaluation. Risk for injury is related to the application of routine nursing care such as lifting, turning, medication administration, needle, and intravenous catheter usage.

Intervention

The intervention and attention control activities are components of the normal course requirements for baccalaureate nursing students and adds no additional educational component for the current nursing curriculum at the study site. Each subject will participate in both the simulation and case study activities to complete the mandatory course requirements for the *Child and Adolescent Healthcare Course*. The research component includes the processes of informed consent and the collection of demographic information and HSRT measures.

Human Patient Simulation (HPS) and Case Studies. The experimental intervention group will receive HPS through simulated clinical experiences while the attention control group will engage in equivalent case study content.

Faculty performing the simulations receive vendor training specific to the simulation equipment utilized. The PI has undergone six credit hours of graduate level education towards a certificate in Leadership in Simulation Instruction and Management. Additional faculty receives National League of Nursing continuing education courses (9 hours) in the use of simulation as a teaching method.

Simulation scenarios selected and programmed into the human patient simulators are from a published and reviewed source representing low to moderate complexity levels. The selected simulations include 1) head injury, 2) fracture/suspect abuse, 3) meningitis, and 4) asthma (Gasper & Dillon, 2012). The simulation design contains subcomponents of the Jefferies simulation framework. These subcomponents include objectives, fidelity, problem solving, student support, and debriefing (Groom, Henderson, & Sitter, 2014).

Objectives.

Objectives are defined as the directions provided to students in order to prepare them for the simulation (Groom et al., 2014). Each participant receives a pre-simulation prep assignment that is included in the corresponding *Clinical Simulations for Nursing Education* text (Gasper & Dillon, 2012). This assignment contains scenario specific content introducing the student to the necessary equipment items for patient care and relevant data through educational exercises that identify sources of patient care data. The preparatory assignment allows the student to review a focused assessment, diagnostic tests, and treatment orders. The final portion of the preparatory assignment includes development of a priority nursing diagnosis with appropriate nursing interventions. Students may collaborate as they complete the prep assignment and each will receive two simulation contact hours for this effort. Additional instructions containing an orientation session detailing the environmental stage and equipment for each simulation scenario will be provided in a prebriefing session for each simulation session (Meakim et al., 2013).

Fidelity.

Fidelity is defined as the low, moderate, or high levels of technical ability that mimic reality immersing the participant in a realistic clinical environment (Groom et al., 2014). This study will utilize high fidelity HPS as the method to create a realistic patient care situation to stimulate the participants nursing knowledge and decision making process. Simulation activities for this study will be conducted in the simulation lab at the research site. The simulation lab provides the realistic clinical environment, equipment, and human patient simulators that are necessary to meet the fidelity component for this research project.

Problem solving.

Problem solving is defined as either high or low levels of situational complexity that provides opportunities for clinical reasoning (Groom et al., 2014). This study will implement both low (asthma and fracture/suspect abuse) and high (head injury and meningitis) complexity simulation scenarios to stimulate the application of nursing knowledge and problem solving for participant. The selected simulation scenarios are developed and reviewed by nursing and simulation experts prior to publication and have been selected by the PI for their low to moderate complexity level.

The low complexity scenarios include a basic set of admission orders that include routine acute care concepts such as vital signs, activity status, dietary, oxygen, intravenous fluid, and medication orders. These scenarios specifically challenge the participant to utilize the noticing and interpreting concepts of Lasater's theory of clinical judgment (Lasater, 2011). Lasater defines noticing as the ability to seek information through focused nursing observations in order to notice the slight deviations from expected patterns (Lasater, 2011). Interpreting involves the ability to organize and prioritize the data in such a manner as to increase your understanding of the situation (Lasater, 2011).

The scenarios are not overly burdensome of interventions or physician orders but rather focus on providing an opportunity for the participant to notice the physiological cues that patients often present during acute illness. Participants face problem solving situations that require the application of nursing knowledge, experience, and judgment to develop improved clinical reasoning skill.

The high complexity scenarios include all the components of the low complexity scenarios with an additional increase in complexity that challenges the participants' clinical reasoning. The added complexity includes multiple medication orders, conflicting or contradictory medication orders requiring clarification or calculation, an increase in the frequency of problem solving cues requiring the application of Lasater's responding concept of clinical judgment (Lasater, 2011). Each participant will experience the high complexity scenarios stimulating the clinical reasoning process by challenging the participants’ response to chaos and complexity. Effective responding includes the reacting to the situation in a calm and confident manner while utilizing clear communication to plan and apply interventions skillfully (Lasater, 2011).

Student support.

Student support is defined as operational cues during the simulation that include observations, patient assessment and diagnostic test data, verbal and physiological responses which can be provided by either the facilitator or the HPS (Groom et al., 2014). The simulation design incorporates the objectives and simulation fidelity subcomponents as methods to provide the student support. Additional limited instructor facilitation may also be utilized during the simulation experience to provide the prompts or cues required to stimulate and redirect participants as they become confused or unsure during the simulation.

Debriefing.

Debriefing is defined as the post simulation reflective examination of each participants’ application of nursing knowledge that explores the thoughts, feelings, and outcomes of their problem solving actions (Groom et al., 2014). Facilitation of the forty minute debriefing sessions by the PI will be guided by the Debriefing for Meaningful Learning (DML) tool encouraging reflective thinking through discussion of performance and application of nursing skills and knowledge as well as providing crucial feedback on overall performance (Dreifuerst, 2010).

Simulation.

The participants will report to the simulation lab on the day of their scheduled simulation experience. The student group will receive the prebriefing that includes detailed descriptions with hands-on demonstrations of the equipment and human patient simulators. There will be two simulations conducted in each of the two rooms utilized for this event. Students will be asked to randomly divide in to equal groups and to voluntarily separate to the two simulation rooms. The PI and research assistant will proceed with the simulated clinical experiences for each room. Each room will conduct two of the four simulation scenarios. The scenarios are 10-minutes in duration for each participant. Each room will complete rotations of each student participant through each of the two assigned scenarios for that room.

Students will regroup in the debriefing classroom for the reflective debriefing session. Students will be given a short break for lunch immediately following the debriefing session. After the break, each student group will report to the simulation room that they have yet to complete. The simulation sessions will continue as described above until all students have completed all four of the simulation scenarios.

Each simulation allows the caregiver to notice, interpret, and respond to the clinical situation. Reactions to the subject's responses to the scenario through a branched scenario design allows for preprogramed physiological responses of the human patient simulator to maintain the realism of the simulation learning environment.

Attention control group.

The attention control group receives equivalent attention time through four separate pediatric case study assignments obtained from published sources. Each case study includes a scenario lead-in, case progression statements, and a series of questions for each participant to complete. Collaboration is encourages for this independent assignment. Cases study content includes cleft palate, pyloric stenosis, fractured femur and humerus, cystic fibrosis, hydrocephaly, head lice, asthma, and gastroenteritis.

Washout.

There is a two-week washout period following the first intervention phase. The two groups will crossover at this point and repeat the intervention phase. Each group will complete both the HPS intervention and the attention control group case study assignment per the course requirements. A positive impact to short-term knowledge acquisition has been measured when exposure to HPS experiences are incorporated into nursing curriculum (Strickland & March, 2015).

The PI will contact facility assets at the Simulation and Clinical Performance Lab (SCPL) to request available training times and dates for simulation activities. The PI will provide the SCPL staff with the equipment and set-up requirements for each scenario.

Study timeline.

		Week						
	1-4	5-7	8	9	10	11	12	13
Orient research team	X							
IRB approval	X							

Sample recruitment, informed consent, group assignment, and pretest		X						
Group A			HPS			AC		
Group B			AC			HPS		
Washout				X			X	
Posttest					X			X
Data Analysis								X

Figure 1. Research Timeline.

Measures.

Demographic Data: Collection of demographic information occurs during the recruitment and informed consent period of the timeline and includes gender, age, prior healthcare experience, prior degree awarded, race, and ethnicity. The informed consent process includes explanation of the proposed research, risks and benefits as well as voluntary consent. Research participation is not part of the academic grade. The decision to participate or not to participate does not impact the academic evaluation of the student. All academic evaluations of the simulation and case studies are determined by grading rubrics. Evaluation of the simulation activities are conducted with the modified Lasater rubric that is not included in the research and is completely independent of the research (Lasater, 2011).

HSRT: Each research participant will complete the research measures as outlined in the timeline. The measure includes the 33-item HSRT for both the initial pretest and both posttest phases for a total of three measurements (see Figure 1). Participants will complete the pretest HSRT prior to the intervention phase during week eight and once more after each washout period (week ten and thirteen) for a total of three HSRT measures. The PI will proctor each testing session.

