DEBRIEFING FOR MEANINGFUL LEARNING: FOSTERING DEVELOPMENT OF CLINICAL REASONING THROUGH SIMULATION

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Dedication

This work is dedicated to my loving family for all their support while I went back to school…again. To my husband, Steve, who is always so proud of me and to my sons, Jacob, Ryan, and Eric, who rarely complained that they shared their Mom with Indiana University; I am so grateful that you agreed to this journey even though we really did not know what we were getting into. I hope I inspired you to value education and to follow your dreams.

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Abstract

Kristina Thomas Dreifuerst

DEBRIEFING FOR MEANINGFUL LEARNING: FOSTERING DEVELOPMENT OF CLINICAL REASONING THROUGH SIMULATION

There is a critical need for faculty, a shortage of clinical sites, and an emphasis on quality and safety initiatives that drive increasing use of simulation in nursing education. Debriefing is an essential component of simulation, yet faculty are not consistently prepared to facilitate it such that meaningful learning, demonstrated through clinical reasoning, occurs from the experience. The purpose of this exploratory, quasi-experimental, pre-test-post-test study was to discover the effect of the use of a simulation teaching strategy, Debriefing for Meaningful Learning (DML), on the development of clinical reasoning in nursing students.

Clinical reasoning was measured in 238 participant students from a Midwestern university school of nursing taking an adult health course that uses simulation. Participants were assigned to either the experimental or control group where the DML was compared to customary debriefing using the Health Sciences Reasoning Test (HSRT) before and after the debriefing experience, and the Debriefing Assessment for Simulation in Healthcare©–Student Version (DASH©–SV) with four supplemental questions about the DML (DMLSQ) process, during the post-debriefing assessment.

This research sought to understand if the DML debriefing strategy positively influenced the development of clinical reasoning skills in undergraduate nursing students, as compared to usual and customary debriefing. The data revealed that there was a statistical difference between total mean test scores measured by the HSRT. There was, additionally, statistical significance in the change in scores between pre-test and post-test for those who used the DML as compared to the control. There was also a difference in the student's perception of the quality of the debriefing measured by the DASH©–SV with the DML rated statistically higher than usual debriefing. Finally, there was a significant correlation, demonstrated through regression analysis, between the change in HSRT scores and students' perception of quality debriefing and the use of the DML.

This study contributes to the growing body of knowledge about simulation pedagogy, provides tools for use in debriefing, and informs faculty on best practices in debriefing.

Pamela R. Jeffries, DNS, RN, FAAN, ANEF, Chair

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Abbreviations

Abbreviations	Terms
CCTDI	California Critical Thinking Disposition Inventory
CCTSI	California Critical Thinking Skills Inventory
CCTST	California Critical Thinking Skills Test
DASH©	Debriefing Assessment for Simulation in Healthcare©
DASH©–SV	Debriefing Assessment for Simulation in Healthcare©–Student Version
DML	Debriefing for Meaningful Learning
DMLSQ	Debriefing for Meaningful Learning Supplemental Questions
HSRT	Health Sciences Reasoning Test
PBL	Problem-based Learning

Chapter I Introduction

Background of the Study

Nurse educators actively seek teaching and learning strategies to engage students in meaningful learning that goes beyond rote repetition and memorization to promote conceptual learning and critical thinking. In response to the expectation that students construct new and deeper understandings of the discipline of nursing and care of patients using critical thinking and clinical reasoning skills and problem-solving, experiential learning pedagogies abound in the nursing literature (Beers & Bowden, 2007; Bowle, 2000; Chalykoff, 1993; Day & Williams, 2002; Kuiper, 2008, Lasater, 2007a; Pless & Clayton, 1993; Ravert, 2008; Tanner, 2006; Williams, 2001). Simulation, as a constructivist, contextual, experiential, and problem-solving learning environment, is a pedagogy that is increasingly used in nursing curriculum.

Faculty using simulations seek resources to foster meaningful learning in their students. Much of the learning done in simulation is foundational knowledge where students develop progressive understanding from their experiences by doing and by thinking. Both types of nursing knowledge, procedural or technical and conceptual or thinking, are components of meaningful learning in the discipline of nursing. Students have an opportunity to learn *knowing that* and *knowing how* contextually (Benner, 1984; Diekelmann, 1992). Learners are said to have conceptual understanding when they can identify relationships between knowing that and knowing how.

This conceptual understanding is the foundation of critical thinking (Shuell, 1990). Debriefing using reflection takes students beyond critical thinking toward higher clinical reasoning skills and understanding of how the experience informs the next clinical situation encountered (Jasper, 2003; Lasater, 2007a). The simulation environment with faculty-facilitated prompting, guiding, and reflecting fosters critical thinking and clinical reasoning development in students (Draper, 2009; Pless & Clayton, 1993).

Critical thinking, complex decision making, and clinical reasoning in new graduates and practicing nurses are all anticipated and desired outcomes of undergraduate nursing education. Never has this been truer than today with high complexity of care, rapid expansion of the art and science of nursing, and increasing diversity in the backgrounds and needs of students (Diekelmann & Ironside, 2002). A perfect storm is brewing in which there is a shortage of nursing faculty, a need for more nurses, shorter inpatient stays, sicker and older patients, and fewer clinical sites as well as an increasing emphasis on patient safety. Furthermore, mandates for practitioner proficiency, competency, and high level thinking are fueled by the Institute of Medicine reports (Cronenwett et al., 2007; Greggory, Guse, Dick, & Russell, 2007).

Expanded use of human patient simulation is one strategy to address this perfect storm. In reality though, much of the emphasis on student use of human patient simulators has been on skill acquisition, task-training, and development of beginning skills in critical thinking. The use of the simulators has a potentially greater value in the nursing curriculum because this teaching tool also provides opportunities for student nurses to safely learn processes that promote clinical reasoning, self-regulation, and metacognition (Jeffries, 2007). These are essential elements for bringing together knowledge, skill acquisition, and clinical experience that provide the foundation for development of expert nursing practice (Benner, 1984).

Successful learning is exemplified when students are able to take the knowledge and skills learned from one patient care experience and use it to approach another—with deeper understanding and confidence. It is the experience of thinking and reflecting to make that learning evident which inform the ability to subsequently incorporate it into clinical decisions, thereby demonstrating critical thinking and revealing clinical reasoning. This capacity to *reflect-in-action* and *reflect-on-action* facilitates movement from novice to expert in clinical nursing practice (Benner, Stannard, & Hooper, 1996; Tanner, 2006) and ought to be modeled by faculty through reflective learning opportunities for nursing students. Use of guided reflection activities and concept mapping during clinical debriefing are teaching-learning strategies designed to support this important reflection process.

Debriefing is a generally accepted component of the simulation experience. Debriefing has been defined and interpreted in many ways (Dismukes, Gaba, & Howard, 2006). When used as a reflective learning opportunity, debriefing occurs as faculty and students engage in recollection, review, reflection, and analysis of the events of the simulation and the thinking processes of students during the simulation experience. Reflection is a component of executive reasoning and can occur during and after clinical experiences (Jasper, 2003; Pesut, 2004). Reflection is also a component of learning but not always innately so, or at the level necessary to advance clinical reasoning.

This disconnection between reflection and learning occurs because critique and evaluation, so common to the debriefing situation, can both foster and inhibit the learning process (Paul, 1993). In some debriefing experiences, students can be so focused on the emotions of the experience they are unable to redirect their thinking to the lessons learned and the experiential knowledge gained that come from debriefing and deep, purposeful thinking about the simulation.

The anticipated outcome of nursing education is competent nurses who are skilled in clinical judgment and demonstrate clinical reasoning. There is considerable literature surrounding the terms critical thinking, clinical decision-making, clinical judgment, and clinical reasoning (Benner et al. 1996; Kautz, Kuiper, Pesut, Knight-Brown, & Daneker, 2005; Lasater, 2007a; Schweitzer, 2008). These are difficult concepts to define. For the purposes of this study, clinical judgment and clinical reasoning will be used as supportive, interchangeable terms.

Operationally, a nurse demonstrates clinical reasoning when he or she uses knowledge, skills, and attitudes associated with *thinking like a nurse* (Ironside, 2005; Tanner, 2006) to inform actionable response to phenomena in the clinical context. This is not a new idea. For decades, nurse educators have focused teaching on development of professional socialization into the role of thinking and acting like a nurse (Given, 1975; Tanner, 2006). Critical thinking and, ultimately, clinical reasoning continue to be goals of the curriculum. To that end, clinical reasoning is a metacognitive process that involves thinking (reflecting) in-action, on-action, and beyond-action as knowledge representation (Dreifuerst, 2009; Kuiper & Pesut, 2004; Schön, 1983).