The HSRT is a 33 item multiple choice test that uses health science situational mini-case vignettes assessing the clinical reasoning capacity of the test taker (Huhn et al., 2011; Panns, Sermeus, Nieweg, & Van Der Schans, 2010). The questions are designed to evaluate the test takers analytical skill, ability to make and interpret inferences or to rationalize the inference resulting in a overall score of critical thinking with an additional set of subscale scores from 5 domains to include analysis, evaluation, inference, deductive, and inductive measures (Huhn et al., 2011). The analysis domain measures the significance and understanding of context where situations, relationships, procedures, and experiences are measured. Analysis also includes the ability to understand and draw inferences between those experiences that can direct the individual towards the appropriate conclusion. Evaluation domain measures the credibility of these contextual experiences and allows for reflective thought and analysis producing rationales for the proposed conclusions. Inference measures the ability to formulate the connection between the context and experiences as well as allowing for identification of pertinent information. Deductive measures the ability to determine the validity of the proposed conclusion. Inductive measures the ability to arrive at the proper conclusion based upon specific set of contextual observations. Through the measurement of these domains, the HSRT produces a weak, average, or strong score indicating the level of clinical reasoning achieved.

Scoring is either correct or incorrect thus a dichotomous measure. Results >24 indicate good critical thinking and scores <15 indicate poor critical thinking with separate scores for each domain with KR-20 reliability scores listed in table 1. The HSRT reliability using Cronbach's α is high reinforcing the instrument's usage in measuring critical thinking (α=0.835) (Scarbrough, 2012). HSRT scores will be compared between pre and posttest results within groups as well as between groups.

Table 1

HSRT Subscale Reliability

Scale	Description	Reliability (KR-20)
Induction	Drawing probabilistic inferences regarding what is most likely true or not true	0.76
Deduction	Understand the content of premise requires conclusions to be true and use this awareness to make judgments	0.71
Inference	Ability to draw conclusions based on reasons and evidence	0.52
Analysis	Ability to identify intended meanings of inferential relationships	0.54
Evaluation	Address the credibility of claims and the strength and weakness of arguments	0.77

(Huhn, Black, Jensen, & Deutsch, 2011)

Procedures quality control.

The simulation case variance can be controlled through consistent presentation of each scenario and avoiding deviations or “on-the –fly” changes of the simulation scenario and script. Further quality control will include utilization of a branching scenario template allowing the simulation to progress according to the decisions made during care activities.

Data management.

All data will be de-identified prior to analysis and storage. Each participant will complete a demographic survey after completion of the voluntary consent. Completed HSRT exams will be submitted for evaluation and storage with the completed demographics survey. Data storage is on university property behind double lock and key access either in a file cabinet for paper or computer for electronic files. The PI will enter the test results and demographics into a statistical database for analysis and store all electronic data files on an encrypted academic server and kept under lock and key within the PI’s academic office. Access to the data will be limited to the PI and statistician.

Statistical analysis.

The proposed research utilizes and experimental crossover design testing the hypothesis that BSN students experiencing HPS will have higher HSRT scores as compared to students without these experiences. Data analysis will explore for the possibility of carry-over effects prior to analysis for measurable significance of the treatment effects. The primary data analysis method of the HSRT results of the two-group crossover design will include both descriptive statistics and the Grizzle Method.

All statistical analysis will be conducted with Statistical Package for the Social Sciences (IBM, SPSS version 22).

Dissemination of results.

Results will be used to meet the PhD degree requirements and published for dissertation purposes. Results will be presented through public presentations and publication in a peer reviewed nursing journal.

Potential limitations/solutions.

Traditionally, the possibility of carryover effects within a crossover study design may limit data analysis to only the first treatment period. However a limitation to traditional crossover studies, this current research project expects that the participant will retain some component of long term learning thus creating a possibility of crossover effects and supporting the research hypothesis.

This research has a relatively short period of exposure to the intervention compared to prolonged repeated exposure throughout the course or school curriculum limiting the outcome. Design of the simulation experience also may affect the outcome. Simulation design and application may vary in levels of fidelity, facilitation, and complexity limiting the engagement and learning of the participant impacting the overall testing effect of the intervention.

Protection of Human Subjects

Risks

This study has a minimal amount of risk to the human subject. The subjects will not encounter any physical or mental demands outside of normal student behavior expected when enrolled in an undergraduate nursing program. Subjects will be asked to engage in routine behaviors of sitting and standing while navigating complex nursing situations including but not limited to, cue identification, information processing, problem solving, and application of cognitive and metacognitive processes to implement clinical reasoning. Students may encounter short periods of anxiety and stress levels associated with performance and evaluation. Additionally, brief periods of risk for injury related to the application of routine nursing care such as lifting, turning, medication administration, needle, and intravenous catheter usage.

Protection

Stress is anticipated as normal for students to encounter yet measures to reduce or eliminate this stress will be designed into the study. Steps to relieve or reduce the stress and anxiety include; subjects will receive informed consent detailing the study parameters, pre simulation worksheets will provide an introduction and time for each student to prepare prior to the simulation, and subjects will be introduced to the simulation equipment and environment prior to any research activities. Exposure to sharps to include needles and IV catheters will be at a minimum. Participants will be required to practice sharps safety by handling and disposing of all sharps according to safe practices.

Benefits and Importance

Understanding how to employ HPS, as a learning method that increases the CR abilities of nursing students will ultimately translate to improved clinical decisions, reduced nursing error, and safer competent care.

Data Safety Monitoring

All data will be de-identified to protect subject confidentiality. Data will be secured on an encrypted academic server with restricted access. Only the PI and statistician will have access to data stored on the encrypted academic server.

Manuscript

Educating Today's Nurses: The impact of Simulation on Baccalaureate Nurse Education

Abstract

Background: The rapidly changing and increasingly complex needs of today's healthcare system combined with the implementation of higher standards of practice challenge baccalaureate nursing educators to implement innovative methods where student outcomes include understanding of systems thinking and proficiency in the application of knowledge, skills, critical thinking, and clinical reasoning.

Purpose: The specific aim of this systematic review was to explore the effect of clinical simulation on baccalaureate education.

Methods: A systematic review of current literature was undertaken targeting articles most likely to report upon the aim of this review. Literature searches were conducted within major databases of MEDLINE, CINAHL, PubMed and ERIC. The PRISMA statement was utilized to help identify and organize the literature included in this paper resulting in 29 published articles for inclusion in this review.

Results: A review of literature identified positive student outcomes as a result of the innovative approach to clinical education through human patient simulation. Investigators reported that clinical simulations produced positive measurable outcomes of

improved knowledge acquisition, confidence, competence, cognition, and improved psychomotor skills.

Discussion: Clinical simulation allows for the incorporation of traditional curriculum knowledge, nursing theory, and clinical experiences into a safe and repeatable experience that is nonthreatening and safe for the development of positive student outcomes. This pedagogy surpasses traditional methods and should be researched to solidify its effectiveness as the unequivocal educational methodology for baccalaureate nursing students.

Introduction

The major challenge facing today's nurse educator involves developing innovative methods aimed at reversing the current trend of increased risk in patient safety and poor outcomes from the lack of basic clinical skills demonstrated by ill-prepared entry-level nurses (Schoening, Sittner, & Todd, 2006). Most significant is the educational challenge to promote clinical reasoning through the translation of nurse theory into safe nursing practice (Wotton, Davis, Button, & Kelton, 2010). In many cases nurses lack the clinical reasoning skill to utilize both inductive, and deductive thinking for effective nursing care (McAllister, 2003). Development of clinical reasoning has become a greater issue within nursing education due to resent increases in complexity of clinical situations resulting in far greater risks associated with decision errors and lower quality of care (Cruz, Primenta, & Lunney, 2009).

Traditional nursing education methods include the utilization of both didactic theoretical education and application of nursing knowledge within essential clinical experiences. Experiential learning provides a critical foundation for development of improved technical and non-technical skills through practical application of nursing knowledge, theory, and psychomotor skills (Reid-Searl, Eaton, Vieth, & Happell, 2011). This time honored educational methodology of traditional clinical experiences is currently challenged by increased student enrollment and scarce clinical resources inspiring nurse educators to explore new and innovative approaches (Ogilvie, Cragg, & Foulds, 2011). One approach to solving this educational dilemma has been the implementation of clinical simulations into the learning/teaching methodologies of nurse educators (Bambini, Washburn, & Perkins, 2009).

Researching the effectiveness of simulated learning experiences is not a novel concept. Most recently Laschinger et al. (2008) conducted a systematic review of literature from 1995-2006 that indicated clinical simulation produce both positive and negative effects on nursing student performance. These effects included increased learner satisfaction, improved psychomotor skills, increased confidence, and the potential for negative learning experiences that reinforce inappropriate actions (Laschinger et al., 2008). Utilizing this prior work as a starting point, this systematic review will concentrate on current literature from 2006-2014 and specifically explore the effectiveness of clinical simulation on the education of baccalaureate nursing students.