Knowledge representations are conceptual processes that allow consideration of actions and outcomes through careful thought which supports and guides action (Davis, Shrobe, & Szolovits, 1993). It is complex thinking that includes reflecting on concepts or knowledge representations that inform action. This careful consideration of options and outcomes builds upon foundational critical thinking and uses the narrative of the clinical story as a frame to cue the thinking process. Within the knowledge representation of thinking like a nurse (Ironside, 2005; Tanner, 2006), reflection and anticipation are critical concepts (Kelso & Engstrom, 2006) that inform clinical reasoning. In essence then, clinical reasoning is demonstrated when student nurses approach a clinical situation with knowledge, skills, and attitudes that support contextually appropriate actionable decisions leading to anticipated client outcomes.

Development of these contextually appropriate decision-making skills bears great significance for nurse educators who struggle with moving students beyond fact memorization, rote return, and skill acquisition, toward integration and application of informed, safe, evidence-based, client care. Traditionally, much of the effort toward synthesis development and demonstration occurred in the clinical setting using experiential and problem-based learning models and activities. With student exposure to a variety of patient situations being limited by cost, site availability, and time constraints, developing best practices for using the simulated environment and facilitating debriefing becomes a critical component for faculty development and subsequent student learning. Research into best practices to facilitate debriefing and foster reflective practices in students is necessary to support expanded use of simulation strategies as an experiential teaching-learning pedagogy.

Statement of the Problem and Research Questions

This exploratory, mixed method, quasi-experimental, pre-test-post-test study explores the influence of faculty-facilitated reflective debriefing using the Debriefing for Meaningful Learning (DML) strategy during simulation experiences on the development of clinical reasoning skills in nursing students. This investigation was conducted in the context of simulation learning that occurred within the undergraduate nursing curriculum in an adult health course. It will address the following questions:

1. Does the use of the DML debriefing strategy positively impact the development of clinical reasoning skills in undergraduate nursing students compared to usual and customary debriefing?
2. Do nursing students perceive a difference in the quality of debriefing when the DML strategy is used compared to usual and customary debriefing?
3. Is there a correlation between the quality of debriefing as evaluated by nursing students and a change in clinical reasoning skills?

Purpose of the Study

The purpose of this study was to describe and test the relationship of a faculty-facilitated guided reflection teaching strategy during simulation debriefing on the development of clinical judgment and clinical reasoning skills of undergraduate nursing students. While debriefing has been identified as a critical component of simulation learning, little research has been done to determine best debriefing strategies for the discipline of nursing. The DML strategy, developed by the investigator, is described and tested in this research study.

Significance of the Study

Nursing students today are preparing to function in a complex healthcare environment where high-level thinking is necessary to provide safe, quality care (Ironside, 2005). The critical need for nursing faculty, the shortage of clinical sites, and the demands of quality and safety initiatives in the healthcare professions continue to drive expanded use of simulation in nursing education to foster this thinking. Despite this, nursing faculty are not consistently prepared to use this cutting edge teaching modality effectively (Jeffries, 2005) and frequently report a lack of preparation for the facilitator role (Dreifuerst, 2009). Currently, there is a paucity of literature on debriefing, although simulation literature is growing dramatically and this area is receiving increased interest. Nevertheless, faculty development is a critical component for student success, and the literature is often where information like this is sought (Kember & Gow, 1994).

This research will contribute to this body of knowledge and provide evidence for best practice strategies that can be used to facilitate simulation debriefing.

While debriefing is considered the cornerstone of simulation learning, debriefing techniques vary greatly (Dreifuerst, 2009). Currently, students and facilitators regularly debrief simulation experiences using a model first developed by the military for pilots (Dismukes et al., 2006). There is a need for research into best debriefing practices to foster meaningful student learning using this experiential, problem-based, teaching-learning pedagogy so students can be prepared to care for patients safely.

Theoretical Framework

Well known education and learning theories provide the foundational underpinnings of this research. Constructivism, the Reflective Cycle (Gibbs, Farmer, & Eastcott, 1988), the Interactive Learning Cycle from the Significant Learning Framework (Fink, 2003), and the E–5 framework for effective teaching (Bybee et al., 1989), informed the development of DML Model (Figure 1) and the DML Simulation Model (Figure 2) used in this research.

The Reflective Cycle (Gibbs et al., 1988) is a circular representation of elements of reflection including: a description of what happened, specific attention to participant feelings, evaluation of the experience, and identification of what was good and bad. This is followed by a period of analysis and sense-making of the experience, determination of conclusions from the experience with particular consideration of alternative actions, and finally, contemplation of an action plan should the experience occur again. The

Reflective Cycle is a framework of thinking based on Gibb's et al. (1998) research on experiential learning that was built upon the foundational work of Kolb (1984). This work describes the learning that comes from practice and testing assumptions contextually through experience. It supports reflective debriefing grounded in a desire to explore understanding of what occurred, the perception of the experience, what could be concluded, and ultimately, what action will result for the next time.

Gibb's et al. (1998) elements of reflective learning are incorporated into the DML Model for debriefing (Figure 1) and the student tools used in the DML debriefing strategy (Appendix A). Using these elements as a guide, the DML strategy and worksheets facilitate debriefing to make nursing practice and thinking like a nurse (Tanner, 2006) explicit. Experienced in tandem, the facets of reflection-in-action, on-action, and beyond-action are incorporated to synthesize the experience and strengthen meaningful learning demonstrated through clinical reasoning (Dreifuerst, 2009; Pesut, 2004; Schön, 1983; Schweitzer, 2008; Tanner, 2006).

Another educational model, E–5, used by elementary education teachers to facilitate significant learning, (Bybee et al., 1989) was adapted into the six cues that provide the structure for faculty to use during debriefing in the DML simulation strategy (Appendix B). This model, based on principles of constructivism, describes phases of learning: engage, explore, explain, elaborate, and evaluate. "The 5–E's allow students and teachers to experience common activities, to use and build upon prior knowledge and experience, to construct meaning and continually evaluate their understanding of a concept" (Bybee et al., 1989, p. 5). These cues provide the discussion points and strategies that model reflection within debriefing to foster meaningful learning and promote clinical reasoning.

Fink's (2003) Interactive Learning Cycle is another model with a circular representation that includes six elements that interactively contribute to the focal point of the circle: significant learning. These elements include "foundational knowledge, application, integration, human dimension, caring, and learning how to learn" (Fink, 2003, p. 33). The elements of human dimension and caring are particularly relevant to the experiential nature of simulation learning, as this pedagogy uses fidelity to manifest a sense of reality into a simulated clinical environment. The ability to create a situation where participants can demonstrate caring and a human dimension in this simulated context solidifies the learning that can be translated into nursing practice.

Fink also notes that "learning how to learn" is important for significant learning (2003, p. 50). This informs the DML as a learning process, the use of the student worksheet (Appendix A) as a teaching tool, and supports the need for faculty development in the area of debriefing. "Teaching to learn," sustains "learning to learn" (Fink, 2003, p. 51). Facilitated debriefing is an opportunity to provide a teaching-learning environment that models reflection to promote the significant student learning described by Fink.

The DML model (Figure 1) illustrates the elements of teaching and learning that potentiate meaningful learning, demonstrated through clinical reasoning in nursing students. The relationships between prior experiences, education, reflection, and the development of knowledge, skills, and attitudes necessary to be a nurse are represented as fluid, interactive, and important components. These components support both development of metacognition and also cultivate use of the nursing process. This leads to a stronger conceptual understanding and application of nursing within the context of patient care that potentiates meaningful learning, evident through clinical reasoning.