Background

Educating pre-licensure baccalaureate nursing students is much more complex than just teaching nursing theory. Nursing educators are confronted with evolving issues of pre-licensure nursing content required by the American Association of Colleges in

Nursing (AACN) *Essentials of Baccalaureate Education for Professional Nursing* as well as the knowledge, skills, and attitudes outlined in the *Quality and Safety Education for Nursing* (QSEN) competencies (American Association of Colleges of Nursing, 2008; Bednash, Cronewett, & Dolansky, 2013). Adapting quality and safety through the implementation of the QSEN standards is a direct result of the Institute of Medicine's (IOM) competencies that recommends implementation of a continuous planned process for improving the quality and safety within the healthcare system (Institute Of Medicine, 2003). Nursing schools are also required to meet state Board of Nursing competencies such as the Texas Board of Nursing's (TBON) Differentiated Essential Competencies (Texas Board of Nursing, 2011).

The application of knowledge and skills through educational practices of simulation has a long history of success in aviation, military, business, and healthcare professions (Curtin, Finn, Czosnowski, Whitman, & Crawley, 2011). The use of simulation within medicine can be dated back to the early years where physical models of the human body as well as patient actors were used in medical schools (Singh et al., 2013). Current technological advancements have improved the capabilities of human patient simulators (HPS) that allow them to realistically mimic human physiological changes providing nursing educators with a valuable training tool with the potential to improve both technical and non-technical skills. The technological advances have altered the perception of nurse educators view clinical simulations and the use of HPS.

Fidelity is the degree of lifelike believability that simulation activity attains as it approaches realism. Determination of the level of fidelity is influenced by the contextual, environmental, and simulation tools that are applied (Meakim et al., 2013). Fidelity is composed of five dimensions that include (1) the physical setting and environment to include all equipment related instruments or tools; (2) the emotions and beliefs of the participants within the simulation event that compose major psychological factors contributing to simulation; (3) the overall attitude and goals of the participants and facilitators of the simulation event; (4) the underlying group culture; (5) and the development of trust and reliability amongst participants as well as their model of thinking (Meakim et al., 2013). These dimensions are then applied within a simulation environment in order to mimic reality in the hopes of eliciting or observing specific human behavior.

High fidelity human patient simulations can now effectively mimic physiological changes that occur during various states of illness and patient deterioration, giving faculty the ability to present educational scenarios with unlimited levels of illness and complexity to students without the risk of harming a patient. This form of human patient simulation is grounded in the concept of simulation-based learning (SBL) where contextual and experiential training opportunities create immersive situational education with reduced risk to the participants (Larew, Lessans, Spunt, Foster, & Covington, 2006). The use of SBL has the potential for repeated controlled practice of psychomotor skills without imposing any risk to the human subject. Designing complex patient scenarios that challenge the technical and non-technical abilities of nursing students characterizes the versatility of SBL as an essential adjunct to traditional clinical experiences (Garrett, MacPhee, & Jackson, 2010).

Challenges currently facing the education of baccalaureate nurses include the increased demand for quality nurses, addressing the nursing shortage across the country, the implementation of new technologies, increase in patient acuity, and the nurse faculty shortage. Issues complicating these challenges include an increased demand by legislators on state-supported schools to increase enrollment numbers and the proliferation of competitive private, for-profit nursing institutions. The acceptance of clinical simulation as an effective teaching methodology assisting nurse educators in overcoming the current challenges has gained support over the past decade (Gates, Parr, & Hughen, 2012). The complex learning that participants experience through the mimicked reality of clinical simulation provides both learning and evaluative processes that promote the development of technical and non-technical skills accelerating their progression from novice to expert nurses (Meakim et al., 2013).

Methods

Search Process

A literature search of major databases to include MEDLINE, CINAHL, PubMed, and ERIC were searched. A set of topic specific search terms was collaboratively developed with a research librarian that included patient simulation, clinical simulation, simulation education, simulation training, nurses' clinical competence, educational measurement, manikin, computer simulation, and undergraduate or baccalaureate education. These search terms or permutations of terms as well as database specific mesh terms were utilized to conduct the literature search.

Inclusion and exclusion criteria are listed in table B1 and were utilized to review and identify which articles would be selected for full text review (see appendix B). All selected articles underwent further full text examination for thematic congruency with healthcare education, utilization of simulation, human patient simulation, high fidelity simulation, and undergraduate education.

Search Outcome

A systematic review of current literature targeting articles most likely to report upon the aim of this review identified 251 items. Removing 11 internal duplicates and screening for selection criteria reduced these findings to 76 records. Full text review of the remaining records meeting the established selection criteria produced the final 29 records for this review (Table B2). The PRISMA statement helped improve the reporting of the included literature and is listed in table B3 (see appendix B).

Results

Researchers utilized several different methodological approaches exploring the effects of simulation in undergraduate nursing education. Researchers applied quantitative approaches (25) more frequently than a qualitative (4). An experimental or quasi-experimental research design was the most frequently used quantitative approach (19) while correlational (2), mixed methods (2), and longitudinal (1) studies ranked the lowest with few qualitative (4) and non-experimental (1) approaches.

The results indicate that researchers focused on not only psychomotor skill development but also examining the effectiveness of clinical simulation as an educational tool to improve knowledge acquisition and higher cognitive abilities. These researchers are also focused on how clinical simulation experiences impact student confidence, competence and overall satisfaction with this method of education.

Confidence and Competence

Clinical simulations can provide valuable learning experiences for baccalaureate nursing students. Results of eleven studies identified clinical simulations as a valuable experience with students reporting improved levels of clinical confidence. Of these studies, two indicated additional improvement in competence while two other studies indicated improvement in competence..

Debriefing sessions in conjunction with realistic and facilitated clinical simulation sessions were viewed by student participants as informative, engaging, and fun educational experiences producing improved self-confidence and competence as measured by qualitative research methods (Ogilvie, Cragg, & Foulds, 2011; Reid-Searl, Eaton, Vieth, & Happell, 2011).

Quantitative results indicate that clinical simulation experiences produce positive effects on baccalaureate nursing student's confidence and competence. Studies measuring the effect of clinical simulation through either a pre-test/post-test or purely post-test designs identified improved learning through clinical simulation when compared to traditional lecture. While differences are not always measurable, the majority of reviewed literature found that nursing students exposed to clinical simulation experiences form higher levels of clinical confidence while one researcher only found these effects when controlling for gender (Bambini, Washburn, & Perkins, 2009; Brannan & Bezanson, 2008; Kaplan, Holmes, Mott, & Atallah, 2011; Kaplan & Ura, 2010; Mould, White, & Gallagher, 2011). Clinical simulation allows the participant to develop higher levels of self-efficacy, illuminating improved confidence, prioritization, delegation, competence, and overall clinical performance while Cardoza et al. (2012) identified a failure to act based upon decreased confidence and loss of self-efficacy (Bambini, Washburn, & Perkins, 2009; Kaplan & Ura, 2010; Liaw, Scherpbier, Rethans, & Klainin-Yobas, 2012; Mould, White, & Gallagher, 2011). Results examining the effects of self-efficacy on student confidence levels and overall performance were illustrated by studies on both ends of the spectrum. Studies found that developing confidence improves clinical collaboration, problem-solving, and positive patient outcomes as compared to the loss of self efficacy and confidence producing poor performance, inability to recall pertinent knowledge, and poor patient outcomes while Smith et al. (2009) measured no change in confidence levels with clinical simulations (Cardoza & Hood, 2012; Ironside, Jefferies, & Martin, 2009; Sharpnack & Madigan, 2012). Conversely, when researchers focused on standardized performance metrics such as exam grades, standardized testing, and grade point averages, they found no measurable difference between educational approaches on student performance (Sportsman, Schumacker, & Hamilton, 2011).

Skill Acquisition

Skill development is a focal point in the education of nursing students. The safe application of psychomotor skills within the provision of care is an essential role for professional nurses. Results of nine studies support the use of clinical simulation as an effective method for teaching nursing skills.

Qualitative studies measured the impact of clinical simulation on skill acquisition through student interviews. These studies indicate that proper planning, realism, and debriefing sessions are key to successful clinical simulations that promote technical and non-technical skill acquisition, improved levels of confidence, collaboration, and patient safety (Ogilvie, Cragg, & Foulds, 2011; Yeun, Bang, Ryoo, & Ha, 2014).

Quantitative approaches exploring the effect of clinical simulation on skill acquisition found positive results without significant measurable differences (Ravert, 2008). Implementing effective clinical simulations for nursing students can result in enjoyable, engaging, and challenging experiences where learners show improved psychomotor skill development as well as intellectual performance (Wotton, Davis, Button, & Kelton, 2010; Gonzol & Newby, 2013). Students report an improved feeling of self-efficacy, confidence, and improved situational awareness resulting in improved acquisition and application of nursing skills, improved patient safety, and overall positive outcomes during non-deteriorating patient clinical simulation scenarios (Cardoza & Hood, 2012; Cooper et al., 2010; Radhakrishnan, Roche, & Cunningham, 2007; Sears, Goldsworthy, & Goodman, 2010).