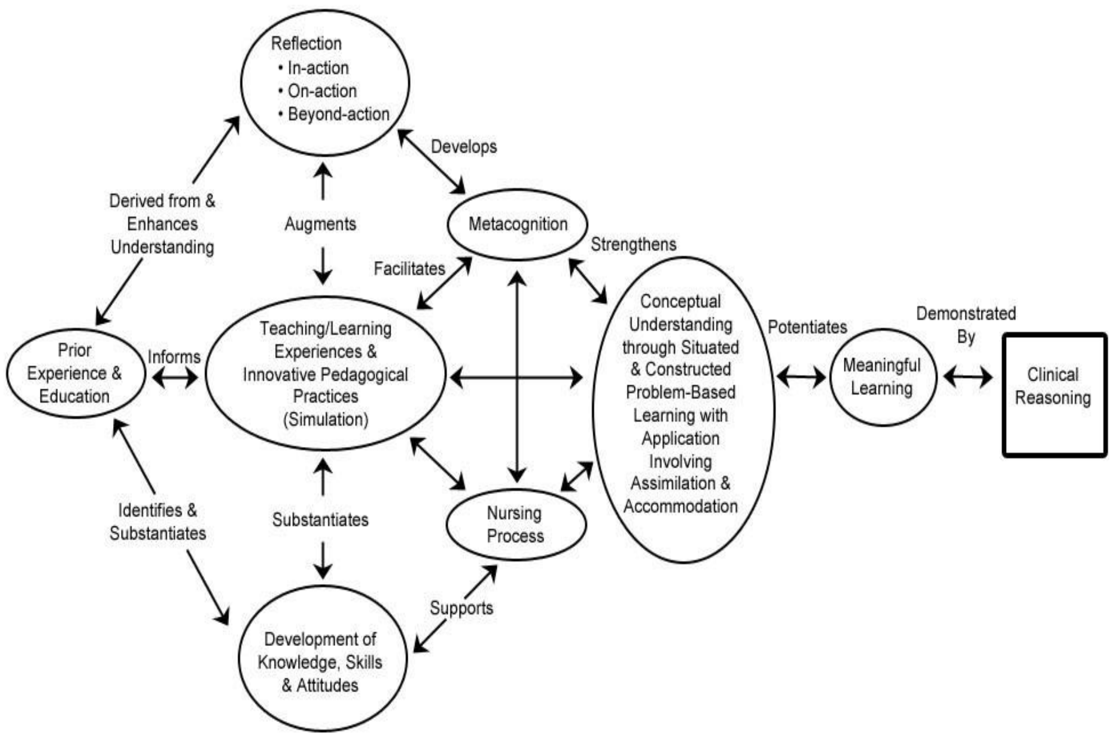


Figure 1. Debriefing for Meaningful Learning Model.

Simulation is an innovative pedagogy and form of problem-based experiential learning that is grounded in constructivism (Jeffries, 2007). The central premise of constructivism is that learners build new knowledge from previous learning and experiences through both assimilation and accommodation

(Richardson, 1997). In simulation, this learning occurs in three domains: cognitive, affective, and psychomotor (Gaba, 2004). The DML Simulation and Debriefing Model (Figure 2) translate the concepts of the DML model specifically for use in simulation pedagogy.

The DML Simulation and Debriefing Model (Figure 2), derived from the DML Model (Figure 1), includes essential elements to support the problem-based, experiential learning in simulation pedagogy. The essential elements foster meaningful learning demonstrated through clinical reasoning in nursing students. The first element is the client story and context, which becomes the context and frame for student learning. The next element is incorporation of nursing knowledge, skills, and attitudes that are developmentally appropriate to the learner and use of the nursing process. Debriefing includes faculty-guided teaching strategies (Appendix B) and student tools (Appendix A) that make visible reflecting and thinking like a nurse in-action, on-action, and beyond-action (Dreifuerst, 2009; Schön, 1983).

During simulation, the student frames the clinical situation or experience, the knowledge brought and gained, the skills demonstrated and learned, and the level of confidence about the learning that occurred (Childs & Sepples, 2006; Jeffries, 2005; Spunt, Foster, & Adams, 2004). Learning occurs as an active rather than passive process in this environment, and the simulated patient is cared for as if a real human. This requires a patient story, the use of nursing process, and knowledge, skills, and attitudes. The active simulation experience is followed by debriefing.

Debriefing is the time that follows the clinical experience when the student and faculty revisit the experience reflectively (Decker, 2007). Debriefing then, as a constructivist teaching strategy, needs to be an experience where students can actively and reflectively build upon prior learning and test assumptions about nursing care and patient responses (Dreifuerst, 2009). It fosters both assimilation and accommodation when attention is paid both to what occurred and what might transfer to other relevant clinical situations the student will encounter in the future. Simulation as a teaching-learning strategy must include the foundational elements of a contextually grounded client story, the nursing process, and nursing knowledge skills and attitudes embedded into it.

The DML Model (Figure 1) and the DML Simulation and Debriefing Model (Figure 2), derived from foundational models and theories in education, provide a framework for simulation and debriefing to foster meaningful learning demonstrated by clinical reasoning. These models inform the DML debriefing strategy and resources for faculty and students to use to structure debriefing and facilitate reflective learning.

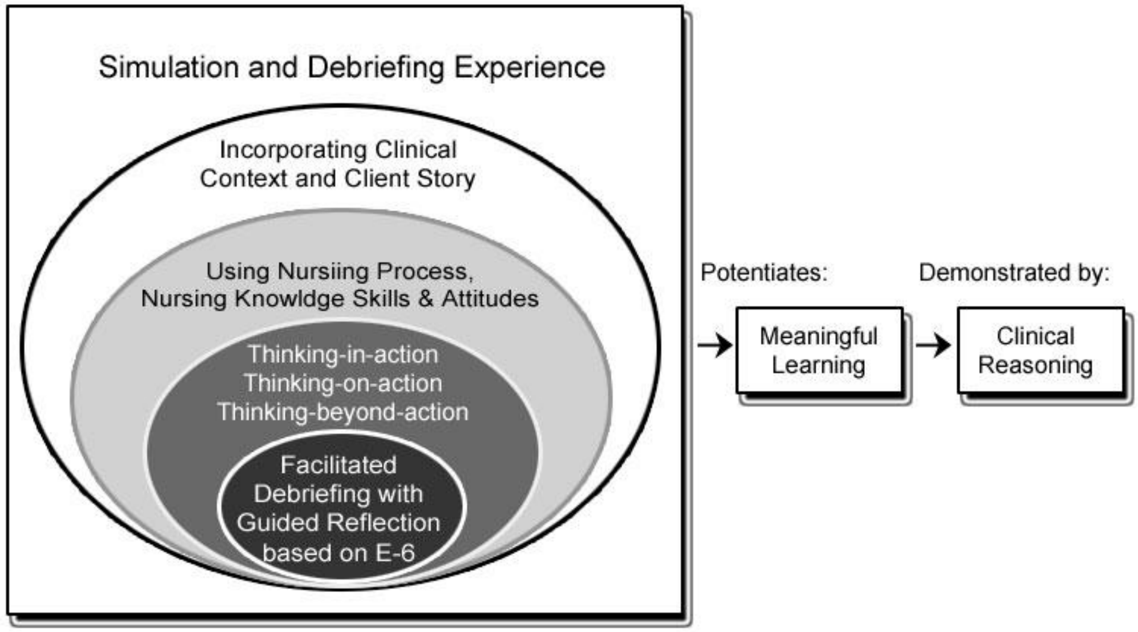


Figure 2. The DML Simulation and Debriefing Model.

Organization

This research study will be presented in five chapters. Chapter I consists of the background, problem statement, research questions, purpose, significance, theoretical framework, and the limitations. Chapter II is comprised of the review of literature including the areas of learning, teaching, and significant learning, critical thinking, clinical reasoning and clinical judgment, meaningful learning and reflection, problem-based experiential learning, simulation, debriefing, and thinking like a nurse. Chapter III presents the methodology that was used in this research study including information on the subjects, the instruments, data collection, and analysis. Chapter IV presents and summarizes the findings of the research. This section includes the participant demographics, the descriptive statistics used to analyze the data, and the results. Chapter V summarizes the study, and contains a discussion of the findings and implications for further research in this area.

Chapter II Literature Review

As a strategy for simulation debriefing, the DML model demonstrates how learning theory informs the understanding of the relationship between purposeful reflection and meaningful learning. It also supports experiential problem-based learning models like simulation with facilitated debriefing as teaching strategies that can influence a student's development of clinical reasoning. Much is reported in the literature about concepts important to this research study. Learning reflection, critical thinking, simulation, and debriefing each contribute to the creation, development, and testing of the DML framework. There are many unanswered questions regarding best simulation teaching practices and best debriefing strategies that facilitate student learning. This study uses concepts derived from learning theory, pedagogy, teaching strategies, and meaningful student learning to develop a reflective debriefing strategy for use with simulation.

Learning

Many pedagogies are used in nursing education. Learning occurs in different environments and contextual frameworks. Simulation, including debriefing, is a teaching-learning pedagogy that fits well into many educational theories and frameworks. Constructivism is frequently cited as the educational theoretical underpinning for simulation (Childs & Sepples, 2006; Decker, 2007; Jeffries, 2005). Constructivism is an ill-defined theory. The literature struggles with characterizing it concisely or consistently (Richardson, 1997). Constructivism is referred to as both a teaching and a learning theory that involves knowledge domains which are complex and ill-structured. This is not unique to constructivism as Shuell notes: “The concern for learning, of course, focuses on the way in which people acquire new knowledge and skills and the way in which existing knowledge and skills are modified” (1986, p.114).

Nearly all conceptions (theories) of learning have involved, either explicitly or implicitly, three criteria for defining learning: (a) a change in an individual's behavior or ability to do something, (b) a stipulation that this change must result from some sort of practice or experience, and (c) a stipulation that the change is an enduring one. Constructivism, however, holds as a central tenet that learners construct knowledge from their experiences and new information is incorporated into that frame of experience through affirmation, refutation, assimilation, and accommodation (Inhelder & Piaget, 1958).

Constructivism developed primarily from the work of Piaget and also Vygotsky who described the effect of language and collaborative participation and engagement in the learning process (Vygotsky, 1986). It focuses on the cognitive activities of the learner-response to the situation including the metacognitive process, the awareness of the experience, the organization of the stimuli and knowledge gain, and the simultaneous use of several learning strategies (Mayer, 2002). Meaning is constructed by the learner, and meaning is constructed from experience and from social interaction with others in the experience (Rockmore, 2005). Understanding in the conceptual sense then requires prior knowledge to build upon, active engagement in the process, and construction of new knowledge based on existing understandings transforming the experience into learning. Piaget described two complementary processes that inform understanding: assimilation and accommodation (Rockmore, 2005).

Assimilation is defined as understanding new knowledge as consistent with existing frames. Accommodation occurs when the knowledge does not fit into the existing frame so modification of understanding or creation of new understanding is necessary (Inhelder & Piaget, 1958). Accommodation and assimilation require active thinking by engaged learners. Active thinking is a state of cognitive awareness, whether reflection or deeper metacognition, and it is paramount for learning transformation (Mayer, 2002). The authors of the Carnegie Foundation study on nursing education noted, “in our research it became clear that furnishing an experiential learning environment and reflection on that experiential learning across the nursing curriculum supports formation” (Benner, Sutphen, Leonard, & Day, 2010, p. 89). In this context, formation and transformation are developmentally related concepts that describe progressive acquisition of identity within a practice profession.

Social interaction, another conceptual component of constructivism supports this. According to Vygotsky, understanding and meaning are facilitated when learners work collaboratively because cognitive development and learning are influenced by social interaction (Richardson, 1997). Nursing faculty model professional formation but this is not the exclusive modality for acquiring identity within the nursing profession. Group dynamics and social structures also foster this developmental growth. Benner et al. (2010) note that “nursing is a particularly relational vocation” (p. 120). To that end, interpersonal communication and group dynamic skills are essential components. They note in their findings that “as observation suggests, there is solidarity in student learning communities around sharing lessons learned with classmates during clinical debriefing sessions” (Benner et al., 2010, p. 121).

Research has demonstrated that experts and novices learn and problem-solve differently. As novices become experts, they learn better with domain-specific experiences such as complex patient care scenarios specific to the area of nursing in which the clinician practices. This is contrasted with novices, who demonstrate greater learning with domain-neutral strategies as in general nursing and prerequisite experiences that do not require prior knowledge and experiences for understanding and meaning (Fardanesh, 2002).

This becomes a critical component of learning when the emphasis then is on understanding and synthesizing rather than on task-training or “the acquisition of knowledge rather than the acquisition of behavior” (Mayer, 2002, p. 229; see also Shuell, 1990). The novice can grasp and demonstrate compartmentalized tasks and knowledge but may struggle when presented with a need to incorporate them into a clinical situation given the complexities of patient care today. The expert nurse, on the other hand, is less attentive to the skills and pieces of knowledge instead addressing the clinical situation as a whole, incorporating assessment, reasoning, and action seamlessly.

Facilitating development of this process is then the essence of meaningful and actionable learning, demonstrating clinical reasoning as cognitive thinking that is beyond critical thinking. Benner et al. (2010) described this actionable thinking as “reasoning through a particular patient condition and situation as a core skill for nurses” (p. 29).

Teaching and Significant Learning

Teaching and learning occur in different ways. Each encounter between the faculty and student influences the outcome. Often, teaching and learning are evaluated for effectiveness based on established criteria. There is considerable literature about the increasingly dichotomous nature of student and teacher evaluation of teaching and learning. Traditionally, teaching effectiveness is defined by the instructor’s degree of success in facilitating student learning (Fink, 2003; Richardson, 1997). The difficulty comes in operationalizing each of the elements in that equation.

Defining and measuring effectiveness, success, and student learning encompasses an entire body of knowledge beyond the scope of this review and is acknowledged to create angst for many in the academy. When a nursing student can master the material but not apply it clinically to inform decision-making, fragmented learning has occurred. Students and teachers however do not always agree in their evaluation of the teaching-learning experience as each enters the equation from a different perspective (Onwuegbuzie et al., 2007).

Assessment and evaluation of the teaching-learning environment requires consideration of input from both student and teacher with the understanding that the role-perspective, context, and circumstances impact interpretations and outcomes. The student may perceive great learning occurred because the content is understood and makes sense. The educator, however, may disagree because that content is not able to be applied contextually or used for actionable decisions.

Fink (2003) suggests that when evaluating new and innovative teaching strategies, using assessment tools that are fundamentally similar for both the faculty and student evaluation of the teaching is recommended. Parallel, if not identical, tools assists with analysis of the data as well as understanding of the outcomes and supports the epistemological underpinnings of the reciprocal relationship of teaching and learning. This is described comprehensively in the work of Onwuegbuzie and colleagues (2007) as reviewed the education literature for the study of how students perceived excellent and effective teaching. While students and teachers may not consistently value the same aspects of teaching-learning nor rate them identically, using similar tools makes the perceptions and assumptions embedded in the different perspectives evident.

The question of significant learning then, becomes, how can it be defined so that students and teachers recognize and desire it? Fink (2003) described learning as: "Change in the learner. Subsequently, significant learning is lasting learning that includes the following elements in this taxonomy of understanding: foundational knowledge, application, integration, human dimension, caring, and learning how to learn" (p. 30). In this dynamic model, each element of learning is interactive and synergistic (Figure 2). Through *foundational knowledge*, students learn the necessary content through "understanding and remembering" (Fink, 2003, p. 37). With *application*, learners "use the foundational knowledge developing particular skills, learning how to manage complex environments and engage in the different types of thinking including critical thinking, practical thinking and creative thinking" (pp. 38–40).

Fostering critical thinking is a task universally recognized by educators. The E–5 learning cycle (Bybee et al., 1989) is one model that is used to support critical thinking development. Developed for elementary education science teachers, it incorporates the concepts of *engage, explore, explain, elaborate*, and *extend* (student learning) through dialogue and activities. This strategy is well-documented to promote active learning and application of critical thinking contextually (Richardson, 1997; Shuell, 1990).

The E–5 learning model is an important, innovative teaching strategy for the discipline of nursing. It provides a structure that supports meaningful learning within an experiential pedagogy which is constructivist and student-centered. Using Bybee's et al. (1989) framework, teachers engage, explore, explain, elaborate, and extend student learning within the simulation environment through dialog and experiential activities directed toward active contextual thinking in each of the areas.

This structure informs the DML strategy used in this study to facilitate reflective debriefing in simulation learning (Appendix B).

To achieve this, the E–5 was adapted to be an E–6 learning framework consisting of *engage, evaluate, explore* (options), *explain* (alternatives), *elaborate* (thinking-like-a-nurse) and *extend* (reflecting-beyond-action to consider assimilation and accommodation to next contextual client situation). Adapting E–5 into E–6 (Figure 2), utilizes principles of Gibbs' et al. (1988) cycle of reflection and Fink's (2003) Interactive Nature of Significant Learning Model.

Through the use of E–6, it is presumed that debriefing can become the foundation and catalyst for meaningful learning when reflection is present and anticipation in the form of thinking-beyond-action (Dreifuerst, 2009) becomes actionable knowledge demonstrated through clinical reasoning. What remains challenging is how to identify and measure this actionable effect of learning demonstrated through critical thinking and clinical reasoning.

Critical Thinking, Clinical Reasoning and Clinical Judgment

Critical thinking is purposeful thought that encompasses interpretation, analysis, explanation, inference, and evaluation (Facione & Facione, 1996). It is the process of self-regulatory judgment. This process uses reasoned consideration to evidence, context, conceptualizations, methods, and criteria (The APA Delphi Report, 1990). Mastery of critical thinking, clinical decision-making, and clinical judgment is a milestone of professional development as the nurse moves from being a novice clinician to becoming an expert. Of concern however, is emphasis that nurse educators have placed on critical thinking.