Knowledge and Cognition

Knowledge acquisition is a primary goal within baccalaureate education programs. The literature review identified twelve articles measuring the effects of clinical simulation on knowledge acquisition with five of these also including the effects of improved cognition while six articles measured the effects of cognition.

Qualitative research indicated that positive learning outcomes and an increase in knowledge when simulation structure and planning incorporate realism, facilitation, and debriefing (Ogilvie et al., 2011). Student reported anxiety, inadequate, and unprepared feelings when faced with the challenge of applying their nursing knowledge and decision-making skill within a simulated care environment (Lasater, 2011). Improved student performance with effective reinforcement of both technical and non-technical skills within a safe environment improved student collaboration, critical thinking, and communication skills while integrating the theoretical classroom knowledge into clinical practice through the process of reflective learning (Lasater, 2011; Spinello & Fischbach, 2008; Yeun, Bang, Ryoo, & Ha, 2014).

Quantitative research methods explored the effect of clinical simulation on knowledge acquisition and cognition. The literature review identified the proper didactic preparation provides the knowledge that prepares students for their role as a professional nurses while clinical simulation is more effective at incorporating didactic knowledge, theory, and clinical experiences within a safe environment allowing for periods of trial and error enhancing both psychomotor skill and higher cognitive abilities (Cooper et al., 2010; Wotton, Davis, Button, & Kelton, 2010). Studies demonstrated the integration of clinical simulations within nursing curriculum produces improved knowledge acquisition with improved clinical performance and content specific examination scores (Gates, Parr, & Hughen, 2012; Howard, Ross, Mitchell, & Nelson, 2010; Liaw, Scherpbier, Rethans, & Klainin-Yobas, 2012). Knowledge acquisition with improved reasoning and decision-making skill resulted in a measurable improvement in clinical performance during high-stakes critical patient care scenarios (Liaw et al., 2012; Wotton et al., 2010). Improvement in intellectual performance, clinical reasoning, and clinical judgment relating to knowledge acquisition is acquired through the transfer of theory to practice and suggests students benefit from clinical simulation while Schlairet et al. (2010) stipulate these effects are equal among simulation and traditional clinical experiences (Gonzol & Newby, 2013; Hauber, Cormier, & Whyte IV, 2010; Lindsey & Jenkins, 2013;

Researchers questioned the value of clinical simulations when they could not find any measurable difference in student performance metrics or cognitive abilities when comparing clinical simulations with multiple approaches that included non-simulation or computer-based self-directed computer scenarios (Levett-Jones, Lapkin, Arthur, & Roche, 2011; Secomb, McKenna, & Smith, 2012; Sportsman, Schumacker, & Hamilton, 2011; Ravert, 2008). Research also indicates that a decline in self-efficacy produces a loss in clinical confidence and competence due to the inability to recall knowledge producing poor clinical performance (Cardoza & Hood, 2012).

Satisfaction

The use of clinical simulation may not be the most effective method if the learner does not feel that the experience is beneficial. This review identified three articles that measured the effects of clinical simulation on student satisfaction.

Qualitative results indicate that improved academic performance and skill acquisition produce positive outcomes of improved student satisfaction (Spinello & Fischbach, 2008). Quantitative studies also identified the importance of simulation design and its positive or negative impact on student satisfaction. Students prefer active learning and diverse educational techniques that improve problem solving, self-confidence, and collaborative team building within well designed and planned clinical simulations (Sharpnack & Madigan, 2012; Smith & Roehrs, 2009).

Discussion

The systematic review of literature indicates that there is an increase in research exploring the effects of clinical simulation on baccalaureate nurse education. Clinical experiences are the core to the development of students' clinical competence and confidence within the nursing profession. The methodological approach of clinical simulations as an adjunct to clinical experiences provides learners the opportunity to practice quality and safety performance standards, decision-making, and error-correction through repetition while posing no threat to human subjects. The single researcher approach to searching and selecting relevant literature may have introduced research bias to this review.

State of the Science

Professional nurses require both cognitive and psychomotor skills to effectively implement the nursing process. The literature review identified conceptual congruencies among studies identifying cognitive processes of confidence, competence, critical thinking, clinical judgment, and the acquisition of nursing knowledge as positive effects of clinical simulation. The review identified that knowledge acquisition is commonly measured by performance metrics such as exit testing, final course grades, standardized testing, and student grade point averages. These measures of knowledge acquisition influence student self perception of their own knowledge and competence. Other studies focused on how clinical simulations affect student satisfaction and skill development. Evidence indicates that clinical simulation is effective in the development of both technical and non-technical skills. The review identified few efforts to investigate the effects of clinical simulation on acquiring higher cognitive abilities such as critical thinking, clinical judgment, and clinical reasoning.

Researchers have utilized various conceptual approaches to thoroughly investigate the effects of clinical simulation on baccalaureate nurse education. Researchers investigate cognitive development within clinical simulation through multiple theoretical approaches that include educational theory, theory of self-efficacy, social cognitive theory, situational awareness, expert-performance approach and constructivist theory (Bambini, Washburn, & Perkins, 2009; Cardoza & Hood, 2012; Cooper et al., 2010; Hauber, Cormier, & Whyte IV, 2010; Kaplan, Holmes, Mott, & Atallah, 2011; Spinello & Fischbach, 2008).

The literature has proposed that clinical simulations ultimately provides positive student outcomes when implemented within current nursing curriculum and subsequently recommends its inclusion to baccalaureate nursing education. Literature suggests that the linkage between clinical simulation and technical and non-technical skill development allows for improved clinical performance and student satisfaction. Skill and knowledge acquisition promote improved competence and confidence while stimulating cognitive growth in critical thinking and clinical reasoning resulting in improved performance levels that are as effective as traditional clinical experiences (Oligie; Yeun et al., 2014).

Barriers to implementation of this pedagogy includes the high cost of HPS, construction and design of the simulation lab, increased staffing to effectively manage the equipment and lab space, and the high demands of designing and operating simulation activities. Financial issues can impede the ability of nursing academia to implement this valuable teaching method across the curriculum. An additional cause for concern includes the accelerated pace of existing nursing education and the demand placed upon students, faculty, facilities, and clinical resources (Cooper et al., 2010; Mould, White, & Gallagher, 2011; Ogilvie, Cragg, & Foulds, 2011; Schlairet & Pollock, 2010; Yeun, Bang, Ryoo, & Ha, 2014).

Implications for Practice

Clinical simulation has been found to be an effective alternative to unpredictable clinical experiences by providing consistent, repeatable simulation experiences where students share the same level and complexity of patient situations. Clinical simulations also add to the student experience by providing a means to simulate patient care situations that may never be encountered during actual clinical, making clinical simulations a valuable commodity within academia. Therefore, educators can utilize the educational method of clinical simulations as an effective adjunct to clinical experiences to provide valuable experiences that foster development of the necessary technical and non-technical skills professional nurses require.

Educating skilled, competent, confident, and knowledgeable nursing professionals that are poised to meet the leadership challenges during this time of healthcare reform while emphasizing quality and safety through the professional standards of the AACN, QSEN, IOM, and state Boards of Nursing, is a challenge that the nursing profession must meet.

Implications for Research

This review has identified the need to shift research from the current focus of satisfaction, knowledge acquisition, and skill development to that of improved cognition and higher thought processes and how this educational method translates to the clinical bedside. Research indicates that far too often students are unable to discern the reasoning for the application of psychomotor skills that they perform producing increased risk and unsafe nursing care (Gonzol & Newby, 2013). Reasoning has become a greater issue within the clinical setting due to increased complex clinical situations that result in far greater risks associated with decision errors and lower quality of care (Cruz, Primenta, & Lunney, 2009). In many cases nurses lack the reasoning and problem solving approach where creativity, inductive, and deductive thinking skills provide the solution vital for effective nursing care (McAllister, 2003). Indicating that additional research must be conducted to understand the impact clinical simulation has on the acquisition of clinical reasoning skills. Additional research should then examine the long-term effects of clinical simulation by measuring bedside application of clinical reasoning.