In the Carnegie Foundation report on the state of nursing education, Benner et al. (2010) sharply call this to the attention of the academy. "Nursing education has fallen into the habit of using 'critical thinking' as a catch-all phrase for the many forms of thinking that nurses use in practice—an unfortunate misnomer” (p. 84). The report goes on to note that students and faculty need to know when a situation requires critical thinking and when, in fact higher, thought processes of clinical judgment, critical reflection, clinical decision-making, or clinical reasoning are indicated.

Clinical decision-making includes nursing knowledge, skills, and attitudes used in tandem with critical thinking to determine action or response (Lasater, 2007b). Clinical reasoning in nursing goes beyond critical thinking and clinical decision-making and includes metacognitive elements. According to Pesut, it “involves four threads of logic woven together: the nursing care needs or nursing diagnosis, the patient’s needs, the nurse’s own logic about the diagnoses and care planning process and the system in which the patient encounter is occurring” (2004, p. 152). Clinical judgments are “those thinking and evaluative processes that focus on a nurse’s response to a patient’s ill-structured and multilayered problems” (Lasater, 2007b, p. 269).

Measuring critical thinking remains problematic. For more than 25 years, researchers have used a variety of instruments to assess critical thinking and the correlation between teaching strategies and change in critical thinking in student nurses with little success. Ravert (2002), in an integrative review of computer-based simulation, discovered only nine studies in the literature of the time that reported outcome education measures and only four involved nursing students (p. 204). There was no consistency in instrument use, and all defined critical thinking differently.

Many tools have been used to measure critical thinking including the Watson-Glaser Critical Thinking Appraisal, (Watson & Glasser, 1964), which measures how students infer, recognize assumptions, deduce, interpret information, and evaluate arguments in general and not specific to nursing or healthcare. Other tools, like the California Critical Thinking Skills Test (CCTST), (Facione & Facione, 1998) measures strength and ability to demonstrate some of the elements which the APA Delphi Report (1990) identified as essential components of critical thinkers: analysis, inference and evaluation (Facione & Facione, 1996). Likewise, the California Critical Thinking Disposition Inventory (CCTDI) (Facione & Facione, 1989), measures the "willing" component of thinking, as in "willing and able" to think critically (Facione & Facione, 1989), and the Cornell Critical Thinking Test tests ability to think critically (Enis & McMillian, 1985).

These similar multiple-choice instruments however, did not demonstrate a correlation between the development of critical thinking and the area of nursing represented. There was no relationship between critical thinking and students' ability to articulate and use elements of the nursing process (Dungan, 1985). Later review of this work by Hicks and Southey (1995), points to an incongruence between Enis & McMillian's (1985) definition and the construct of critical thinking as a practical activity that organizes given information toward conclusions and not a higher order thinking that involves reasoning, assimilation, or accommodation to infer or conclude actionable outcomes. Critical thinking, then, becomes a foundational scaffolding of clinical reasoning, despite the fact that even today, many nurse educators use the terms critical thinking, clinical judgment, and clinical reasoning interchangeably.

Clinical decision-making includes nursing knowledge, skills, and attitudes used in tandem to determine action or response (Pesut, 2004). Clinical decision-making and critical thinking inform clinical judgment and clinical reasoning (Schweitzer, 2008). Together, critical thinking, clinical decision-making, clinical judgment, and clinical reasoning are essential components of nursing practice and thinking like a nurse (Tanner, 2006). Mastery of these skills is a milestone of professional development as the nurse moves from being a novice to becoming an expert clinician.

Developing and measuring critical thinking and clinical reasoning remains problematic. There is inconsistency in the instruments, and the limited work that has been done in this area resulted in inconsistent results. Much of this research has used problem-based experiential learning environments to test students' development of critical thinking and clinical reasoning. This prior work informs the decision to use the Health Sciences Reasoning Tool (Facione & Facione, 2006) to test the effect of a reflective debriefing strategy within simulation learning. Clinical experiences including simulation provide an opportunity for meaningful learning to occur.

Meaningful Learning and Reflection

There are many models of meaningful learning. Ausubel, Novak and Hanesian (1986) define it as a learning process where new concepts are associated with existing knowledge and experiences in a logical and meaningful way, symbolically or organizationally through verbal or pictorial representations. A central component of meaningful learning is the element of reflection as it informs the relationship between what is new and what is known. Reflective learning is experiential, contextual, problem-based learning that “helps to narrow the gap between theory and practice and puts learners in a continual learning cycle (Horton-Deutsch & Sherwood, 2008, p. 947).

Novak and Gowin (1984) differentiate meaningful learning from training noting, “training programs can lead to desired behaviors, educational programs should provide learners with the basis for understanding why and how new knowledge is related to what they already know and give them the affective assurance that they have the capability to use this new knowledge in new contexts” (p. xi).

Another definition of meaningful learning is “the integration, assimilation or construction and transfer of prior cognitive knowledge with new conceptual knowledge” (Schweitzer, 2008, p. 135). The concept of meaningful learning is significant to nurse educators because students have a difficult time with making meaning of conceptual knowledge.

Benner et al. (1996) described the novice nurse as having different thinking about the situation at hand than experts. Newer nurses focused on the immediate cues and often missed changes in patient status that became apparent from repeated assessment and an understanding of changed however subtle in the contextual frame of the situation. Teachers have an important role in helping students understand subtle context changes through the use of reflection-on-action (Schön, 1983).

Schweitzer (2008) noted that “students and recent nursing graduates need methods on how to improve their ability to identify significant data and patient changes, determine the meaning of those changes and how to effectively reason to determine the patient’s priority problem and potential nursing actions to produce optimal outcomes” (p. 164). She further notes that students need to develop clinical reasoning skills through active teaching methods that make reflection explicit.

Reflective learning encompasses the ability to think-in-action as well as think-on-action (Schön, 1983). Thinking-in-action is done in the moment and occurs as events are unfolding. Thinking-on-action is retrospectively reflective and occurs after the fact. The importance of reflective learning as an element of teaching students to apply what has been learned from one clinical situation into the next is also well documented in the nursing education literature (Benner et al., 1996; Chalykoff, 1993; Davies, 1995; Facione & Facione, 1996; Ironside, 2003, Kautz et al., 2005, Tanner, 2006).

Dewey (1910) defined reflection as purposeful and active thought. “The purport of this act of inquiry is to confirm or refute suggested belief. New facts are brought into perception, which either corroborate the idea that a change is imminent, or refute it” (p. 10). In this fashion, reflection is also the active, cognitive process of turning experience into anticipation by organizing—framing and ordering it to make sense of what has occurred in the context of what was known previously to be ready for what is encountered next (Facione & Facione, 1996; Schön,1983). This paradoxical relationship of looking back while anticipating forward defines thinking-beyond-action (Dreifuerst, 2009) and supports the intuition that Benner (1984) described in defining expert nursing practice.

Framing is the thinking activity of organizing and manipulating recognizable categories with the information the brain is receiving. It involves building “mental constructions that enable the learner to further analyze and interpret a particular situation which enhances learning” (Teekman, 2000, p. 1130). Framing informs action because it provides contextual meaning to options for addressing the clinical situation at hand. This is evident not only in familiar circumstances but also in unfamiliar.

Teekman (2000) and Taylor (2006) observe that subjects (students), when facing a situation of doubt or stress, yet feeling it necessary to act, would focus on the nature of the situation and search their memory for similar and dissimilar events on which to draw then choose options for actions. Teekman goes on to say that “Schön never mentioned the existence of anticipatory reflection yet it was evident in her findings” (2000, p. 1131).

This correlates to Benner’s (1984) critical work on novice to expert nursing practice where *clinical forethought* is identified as a hallmark of developed clinical expertise. Clinical forethought is “the ability to foresee, anticipate and prevent future problems” (Orsolini-Hain, 2008, p. 15). Benner considered this to be “manifested as an intuitive gestalt that moves the nurse to use proactive measures to prevent likely complications and to prepare for the possibility of crisis" (Orsolini-Hain, 2008, p. 15).

Taylor (2006), articulating the relationship between brain functioning and adult learning, describes a concrete learning activity that occurs within the brain synapses:

> A teacher must start with the existing networks of neurons in a learner's brain, because they are the physical form of prior knowledge. The brain is never a blank slate. Given that the brain embodies experience, doing precedes understanding, particularly in the development of thought. We must make meaning before it becomes our own [action]. We are inevitably meaning-making, not meaning-taking, organisms. An experience that creates and anticipates connections between new material and what adults already know—that is, what their mind and bodies have experienced—is much more likely to help them shift from passive to active learners. Metaphorically speaking, their synapses have been primed. (pp. 73–75)

The paradoxical relationship of looking back while anticipating forward defines thinking-beyond-action (Dreifuerst, 2009). David Kolb (1984), articulating the Experiential Learning Cycle, described a cyclical relationship of experience, reflection, conceptualization, active experimentation, and development of new knowledge and insight. Reflection is the thought process of critically interpreting experience and current information concurrently to inform decisions about when processes or premises should be different or remain the same from encounter to encounter (Williams, 2001).