Limitations

The selected literature demonstrates several weaknesses that could produce questionable results. A major concern limiting this review is the lack for internal validity where history, testing, instrumentation, selection, and statistical conclusion validity may have influenced the outcome (Mazurek-Melnyk & Morrison-Beedy, 2012). Many of the studies occurred while students were enrolled in other courses and clinical experiences causing a possible effect to the research outcome. Poor internal validity was apparent in the selection of several single group study designs and the usage of inconsistent instruments lacking psychometric validity and reliability may have had a combined impact on the results. Further threats to validity are the heavy usage of self-reported outcomes encountering the response shift phenomenon where individuals' self-evaluation undergoes a change requiring bias control. Selection of subjects produced several inconsistencies within the selected articles where group selection was commonly done through convenience or without randomization. Threats to statistical conclusion validity include the studies that had low statistical power, small sample size and negative outcomes.

Additional limitations to the review include the introduction of publication bias where journal policies limit acceptable manuscript submissions to only those that have positive outcomes may be present in this review. Finally, a meta-analysis would have allowed for stronger evidence of relationships between and amongst the literature thus strengthening any conclusions made.

Conclusion

The available evidence supports clinical simulation as an effective and efficient educational approach within baccalaureate education. The evidence within this review identifies the following effects of clinical simulation on baccalaureate nursing: improved development of higher order thinking (cognition), improved confidence and competence, knowledge acquisition, and improved psychomotor skills. Combining clinical simulations with current baccalaureate nursing curriculum can be costly, but it undoubtedly produces improvements allowing faculty to focus on consistent repeatable learning experiences that ultimately improve the efficiency and quality of education.

The research clearly identified clinical simulation as an effective and efficient modality that faculty can manipulate to present boundless clinical situations. This unique capability in conjunction with traditional teaching methods such as lecture, skill performance, and real-life patient care provides a pedagogy that surpasses current traditional methods. This new educational pedagogy produces improvements in student's acquisition of technical and non-technical skills resulting in improved clinical reasoning. Additional research exploring the translational effect of this education method has on the quality of bedside nursing care mandates further investigation. The literature indicated that several studies did not substantiate clinical simulation as having any significant positive effects on student performance. Therefore, additional research exploring the application and effectiveness of standardized clinical simulation techniques should help establish unequivocal evidence supporting its widespread adoption within nursing curriculum.

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Journal, 41(1), 15-72.

Simpson, K. R. (2004). Failure to rescue: Implications for evaluating quality of care during labor and birth. *Journal of Perinatal and Neonatal Nursing, 19*(1), 24-34. Retrieved September 20, 2011, from EBSCOhost.

Singh, H., Kalani, M., Acosta-Torres, S., El Ahmadieh, Ty., Loya, J., & Ganju, A. (2013). History of simulation in medicine: From Rususci Annie to Anne Myers Medical Center. *Neurosurgery, 73*(1), 9-14.

Smith, S. J., & Roehrs, C. (2009). High fidelity simulation: Factors correlated with Nursing Student satisfaction and self-confidence. *Nursing Education Perspectives, 30*(2), 74-78.

Spinello, E. F., & Fischbach, R. (2008). Using a web-based simulation as a problem-based learning experience: Perceived and actual performance of undergraduate public health students. *Public Health Reports, 123*(2), 78-84.

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Strickland, H. P., & March, A. L. (2015). Longitudinal Impact of a Targeted Simulation Experience on High-Stakes Examination Outcomes. *Clinical Simulation in Nursing, 11*(7), 341-347. Retrieved from http://dx.doi.org/10.1016/j.ecns.2015.04.006

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Yeun, E. J., Bang, H. Y., Ryoo, E. N., & Ha, E. H. (2014). Attitudes toward simulation=based learning in nursing students: An application of Q methodology. *Nurse Education Today, 34*, 1062-1068.

Appendix A

Crossover Study Design Elements

Table A1

Study Design for a 2X2 Crossover

	HSRT	PERIOD 1	CROSSOVER	HSRT	PERIOD 2	HSRT
SEQUENCE 1	X	TREATMENT A		Y	TREATMENT A	Y
SEQUENCE 2	X	TREATMENT B		Y	TREATMENT B	Y

X= pretest
Y=posttest

Table A2

Simulation Learning Objectives

Objective	
1	Apply knowledge and skills for emergency assessment and treatment of seriously ill pediatric patients
2	Recognize health conditions of head injury, asthma, infection, and fracture/suspect abuse.
3	Provide appropriate lifesaving actions within minutes of response and stabilize the condition until patient transfer to higher level of care.
4	Understand the systematic approach of cyclical process of evaluate, identify, and intervene.
5	Demonstrate the appropriate actions to stabilize the pediatric patient. Recognize and determine the appropriate action for each situation.

	Simulation	Case Study
Specific Objectives	X	X
Fidelity	X	
Problem Solving	X	X
Student Support	X	
Debriefing	X	

Figure A1. Treatment Design. Comparison of treatment design characteristics based on Jefferies simulation framework and the INACSL Standards of Best Practice: Simulation^{SM}.

Table A3

INACSL Standards of Best Practice: Simulation^{SM}

Standard	
I	Terminology
II	Professional Integrity of Participant(s)
III	Participant Objectives
IV	Facilitation
V	Facilitator
VI	Debriefing Process
VII	Participant Assessment and Evaluation
VIII	Simulation Enhanced Interprofessional Education
IX	Simulation Design

(Borum et al., 2013)

Table A4

Sample Demographics

	Gender		**Age**		**PHPE[1]**		**Ethnicity**					
	Male	**Female**	**Mean**	**SD**	**Yes**	**No**	**African[2]**	**Anglo[3]**	**Asian[4]**	**Hispanic[5]**	**Native[6]**	**Mixed[7]**
Group A	10	48	25.16	5.254	11	47	5	20	13	12	1	7
Group B	10	46	25.84	6.315	12	44	7	24	15	8	0	2

Note. 1 = Prior Healthcare Provider Experience (PHPE), 2 = African American, 3 = Anglo American/Caucasian, 4 = Asian American/Pacific Islander, 5 = Hispanic, Latino/ Mexican American, 6 = Native American, 7 = Mixed/Other

Table A5

Estimates of Covariance Parameters

Parameter		**Estimate**	**Std. Error**	**Wald Z**	**Sig**
Repeated Measures	**Var: Period 1**	1.559	0.673	2.316	**0.021**
	Var: Period 2	4.920	0.961	5.123	**0.000**
Intercept	**Var: (subject=Subj*Seq)**	4.708	0.915	5.144	**0.000**

Table A6

Mean HSRT Score

Group	**Baseline**	**Period 1**	**Period 2**
A	22.65	22.84*	22.82*
B	23.81	23.64*	23.20*

Note. *Adjusted for baseline score and experience

Table A7

Period Mean Score

	N	Minimum	Maximum	Mean	Significance
Baseline Score	114	9	31	23.228	0.000
Period 1: Score after training	111	12	32	23.396	0.959
Period 2: Score after training	102	9	32	22.951	#

Note. Table represents the combined mean score of both HPS and Case Study groups during treatment period. # = Indicates parameter is set to zero because it is redundant.

Appendix B

Literature Review for Manuscript

Table B1

Inclusion and Exclusion Criteria

INCLUSION CRITERIA	EXCLUSION CRITERIA
Human patient simulation, simulation, computer simulation	Full text not available
Simulation	Other than English language
Effectiveness of simulation	Non baccalaureate nursing program
Undergraduate education or undergraduate healthcare education	Not a health-related field
Examining simulation as an effective educational method	Not exploring the effectiveness of simulation/outcomes of simulation
	Simulation measurement tool development
	Review, comment, letter, editorial

Table B2

Evidence Table of Selected Literature

Quantitative Literature

Author/Title	**Purpose**	**Design**	**Sample**	**Intervention**	**Outcomes**	**Results**
Bambini, D., Washburn, J., & Perkins, R. (2009). Outcomes of clinical simulation for novice nursing students: Communication, confidence, clinical judgment. *Nursing Education Perspectives, 30*(2), 79-82.	Effectiveness of clinical simulations as a teaching/learning modality. Evaluate simulated clinical experiences as a teaching-learning method to increase the self-efficacy of nursing students during their initial clinical course in a four-year baccalaureate program	Integrated quasi-experimental Repeated measures design	BSN, convenience n=112	HFPS, MFPS, LFPS	Researcher developed surveys (3) with six questions; 10-point scale, content validity. Increased confidence. Qualitative data suggests students found simulation sequence to be a valuable learning experience.	$p<0.01$

Gates, M. G., Parr, M. B., & Hughen, J. E. (2012). Enhancing nursing knowledge using high-fidelity simulation. *The Journal of Nursing Education, 51*(1), 9-15. doi:10.3928/01484834-20111116-01 [doi]	Brannan, J. D., White, A., & Bezanson, J. L. (2008). Simulator effects on cognitive skills and confidence levels. *Journal of Nursing Education, 47*(11), 495-500. doi:10.3928/01484834-20081101-01
Effects of high fidelity simulation on nursing students' knowledge acquisition as evidence in the performance on the NCLEX-RN.	Compare the effects of two Instructional methods of teaching nursing education content where the instructional methods included traditional classroom lecture compared to human patient simulation method.
Experimental design.	Prospective quasi-experimental pretest posttest comparison group design
BSN, n=104	BSN, n=107
METI scenario HPS	Lecture content, HPS
Researcher designed posttest with 10 items in NCLEX style. High fidelity simulation positively relates to nursing student knowledge acquisition with higher scores on content specific examinations.	Instrument included AMIQ (Acute myocardial infarction questionnaire). HPS improved AMIQ scores. No measureable change in Confidence Level (CL tool)
$p<0.005$	$p=0.05$

Hauber, R., P., Cormier, E., & Whyte Iv, J. (2010). An exploration of the relationship between knowledge and performance-related variables in high-fidelity simulation: Designing instruction that promotes expertise in practice. *Nursing Education Perspectives, 31*(4), 242-246.	Gonzol, K., & Newby, C. (2013). Facilitating Clinical Reasoning in the Skills Laboratory: Reasoning Model verses Nursing Process-Based Skills Checklist. Nursing Education Perspectives, 34(4), 265-267.
Determining the relationship among students' abilities to prioritize actions, associated cognitions, and the physiologic outcomes of care in high fidelity patient simulations.	Determine if the IRUEPIC reasoning model is more effective than traditional nursing-process skills checklist in the development of psychomotor nursing skills
Quasi-experimental.	Quasi-experimental
BSN, n=15	BSN, n=30
HFPS	MFPS
Knowledge related measures (fundamentals and adult health course grades) showed improvement.	IRUEPIC outcomes indicated improved intellectual performance/reasoning.
$p<0.001$	Identify ($p<0.085$); Relate ($p<0.041$); Understand/Explain ($p<0.004$); Predict ($p<0.005$); Influence ($p<0.031$); Control ($p<0.012$)

Kaplan, B., & Ura, D. (2010). Use of multiple patient simulators to enhance prioritizing and delegating skills for senior nursing students. *Journal of Nursing Education, 49*(7), 371-377. doi:10.3928/01484834-20100331-07	Ironside, P. M., Jeffries, P. R., & Martin, A. (2009). Fostering patient safety competencies using multiple-patient simulation experiences. *Nursing Outlook, 57*(6), 332-337. doi:10.1016/j.outlook.2009.07.010 [doi]
Utilization of simulation-based learning experiences to increase student competence, enhance student ability to safely and effectively prioritize, delegate and implement care for numerous patients.	Examined the impact of multi-patient simulation experiences on the development of nursing students' Patient safety competencies
Quasi-experimental	Experimental
BSN, n=97	BSN, ADN; convenience, n= 14-120
SBL	HPS, 20-minute simulation scenarios (4 cases in acute care)
High levels of student confidence and understanding with the ability to prioritize and delegate.	Improved patient safety competencies with negative correlations to student factors. Cognitive measure of judgment (MSTAT-1), Patient safety competencies (investigator-developed) .
Response rates reported agree/strongly agree >45%	$p<0.0002$

Levett-Jones, T., Lapkin, S., Hoffman, K., Arthur, C., & Roche, J. (2011). Examining the impact of high and medium fidelity simulation experiences on nursing students' knowledge acquisition. *Nurse Education in Practice, 11*(6), 380-383. doi:10.1016/j.nepr.2011.03.014 [doi]	Kaplan, B. G., Holmes, L., Mott, M. & Atallah, H. (2011). Design and implementation of an interdisciplinary pediatric mock code for undergraduate and graduate nursing students. *Computers, Informatics, Nursing,* 29(9), 531-538
Measure and compare knowledge acquisition in nursing students exposed to medium or high fidelity simulation.	Utilization of high fidelity HPS to teach critical thinking, resuscitation skills and team communication
Quasi-experimental pre-and posttest design.	Experimental, pre/post-test
BSN, n=84	Convenience, BSN, n=43, ENP, n=12
HFPS & MFPS	HPS, Pediatric code scenario
21 item multiple-choice test constructed by the investigator to explore concepts of the simulation with face validity.	Confidence levels grew post simulation experience.
	BSN 72% increased to 97%; ENP 80% increased to 100%

Lindsey, P., L., & Jenkins, S. (2013). Nursing students' clinical judgment regarding rapid response: The influence of a clinical simulation education intervention. *Nursing Forum, 48*(1), 61-70. doi:10.1111/nuf.12002	Liaw, S. Y., Scherpbier, A., Rethans, J. J., & Klainin-Yobas, P. (2012). Assessment for simulation learning outcomes: A comparison of knowledge and self-reported confidence with observed clinical performance. *Nurse Education Today, 32*(6), e35-9. doi:10.1016/j.nedt.2011.10.006 [doi]
Examine the impact of novel educational intervention on student nurses' clinical judgment	Determine whether self-reported confidence and knowledge tests are indicators of clinical performance in a situation-based assessment on care of a deteriorating patient.
Pre/posttest; Randomized control trial.	Prospective randomized control trial
BSN, n=79	BSN, n=31
HPS	HPS
Investigator developed 11 item multiple-choice survey, improving students' knowledge and clinical judgment.	Pretest questionnaires for knowledge, self-confidence and demographics. Measuring 31 items, Rescuing a patient in deteriorating situation (RAPIDS). 53-item multiple-choice questionnaire assessing knowledge, 5 item confidence scale. Intervention group had superior clinical performance and knowledge in assessing and responding to patient deterioration.
$p<0.001$	$p<0.001$

Radhakrishnan, K., Roche, J. P., & Cunningham, H. (2007). Measuring clinical practice parameters with human patient simulation: A pilot study. *International Journal of Nursing Education Scholarship, 4*(1), 1-11. doi:10.2202/1548-923X.1307	Mould, J., White, H., & Gallagher, R. (2011). Evaluation of a critical care simulation series for undergraduate nursing students. *Contemporary Nurse: A Journal for the Australian Nursing Profession, 38*(1), 180-190. doi:10.5172/conu.2011.38.1-2.180
Evaluate the effects of simulation practice using HPS on the clinical performance	Assess self-report of confidence and competence using scenario-based simulations.
Quasi-experimental study.	Experimental, Pretest/ posttest design.
BSN, convenience; n=12	BSN, n=252
HPS	HFPS
Instrument; Clinical simulation evaluation tool (CSET). Improved patient safety and basic assessment skills.	Improved confidence and competence by gender
Safety $p<0.05$; assessment $p\leq0.009$	$p<0.001$

Schlairet, M. C., & Pollock, J. W. (2010). Equivalence testing of traditional and simulated clinical experiences: Undergraduate nursing students' knowledge acquisition. *Journal of Nursing Education, 49*(1), 43-47. doi:10.3928/01484834-20090918-08	Ravert, P. (2008). Patient simulator sessions and critical thinking. *Journal of Nursing Education, 47*(12), 557-562. doi:10.3928/01484834-20081201-06
Explore student knowledge acquisition associated with simulated clinical experiences.	Determine whether measures of critical thinking show differences between three groups (simulation, non-simulation, control) with a secondary purpose of
2X2 crossover design with two interventions (simulation and traditional clinical experiences).	Pretest posttest research design.
BSN, n=74	BSN, n=25
HFPS and traditional clinical experiences.	HPS
Equivalence testing, 100 point scale knowledge test created randomly from NCLEX RN study book (25 item). Outcomes; no differences between pretest knowledge scores or course midterm grade. Positive knowledge gain was observed and identified by the psychometric analysis of both simulated and traditional clinical experiences as a primary intervention. Suggesting that students benefit from simulated clinical and traditional clinical experiences.	Interviews were conducted, utilized the CCTDI,CCTST. Positive results overall without any measurable difference.
$p<0.05$	

Secomb, J., McKenna, L., & Smith, C. (2012). The effectiveness of simulation activities on the cognitive abilities of undergraduate third-year nursing students: A randomized control trial. *Journal of Clinical Nursing, 21*(23), 3475-3484. doi:10.1111/j.1365-2702.2012.04257.x	Sears, K., Goldsworthy, S., & Goodman, W. M. (2010). The relationship between simulation in nursing education and medication safety. *Journal of Nursing Education, 49*(1), 52-55. doi:10.3928/01484834-20090918-12
Provide evidence on the effectiveness of simulation activities on the clinical decision-making abilities of undergraduate nursing students	Simulation intervention can in fact contribute to the success of new nurses in overcoming the risks of error and increase their safety and medication administration.
Pretest posttest parallel group Randomized control trial.	randomized controlled trial
BSN, n=28	BSN, n=54
Computer-based self-directed computer scenarios and HPS.	Replacing early term clinical hours with exposure to simulated case scenarios.
Learning environment preferences inventory (LEP), Cognitive complexity index (CCI) utilized to measure cognitive abilities. No difference in cognitive development.	Researcher developed measure with face & content validity. Outcomes indicated HPS positively impacts medication safety skills.
	$p<0.05$