Thought processes are the cornerstone of thinking and reasoning. Reasoning is logical thinking that connects thoughts in ways that make them meaningful. Clinical reasoning then is the reflective, cognitive process where the clinician uses prior knowledge and assessment and analysis of the client to make an informed response. Reflection based on experience and prior knowledge provides the criteria for knowing the variance from the expected in any given experience (Kane, Sandretto, Heath, 2004). It can be reflection-on-action that happens after the event when reviewing and recalling activity and decision-making (Schön, 1983). Finally it can be reflection-beyond-action where anticipation of variance and experience are considered prior to a new experience but based on what has already happened (Dreifuerst, 2009).

Taylor (2006, p. 76), also notes, “to the extent that we can make explicit those aspects of our systems of thought that formerly were implicit we develop more flexible, inclusive ways of knowing that allow us to address the unfamiliar.” Critical reflection is attained when students and practitioners question underlying assumptions and understandings and there is a transformation of meaning that leads to action (Williams, 2001). Mezirow (1991) associates critical reflection with transformative or meaningful learning. Reflection informs assimilation and accommodation. According to Piaget, assimilation and accommodation are the two sides of adaptation, and the foundation of learning (Piaget, 1954).

Assimilation is incorporation of new concepts into existing ways of thinking or schemas. Accommodation however is different. It is the means of adapting existing schemas to fit new experiences or the creation of new schema derived from experience. Incorporation of new information into existing knowledge and experiences is the catalyst for learning, demonstrated through mature and cogent reasoning (Ausubel et al., 1986).

Knowledge learned from the simulation experience is often adapted and applied to subsequent experiences encountered when reflection is used in the process and circumstances are recognized as similar (Lasater, 2007b). When new encounters do not match the frame well, but can be reasoned out from the existing knowledge or recognized as something new, accommodation and formal operational thought impacts meaningful learning and supports reflection and anticipation (Ausubel et al., 1986; Boud, Keogh, & Walker, 1985; Facione & Facione, 1996).

Reflection is not always a natural process. How often does the teacher today hear those dreaded words “just tell me what I need to know to pass the test”? The success, value, and significance of reflection and student learning, particularly in simulated learning experiences, are often associated with how the instructor facilitates the reflection. Students have become so familiar with memorization and rote-return learning that reflection and thinking *in, on*, and *beyond action* are challenging and underutilized. Faculty instead, mentor and coach students by providing a structure and framework that can be used to facilitate framing, thinking, and learning.

Pedagogically, teachers need to present reflection in, on, and beyond action explicitly for students, especially in experiential learning situations like the nursing laboratory or in the nursing clinical setting. Nowak and Gowin (1984) note that a “principal problem with teaching and learning today is that too often neither the leaders nor the participants in clinical or field exercises know what they are supposed to teach or learn” (p. 48). As a result, the experience occurs with teachers and students who “do not have a framework for assimilating and accommodating their observations, actions and responses” (Nowak & Gowin, 1984, p. 48). The learning is fragmented and difficult to transfer to the next clinical encounter. Traditional care plans grounded in the nursing process are intended to facilitate this framework but often fall short in fostering nursing praxis (Sandelowski, 1997). Embedding reflection and experience in a problem-based learning environment is one strategy used to address this shortcoming.

Problem-Based Experiential Learning

Problem-based learning (PBL) in an experiential context has been suggested as a pedagogical approach to facilitate student nurse learning beyond critical thinking toward reflective clinical reasoning (Benner et al., 2010; Caine & Caine, 2006). It is a learner-centered teaching-learning strategy that encompasses use of the group process to address ill-defined or unstructured problems in a cooperative and collaborative format, based on the theoretical work of Vygotsky, Dewey, and Gagne. The learning strategy incorporates several constructivist concepts that support this thinking and inform simulation debriefing designs ultimately fostering clinical reasoning in students because it demands knowledge construction, application of contextual knowledge, problem-solving abilities, self-directed learning strategies, and team participation skills from the learner (Vernon & Blake, 1993).

Concepts of constructivism recognize that practical, cognitive gain occurs through an interface between knowledge and experience. Second, student engagement in the experiential yet contextual environment, especially in the presence of fidelity or realism, fosters learning, and finally, knowledge is developed through social experiential connectedness or group problem-solving and discussion (Benner et al., 2010; Rideout, 2001; Vernon & Blake, 1993). The underpinnings of PBL provide the research framework that informs the development of the debriefing strategy that is the focus of this study on reflective debriefing.

The nursing education literature, as well as the kindergarten through grade twelve, secondary, and post-secondary education literature, was reviewed, using multiple databases including Google Scholar, CINAHL, Proquest, Cochrane Library, PubMed, Medline, Science Direct, OVID, ERIC, Education Full-text (WilsonWeb), and Education (Sage). This search focused on interventional studies related to the use of debriefing and learning. Initially, the databases were mined for studies written in English that identified debriefing as a variable.

The results were wide and not specific to nursing or debriefing in simulation. It was narrowed to included constructivism, nursing, and simulation. This limited the results considerably. There were many descriptive studies but only three with an experimental design. The search was expanded to include reflection, critical thinking, clinical reasoning, and clinical judgment as key words along with the terms experimental and quasi-experimental studies, in all possible combinations. All studies published from 1970–2008 that met these criteria were considered.

Next, references from all the descriptive and interventional studies were reviewed and analyzed for additional publications for inclusion and for additional key words. Additional key words from this second search included problem-based learning, experiential learning, and faculty development.

Finally, despite uncovering only a handful of articles that met the criteria for inclusion, saturation was determined when the reference lists continued to cite similar works, and no new ones were discovered. Publications included in this literature review were limited to secondary education environments with interventional studies that included a problem-based or experiential teaching strategy and used elements of reflective learning which resulted in a change in student understanding demonstrated by critical thinking or decision-making by empirical methods. Studies that only reported student perception of learning or faculty subjective data were excluded. All of the included studies used an experimental or quasi-experimental design and were peer-reviewed prior to publication.

From this exhaustive literature search, six articles met all of the inclusion criteria. Two additional studies that surfaced after the initial review of the literature were subsequently added. While the population was not limited to nursing students, all of the studies used them in their sample. Each study focused on a change in teaching methodology using principles of constructivist theory often identified as PBL, which was intended to promote a change in student learning demonstrated by critical thinking or clinical judgment or clinical decision-making.

A total of 771 undergraduate nursing students were included in these eight combined reports. The convenience samples varied from 46 to 257 participants and were predominantly female (93%) between the ages of 16 and 24 (97%). Two studies, involving 16% of the total sample set, were Chinese (Tiwari, Lai, So, & Yuen, 2006; Yuan, Kunaviktikul, Klunklin, & Williams, 2008a) and one, that represented 63% of the total sample, was Hawaiian (Magnussen, Ishida, & Itano, 2000). The remaining students were from the United States with 92% of those students reported as Caucasian (August-Brady, 2005; Beers & Bowden, 2007 Day & Williams, 2002).

August-Brady (2005) reported a “power estimate of 45 students was needed per group based on a two-tailed alpha level of 0.05 a moderate effect size of 0.30 and a power of 0.80 based on Cohen’s formula” (p. 299) but was unable to meet those requirements in both groups. The sample sizes in the remaining studies were explained through a need to draw participants from available convenience populations, and those authors did not reference power analysis information (Beers & Bowden, 2007 Day & Williams, 2002; Magnussen et al., 2000; Tiwari et al., 2006; Yuan et al., 2008a). Based on a review of Lipsey (1990), all of the studies (August-Brady, 2005; Beers & Bowden, 2007 Day & Williams, 2002; Tiwari et al., 2006; Yuan et al., 2008a) except Magnussen et al. (2000) were underpowered due to a low sample size for alpha 0.05 two-tailed test with power of 0.80, beta of 0.20 and effect size of 0.50, which would have required at least 62 subjects per group (Lipsey, 1990, p. 91). Of note, all subjects invited to these various studies chose to participate, and there was no evidence of attrition reported.