Sharpnack, P., A., & Madigan, E., A. (2012). Using low-fidelity simulation with sophomore nursing students in a BACCALAUREATE NURSING PROGRAM. *Nursing Education Perspectives, 33*(4), 264-268.
Help nursing students develop skills required to practices safe and competent professionals upon graduation, through the utilization of simulation.
Posttest Quasi-experimental.
BSN n=32
LFPS
Education practice scale, student satisfaction self-confidence in learning questionnaire, simulation design scale. Active learning, diverse methods of learning, positive expectations for students, improved problem solving, self-confidence and collaborative/teambuilding. Simulation is effective teaching and evaluation strategy improving competence and confidence
reliability of measures $\alpha \geq 0.95$

Cardoza, M. P., & Hood, P. A. (2012). Comparative study of baccalaureate nursing student self-efficacy before and after simulation. *CIN: Computers, Informatics, Nursing, 30*(3), 142-147.	Wotton, K., Davis, J., Button, D., & Kelton, M. (2010). Third-year undergraduate nursing students' perceptions of high-fidelity simulation. *Journal of Nursing Education, 49*(11), 632-639. doi:10.3928/01484834-20100831-01
Examines students reported self-efficacy or confidence in providing family-centered care using high fidelity patient simulator	High fidelity simulation with the potential to enhance cognitive and timeless skill can help students develop clinical reasoning.
Descriptive correlation design	Evaluated study, survey post simulation experience.
BSN, convenience sample, n=52	Convenience BSN, n=297,271,250
Group performance In scenario-based simulations	HPS
General Self-efficacy (GSE) scale found lower scores in self-efficacy. Unable to recall critical components of prior knowledge.	11 standardized question, Likert scale. Positive aspects of simulation include confidence, realistic, rational, knowledge, and teamwork. HPS is enjoyable and positive, identified areas for improvement. HPS enhances clinical reasoning, transfers of theory to practice, skill acquisition, and critical thinking.
$p<0.001$	Qualitative: identified key themes positive aspects of HPS, areas for improvement and what was learned. Quantitiative:90% enjoyed HPS,94.7% HPS kept them engaged, 92.4% HPS was challenging, 95% HPS useful

Cooper, S., Kinsman, L., Buykx, P., McConnell-Henry, T., Endacott, R., & Scholes, J. (2010). Managing the deteriorating patient in a simulated environment: Nursing students' knowledge, skill and situation awareness. *Journal of Clinical Nursing, 19*(15-16), 2309-2318. doi:10.1111/j.1365-2702.2009.03164.x	Gates, M. G., Parr, M. B., & Hughen, J. E. (2012). Enhancing nursing knowledge using high-fidelity simulation. *The Journal of Nursing Education, 51*(1), 9-15. doi:10.3928/01484834-20111116-01 [doi]
Examine the ability of nursing students to assess, identify and respond to patients either deteriorating or at risk of deterioration.	Effects of high fidelity simulation on nursing students' knowledge acquisition as evidence in the performance on the NCLEX-RN.
Mixed method design measuring performance. Qualitative reflecting such decision process	Experimental design.
BSN, n=51	BSN, n=104
HPS	METI scenario HPS
Situational awareness (SA) perception, understanding and prediction measure; Multiple choice questionnaire (MCQ) knowledge measure; Skill performance with improved skills with non-deteriorating scenarios.	Researcher designed posttest with 10 items in NCLEX style. High fidelity simulation positively relates to nursing student knowledge acquisition with higher scores on content specific examinations.
Skills, $p<0.01$	$p<0.005$

Spinello, E. F., & Fischbach, R. (2008). Using a web-based simulation as a problem-based learning experience: Perceived and actual performance of undergraduate public health students. *Public Health Reports (Washington, D.C.: 1974), 123 Suppl 2*, 78-84.	Howard, V. M., Ross, C., Mitchell, A. M., & Nelson, G. M. (2010). HPS and interactive case studies: A comparative analysis of learning outcomes and student perceptions. *Computers, Informatics, Nursing : CIN, 28*(1), 42-48. doi:10.1097/NCN.0b013e3181c04939 [doi]
This study investigated web based community health simulation as a problem-based learning experience.	Comparison of interactive case studies with human patient simulation evaluating which would be the most effective teaching method.
Non-experimental comparative design.	Qualitative, quasi--experimental group pretest and post test design.
Undergraduate, n=21	BSN; traditional (n=13), accelerated (n=13), diploma (n=23). Total sample size n=49.
Computer based simulation	HPS and interactive case studies covering the same content.
Student course experience questionnaire (SCEQ), Learning community subscale (LC) Academic performance measures. Student performance improved.	Pre/posttest Health Education Systems Incorporated (HESI). Improved learning with HPS. Qualitative results are positive towards HPS.
PBL ($p=0.03$); Health-behavior theory ($p=0.04$), Cognitive learning ($p=0.03$)	$p \leq 0.05$

Qualitative Literature

Author/Title	Purpose	Design	Sample	Intervention	Outcomes	Results
Lasater, K. (2007). Clinical judgment development: Using simulation to create an assessment rubric. *Journal of Nursing Education, 46*(11), 496-503.	Explore the effects of high fidelity simulation on the development of the students' clinical judgment using several dimensions.	Qualitative	BSN, n=39	HPS	Focus groups identified: strengths of high fidelity simulation, feelings of anxiety, inadequacy and unpreparedness. Need direct feedback. Integrate classroom, skills lab, clinical practice through reflective learning.	
Ogilvie, S., Cragg, B., & Foulds, B. (2011). Perceptions of Nursing Students on the process and outcomes of a simulation experience. Nurse Educator, 36(2), 56-58. doi:10.1097/NNE.0b013e31820b4fd5	Perceptions of students with HFPS experiences translating to clinical competence.	Qualitative descriptive	BSN, n=10	HPS	semi structured interview process. Four key elements lead to positive HPS; clinical scenario, realism, facilitation, debriefing. Resulting in enhanced knowledge and skills acquisition with improved confidence.	

Yeun, E. J., Bang, H. Y., Ryoo, E. N., & Ha, E. H. (2014). Attitudes toward simulation-based learning in nursing students: An application of Q methodology. *Nurse Education Today, 34*(7), 1062-1068. doi:10.1016/j.nedt.2014.02.008 [doi]	Reid-Searl, K., Eaton, A., Vieth, L., & Happell, B. (2011). The educator inside the patient: Students' insights into the use of high fidelity silicone patient simulation. *Journal of Clinical Nursing, 20*(19), 2752-2760. doi:10.1111/j.1365-2702.2011.03795.x
Identify the perceived attitudes of undergraduate nursing students towards simulation-based learning. Understanding the perception and attitudes to improve education of nursing students.	Explore undergraduate nursing students' experiences of high fidelity patient silicone simulation.
Q-methodological approach.	Qualitative exploratory approach
BSN, n=22	BSN; n=21
SBL	SP, silicone moulage
Written narratives, in depth interviews; Q methodology. HPS in SBL is effective tool to reinforce technical and non-technical skills without patient harm; improves collaboration, critical thinking, and communication skills.	Focus groups interviews. Approach is informative, educational, and fun. Positive student response to realism.

Note. **HPS** (human patient simulation); **SBL** (simulation based learning); **HFPS** (high-fidelity patient simulation); **MFPS** (mid-fidelity patient simulation); **LFPS** (low-fidelity patient simulation); **SP** (standardized patients)

Table B3

PRISMA Screening and Eligibility Evaluation of Literature

Committee for the Protection of Human Subjects

Pilot Study

Michael Brown, MSN
UT-H - SN - Department of Family Health

October 29, 2014 HSC-SN-14-0835 - The Impact of Simulation on Nursing Student's Clinical Reasoning

The above named project is determined to qualify for exempt status according to 45 CFR 46.101(b)

CATEGORY #1 : Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as:

a. research on regular and special education instructional strategies,

b. research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

CHANGES: Should you choose to make any changes to the protocol that would involve the inclusion of human subjects or identified data from humans, please submit the change via iRIS to the Committee for the Protection of Human Subjects for review.

STUDY CLOSURES: Upon completion of your project, submission of a study closure report is required. The study closure report should be submitted once all data has been collected and analyzed.

Should you have any questions, please contact the Office of Research Support Committees at 713-500-7943.

THECB: Nursing Innovation Grant Program

Michael Brown, MSN
UT-H - SN - Department of Family Health

March 30, 2015 HSC-SN-15-0228 - THE POWER OF REASONING: HOW STUDENT NURSES DEVELOP

CONFIDENCE IN REASONING

The above named project is determined to qualify for exempt status according to 45 CFR 46.101(b)

CATEGORY #1 : Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as:

a. research on regular and special education instructional strategies,

b. research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

Health Insurance Portability and Accountability Act:

Exempt from HIPAA

CHANGES: Should you choose to make any changes to the protocol that would involve the inclusion of human subjects or identified data from humans, please submit the change via iRIS to the Committee for the Protection of Human Subjects for review.

STUDY CLOSURES: Upon completion of your project, submission of a study closure report is required. The study closure report should be submitted once all data has been collected and analyzed.

Should you have any questions, please contact the Office of Research Support Committees at 713-500-7943.

Curriculum Vitae

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Michael.F.Brown@uth.tmc.edu

EDUCATION

Master of Science in Nursing Education	West Texas A&M University, Canyon TX	May 2008
Bachelors of Science in Nursing	West Texas A&M University, Canyon TX	May 2008
Associate Degree in Science of Nursing	Amarillo College, Amarillo TX	May 2004

LICENSURE & CERTIFICATION

Registered Nurse, #708547 Texas	Active	
Basic Life Support Healthcare Provider Instructor	American Heart Assoc.	2009-present
Pediatric Advanced Life Support Instructor	American Heart Assoc.	2011-present

PROFESSIONAL EXPERIENCE

Institution	Position title	Dates
U.S. Army	Combat Medic/Ophthalmic Assistant	1992-1998
Louisiana National Guard	Squad Leader/Combat Medic	1998-2000
Panhandle Eye Group	Ophthalmic Assistant	2000-2001
Baptist Saint Anthony's Hospital	Nurse Assistant	2003-2004

Baptist Saint Anthony's Hospital	Registered Nurse/Cardiology	2004-2005
Northwest Texas Healthcare System	Registered Nurse/PICU	2004-2006
Northwest Texas Healthcare System	Registered Nurse/Charge Nurse PICU	2006-2008
West Texas A&M	Clinical Instructor/Pediatrics	2007-2008
Children's Memorial Hermann Hospital	Education Resource Specialist	2008-2010
Texas Women's University	Adjunct Clinical Faculty/Pediatrics	2009
Pediatric Services of America	Registered Nurse/Pediatric Home Health	2009-2010
University of Texas Health Science Center, School of Nursing	Adjunct Clinical Faculty/Pediatrics	2010
Texas Women's University	Adjunct Clinical Faculty/ Nursing Fundamentals	2010-2011
Lone Star College, Kingwood	Adjunct Clinical Faculty/Nursing Fundamentals	2011-present
University of Texas Health Science Center, School of Nursing	Teaching Assistant/Child and Adolescent Healthcare	2010-present
	Director Simulation and Clinical Performance	2011- 2013

<u>HONORS & AWARDS</u>

Award	Awarding Organization	
"Nursing by the Numbers" grant recipient	Department of Labor and Amarillo College	2006
Sjoerd Steunebrink Scholarship	UT-Health	2012

Sigma Theta Tau International PhD Award	Zeta Pi Chapter	2013

GRANTS

Research Grants

THECB Innovations Grant	THECB	2015
Proposal for Childhood Obesity Study	Partners Grant	2012

PRESENTATIONS

Local

Michael Brown;2010-2016; AHA PEARS course Instructor, UT-Health SON, speaker, presenter

Michael Brown; 2014; Health Assessment, Pain Management, Disorders of the Eyes and Ears, Cognitive and Mental Health Disorders, Neuromuscular & Musculoskeletal Disorders, Respiratory Disorders; UT-Health SON, Speaker presenter

Michael Brown; 2013; Child and adolescent growth and development; UT-Health SON; speaker

Michael Brown; Health Assessment; UT-Health SON; speaker presenter

Michael Brown; 2008-2010; Pediatric Early Warning Signs; Memorial Hermann Healthcare System, Houston, TX; Speaker

Michael Brown; 2008-2010; Clinical Practice Committee; Memorial Hermann Healthcare System, Houston, TX; Speaker

Michael Brown; 2008-2010; Nursing Professionalism; Memorial Hermann Healthcare System, Houston, TX; Speaker

Michael Brown; 2008-2010; External Ventricular Device Management; Memorial Hermann Healthcare System, Houston, TX; Speaker

Michael Brown; 2008-2010; Pediatric Abdominal Assessment; Memorial Hermann Healthcare System, Houston, TX; Speaker

Michael Brown; 2008-2010; Pediatric Respiratory System Review; Memorial Hermann Healthcare System, Houston, TX; Speaker

Michael Brown; 2008-2010; Asthma Core Measures; Memorial Hermann Healthcare System, Houston, TX; Speaker

Sue Thomas; 2008-2010; Healthy Work Environment; Memorial Hermann Healthcare System, Houston, TX; Speaker

Michael Brown; 2008-2010; Guidelines to the Prevention of Medication Errors in Pediatrics; Memorial Hermann Healthcare System, Houston, TX; Speaker

Michael Brown; 2008-2010; Education Needs Assessment; Memorial Hermann Healthcare System, Houston, TX; Speaker

Michael Brown; 2008-2010; Critical Thinking and Clinical Judgment; Memorial Hermann Healthcare System, Houston, TX; Speaker

Michael Brown; 2009-2010; Dealing with Conflict; Memorial Hermann Healthcare System, Houston, TX; Speaker

Michael Brown; 2008-2010; Health Problems of Infants; UT-SON, Houston, TX; Speaker

Michael Brown; 2008-2010; Health Problems in Early Childhood; UT-SON, Houston, TX; Speaker
Michael Brown; 2008-2010; Health Problems in Middle Childhood; UT-SON, Houston, TX; Speaker
Michael Brown; 2008-2010; Health Problems of Adolescence; UT-SON, Houston, TX; Speaker
Michael Brown; 2008; Personal Nursing Educational Philosophy; West Texas A &M University, Canyon, TX; Speaker
Michael Brown; 2008; The Importance of Bearing Witness during the Nursing Process; West Texas A &M University, Canyon, TX; Speaker
Michael Brown; 2008; Pediatric Musculoskeletal Disorders; West Texas A &M University, Canyon, TX; Speaker
Michael Brown; 2008; Pediatric Rapid Response; Memorial Hermann Healthcare System, Houston, TX; Speaker

PROFESSIONAL SERVICE

Editorial Boards/Panels

Journal	Role	Dates
Pearson Health Science	Book Reviewer	2010-2012

Professional Memberships

Sigma Theta Tau	member	2008-2011
NLN	member	2012-present
ANA/TNA	member	2012
INASCL	member	2012-present

Institutional Service (past to current)

Institution: University of Texas Health Science Center, School of Nursing

Committee	Role	Dates
Administrator Evaluation Ad Hoc	Member	2014
Faculty Life Counsel	Member	2014-2015
Curriculum Advisory Committee	Member	2011-present
Baccalaureate Counsel	Member	2010-present
Faculty Assembly	Member	2010-present

Institution: Memorial Hermann Healthcare System

Committee	Role	Dates
Clinical Practice Counsel	Member	2008-2010
Pediatric Code Committee	Member	2008-2010
Code Competency Committee	Member	2008-2010
Nursing Research and Evidence Based Practice Counsel	Member	2009-2010
Pain Champion Committee	Chair	2009-2010
Infection Control Steering Committee	Member	2008-2010

OPTIONAL APPENDICES

Courses Taught

West Texas A&M University

Professional Nursing IV: Maternal Child Acute Care and Mental Health; NURS 3552, 5 credits, Clinical Faculty; 2007-2008; clinical

Texas Women's University

Child Health Competencies; N4055, 5 credits, Clinical Faculty; 2009-2010; clinical

Texas Women's University

Concepts and Clinical Competencies; N3005, 5 credits, Clinical Faculty; 2010; clinical

University of Texas Health Science Center School of Nursing

Health Assessment; N3511; 3 credits; Clinical Faculty; 2012; clinical instructor

Child and Adolescent Health Care; N3536B; 2 credits; 2012-2013; faculty

Child and Adolescent health Care; N3536; 4 credits; 2013; faculty

Child and Adolescent Healthcare for BSN; N3536, 6 credits; Clinical Faculty; 2010; clinical

Child and Adolescent Healthcare for BSN; N3536, 6 credits; Faculty; 2010; didactic and clinical

Child and Adolescent Healthcare for BACC2; N3802, 6 credits; Faculty; 2011; didactic and clinical

Lone Star College 20011-present

Clinical Nursing IV, 3 credits; Clinical Faculty

Clinical Nursing III, 3 credits; Clinical Faculty

Clinical Nursing I; RNSG 1361; 3 credits; Clinical Faculty; 2011; clinical

Clinical Nursing II, 3 credits; Clinical Faculty; 2011; clinical

<u>List of Project/Thesis/Dissertation Advisees (past to current)</u>

West Texas A&M University, Thesis; The Importance of Bearing Witness during the Nursing Process, BSN/MSN; May 2008, author.