Each of these studies except Day and Williams (2002) used similar two-group experimental and quasi-experimental designs with a pre-test-post-test format. Four contained a non-equivalent control group (August-Brady, 2005; Beers & Bowden, 2007; Magnussen et al., 2000; Tiwari et al., 2006). Tiwari et al. (2006) performed a blinded, randomized control trial using repeated measures, longitudinal design over a three-year period. Beers & Bowden (2007) incorporated a cohort sampling method, and students were not randomized to groups. August-Brady (2005) also used a cohort sampling method but within cohorts students also were randomized to control or intervention groups. A longitudinal pre-test-post-test design including randomization after the pre-test was performed by Magnussen et al. (2000). Students in the Tiwari et al. (2006) study were "randomly assigned to groups by drawing lots from a sealed box" but it is not clear if stratification was used in the process. Yuan et al. (2008a) used random assignment through matching.

While all of the studies referenced PBL as the theoretical framework for their research, there was a great deal of variation in the interpretation and actualization of this in their study designs. All concur however, that PBL is foundationally a constructivist learning framework that is learner-centered. Three of the studies specifically referenced conceptual models grounded in this perspective. The 3P (Presage–Process–Product) Model used by August-Brady (2005) focuses on teaching-learning relationships and uses interpretive learning approaches to mediate deep and significant learning. It is also derived from the E–5 model (Bybee et al., 1989).

Tiwari et al. (2006) identified the Barrows Reiterative Model using an ill-defined problem in a circular nature to form learning through group activity, discussion, and active learning. This is similar to Mezirow's Theory of Transformational Learning cited by Yuan, Williams, and Fan (2008b), which involved questioning assumptions, beliefs, and values within the context of considering different points of view through a rational and analytical process of inquiry that is learner-driven and promotes significant learning. Both Day and Williams' (2002) model, incorporating Socratic Inquiry, and Magnussen's et al. (2000) model, using an inquiry-based, dialog design, were also derived from Mezirow's theory.

Each of these conceptual models consistently supports the overall theoretical framework of learner-centered, PBL, involving dialog and independent, as well as group, participation. Although each study uses different intervention strategies and instruments to measure outcomes, all stay grounded within this theoretical underpinning.

The studies by August-Brady (2005), Beers (2005), Magnussen et al. (2000), Tiwari et al. (2006), and Yuan et al. (2008a) used existing nursing courses and curriculum with interventions that were identified as problem-based, but not experiential. Most involved verbal interaction with fellow students and concept mapping activities. The duration of the interventions followed typical semester timeframes within higher education. Some were completed in single semesters (August-Brady, 2005; Beers, 2005) and others followed students longitudinally through several semesters or throughout the entire curriculum (Magnussen et al., 2000; Tiwari, 2006).

Nurse educators assigned to these courses were involved in the study designs and implemented the interventions in the control and experimental groups. The intent of these interventions was to enhance student learning demonstrated through critical thinking, but none of the authors reported why particular teaching-learning strategies were selected from the myriad of options within PBL.

It is not clear how the choice of intervention strategies influenced the reported outcomes. Little data was reported on the intensity of the interventions although August-Brady (2005) indicated students would be involved with six concept mapping activities and Tiwari et al. (2006) reported that students had weekly activities involving equivalent hours to the assigned lecture time of the control group. The longitudinal designs used by Magnussen et al. (2000) and Tiwari et al. (2006) also demanded that faculty teaching courses throughout their curriculum consistently deliver content using specific methodology but did not detail how this occurred or if there was assessment of any variation between faculty and classes that might have influenced their outcomes.

All of the reviewed studies noted that when a control group was part of the design, those students would receive “usual education and teaching strategies” typically offered for that course. Beers (2005) and Day and Williams (2002) did not describe their intervention specifics or intensity criteria. This lack of specificity regarding the intervention in all the studies not only impedes evaluation of integrity and comparison but also makes study replication impossible.

Each of these studies used different instruments and statistical analysis. August-Brady (2005) used the Revised Study Process Questionaire-2 Factor. This 20-item Likert scale tool has two scales: a deep approach learning scale (DAL) and a surface approach learning scale (SAL). August-Brady reports that a "high score on the DAL indicates motivation for meaningful learning and high level decision-making defined as critical thinking" (2005, p. 299). Likewise, a "high score on the SAL reflects less motivation for meaningful learning and a tendency toward memorization strategies and low level decision-making (August-Brady, 2005, p. 299).

Cronbach's alpha test for reliability was 0.71 (adaptive), 0.80 (inflexible), and 0.78 (irresolute); the subsets of the test, respectively (August-Brady, 2005, p. 299). "An analysis of the data revealed a statistically significant increase in overall and aggregate deep learning scores in the intervention group when compared to the control as measured by the post-test in week 15 at the end of the semester with $p = .040$ (DAL) and $p = 0.002$ (SAL)" (August-Brady, 2005, p. 303).

The study conducted by Beers (2005) found no statistical difference between the control group and the experimental group using a ten item multiple choice test from Health Education Systems Incorporated, a well-known nursing education testing company. This objective exam is based on recall of knowledge and application of it to situated scenarios from the content objectives. “Reliability was determined to be 0.829 on the pre-test and 0.807 on the post-test using the Kuder-Richardson Formula-20” (Beers, 2005, p. 307). While the test measures decision-making in the clinical setting and is presumed to measure critical thinking, the authors note that this test did not match the design of the intervention well and may not have captured meaningful student learning that was otherwise apparent by the faculty.

Additionally, the post-test was given during week four emphasizing recall and memorization, which are not elements typically associated with problem-based learning strategies. Scores were reported as a range of 3–7 (mean 5.11) for the pre-test and a range of 3–9 (mean 4.94) for the intervention group. This is very similar to the results of the control group with a pre-test range of 2–8 (mean 4.72) and post-test range of 2–9 (mean 4.97) and statistically insignificant.

Day and Williams (2002) used both the California Critical Thinking Skills Inventory (CCTSI) and the CCTDI to measure outcomes when they converted their entire curriculum to a problem-based methodology because they were not satisfied with student outcomes from the traditional format. Following the change in format, the students’ critical thinking increased significantly in mean overall scores from 1.578 to 1.890 (t = 2.650, p = .014) on the CCTSI and from 16.01 to 17.24 (t = 1.915, p = .070) on the CCTDI.

Magnussen et al. (2000) had mixed outcomes using the Watson-Glasser Critical Thinking Appraisal. Form A was used for the pre-test and Form B for the post-test, and the intervention group received instruction using a tutorial methodology and Socratic Inquiry in the group discussion format. When the overall mean scores did not change significantly, they stratified only the students who had taken both the pre-test and post-test (paired scores) into three groups: low scores of less than 54 on the pre-test (n = 49), medium scores between 54 and 59 (n = 53), and high scores of greater than 60 (n = 48).

Magnussen et al. (2000) found that students with low scores in the beginning of the program demonstrated a significant increase in mean scores of 2.23 (t = 2.76, p = < .01). Students stratified into the middle group did not demonstrate a significant change in mean scores, and those in the high group decreased their mean score of 4.79 significantly (t = -4.81, p = < .01). This inconsistency in scores may be related to the type of learners in the stratified groups, the type of questions on Form B, or regression toward the mean.

Tiwari et al. (2006) used the Chinese version of the CCTDI (Facione & Facione, 1990) repeatedly over three years to measure critical thinking development in a longitudinal design. This comprehensive test uses a 75-item multiple-choice Likert scale exam further delineated into seven subscales to measure student's critical thinking. Data was collected during week 15 of 16 in semesters two, four, and six of the nursing program. Standardized scores were calculated for each subscale in addition to an aggregate score.

These scores ranged from 5–60 for each subscale with a maximum aggregate of 420 and an actual high and low value of 35 and 420. Scores that were greater than 350 indicated a strong critical thinking disposition. Scores between 280 and 349 showed positive development of critical thinking, and scores less than 279 reflected a lack of it. The findings revealed no difference between the control and the intervention groups on the pre-test. It did demonstrate, however, statistically significant differences incrementally each subsequent data collection time, demonstrating greater improvement and defined critical thinking by the intervention group throughout the nursing program.

Students, who received the intervention specifically, differed from those in the control group in their ability to synthesize and test newly acquired knowledge. "They also differed in their ability to reason and systematically make increasingly sophisticated clinical judgments with complex patient situations" (Tiwari et al. 2006, p. 552).

A similar test, the CCTST–Form A, Chinese version (Facione & Facione, 1990), was used by Yuan et al. in their 2008a study comparing students' critical thinking following a PBL format. This involved using facilitated small discussion groups with case studies including concept mapping, trigger questions, and faculty guided inquiry compared to traditional graphical presentation lecture format. Evidence of reliability of this test was reported by the authors using the Kuder-Richardson Formula 20 as .80 overall and .60–.78 for the subscale components.

The CCTST was given to all students at the beginning and the end of the semester. Students in the intervention group met for two hours and worked independently an additional two hours per week for 18 weeks followed by completing this 34-item multiple choice test. Students in the control group received two hours of graphical presentation lecture per week in addition to reading and writing assignments. Results of the CCTST–A revealed statistically significant improvement in scores of the intervention group indicating improved critical thinking. When compared to the students in the control group, those in the intervention group showed significant differences (p = .040).

Several threats to validity are evident in each of these reviewed studies. Unreliability of measures and low power were the common identified validity threats. Day and Williams (2002), Tiwari et al. (2006) and Yuan et al. (2008a) controlled for unreliable measures by reporting complete statistical data, and August-Brady (2005), Magnussen et al. (2000), and Tiwari et al. (2006) met power requirements with adequate sample size and use of alpha = .05. Internal validity was threatened by maturation in all the studies except Beers (2005) through the nature of the design. The lack of this in Beer’s study, contributed to construct validity issues with construct confounding and poor measurement selection because students were studied after only one module of content over three weeks’ time instead of looking at learning over a semester or longer.

External validity threats were not consistently reported in any of the reviewed studies. Only Magnussen et al. (2000) and Yuan et al. (2008a) noted interactions between students and causal relationship with outcomes, but careful review of the other studies revealed the potential for these threats in all of the studies that were reviewed. Construct validity was reported more consistently. Novelty was the most common (August-Brady, 2005; Day & Williams, 2002; Yuan et al. 2008a), and an argument could be made that it was evident in all the studies since PBL methods were an innovative teaching strategy for all of the subjects. Clearly, threats to validity are evident in these studies and may influence the conclusions from the outcomes.

There are similarities and differences between these studies that influence the ability to generalize conclusions and inform the design of the current study. The samples were similar undergraduate nursing students but contained a great deal of variability related to age, nationality, and seniority in the program. Five of the programs used a quasi-experimental design, and one was a randomized controlled trial. All of the studies used a pre-test-post-test design, and only one did not have a control group. The interventions varied considerably but all used a problem-based methodology.

There was a great deal of variability in the tests used to measure effect on critical thinking, but all showed validity except the test used by Beers (2005). The statistical analyses were not consistent, and it is difficult to generalize specific conclusions. All of the studies, however, reported some positive change in critical thinking by students who experienced PBL. The argument can be made that with consistent interventions and consistent use of measurement tools, a clearer understanding of the influence of PBL on critical thinking could be discerned. From these studies, the only conjectures that can be derived is that some positive effect on critical thinking can be attributed to PBL and that the tools to measure this effect are limited and inconsistent.

Despite the lack of consistent, intervention-based research on debriefing, much can be drawn from these eight studies that looked at different elements of problem-based and experiential learning components. Inferences can be drawn about faculty development, guiding reflective learning to foster critical thinking and clinical reasoning, gaining a deeper understanding of the necessary elements for facilitating debriefing, and creating significant learning environments.

Although PBL is learner-centered, self-directed learning, it is also facilitated by faculty. This form of learning involves self-assessment, reflection, structure for thinking, information management, and group skills (Rideout, 2001). It provides the theoretical underpinnings for actualizing the Kolb framework that the DML strategy is based upon. Additionally, the E–5 educational method (Bybee et al., 1989), a strategy used extensively in the kindergarten through grade six elementary education science curriculum, informs the teacher cues embedded in this debriefing strategy (Appendix A) and supports student learning of contextual nursing care.

Elements of PBL such as a challenging problem of patient care, small group work, and guidance and feedback from a facilitator are also elements of simulated clinical nursing experiences. These components assist learners to experience a patient care situation and also to reflect on the process and thinking, which supports meaningful learning demonstrated through critical thinking. Clearly though, further research into the use of simulation as a problem-based educational strategy in nursing, is warranted.

Simulation

Simulation in nursing is an innovative teaching strategy that replicates the patient care environment with various levels of fidelity to mimic the actions and interactions that nurses face in their practice. These computer-assisted devices demonstrate the physiology of the human patient in such areas as heartbeat, respirations, patient distress, and positive patient response to actions the clinician takes (Ravert, 2002).

Simulation provides an active learning environment for students to experience clinical situations and to make use of cognitive, affective, and psychomotor skills and, at the same time, practice critical thinking, clinical decision-making, and clinical judgment in the context of the (virtual) patient care environment without risk to actual patients (Childs & Sepples, 2006; Jeffries, 2008; Larew, Lessans, Spunt, Foster, & Covington, 2006). It is an interactive learning environment because the simulated patient responds to the student, and it is a safe learning environment because the student can repeat the experience, changing responses and outcome without creating danger to real human patients (Childs & Sepples, 2006; Larew et al., 2006).

According to Jeffries (2005),

> Simulations are defined as activities that mimic the reality of a clinical environment and are designed to demonstrate procedures, decision-making, and critical thinking through techniques such as role playing and the use of devises such as interactive videos or mannequins. (p. 97)

Static mannequins have been used in nursing education since the 1940s (Bauman, 2007; Ravert, 2002). These models were early task trainers, but as the complexity of nursing grew, the fidelity of the mannequins grew concurrently.

Simulated models and simulated patients provide an opportunity for students to be exposed to clinical situations that might not otherwise be available but nonetheless are necessary for the transition from novice to expert nurse clinician (Benner, 1984; Larew et al., 2006).

For the purposes of this study, simulation and simulated patient care will be defined as controlled experiential clinical learning environments occurring with mannequins, using computer interfaces that mimic the physiological responses of humans across the illness trajectory. These mannequins range from low- to high-fidelity and can be used for task training as well as complex scenarios requiring different levels of student thinking and performing.

Use of high-fidelity simulation in nursing education is an increasingly common innovative teaching strategy. Simulation experiences typically include the components of faculty preparation: scenario development, student preparation, set-up of the simulation environment, and student involvement in the scenario using high-fidelity simulated patients followed by student and faculty debriefing (Fuller, 2007; Jeffries, 2007). The use of simulation in many forms is well documented in the education literature and has been identified as a critical component of experiential learning (Kolb, Rubin, & McIntyre, 1974).

Debriefing

Debriefing is the period at the end of a simulated clinical encounter when the faculty and student re-examine the experience. Debriefing can be a structured or unstructured process. Debriefing is a generally accepted component of the simulation experience. Debriefing has been defined and interpreted in many ways (Dismukes et al., 2006). When used as a reflective learning opportunity, debriefing occurs when faculty and students engage in recollection, review, reflection, and analysis of the events of the simulation and the thinking processes of the student(s) during the simulation experience.

Reflection is a component of executive reasoning and can occur during and after clinical experiences. It is also a component of learning but not always innately so or at the level necessary to promote clinical reasoning. This is likely because critique and evaluation, so common to the debriefing situation, can both foster and inhibit the learning process (Paul, 1993).

Debriefing is not a new teaching-learning strategy. The use of simulation is well documented in the education literature, and simulation has been identified as a critical component of experiential learning (Kolb et al., 1974). Its role in learning has been explained in many ways. Warrick, Hunsaker, Cook, and Altman (1979) noted, the “debriefing phase is an intentional and important process that is designed to synergize, strengthen and transfer learning from an experiential learning exercise” (p. 91). They further define the objectives of debriefing to include:

- Identifying the different perceptions and attitudes that have occurred.
- Linking the exercise to specific theory or content for the course.
- Linking the exercise to skill-building techniques.
- Developing a common set of experiences for further thought.
- Providing participant’s feedback on the nature of their involvement, behavior and decision-making.
- Re-establishing the desired classroom climate such as regaining trust, comfort and purposefulness. (Warrick, et al., 1979, p. 95)

Debriefing provides an opportunity for students and faculty to re-examine what occurred during the simulation process and discern what has been learned. Nursing faculty generally focus the discussion on learning outcomes and the intended objectives of the experience (Fuller, 2007). Debriefing can involve reflective practice when students analyze their own assumptions and think about how to further enhance or develop more skillful nursing practice.

Reflective practitioners who engage in this self-introspection learn to self-correct and assimilate new experiences with prior ones and thus improve professional competence (Rudolf, Simon, Rivard, Dufresne, & Raemer, 2007). In addition, when skills in reflection are facilitated during debriefing, students learn to embed this into their practice. Paget (2001) studied the ability for reflecting on practice to be "taught as a habit to determine if higher order thinking skills would consequently develop and be applied in clinical practice" (p. 209). He found that not only was this supported, "there was also evidence that the skill of reflecting, once learned, could be a medium for constant review of professional practice" (Paget, 2001, p. 209). The role of the facilitator was critical to this model.

Facilitating debriefing is an important faculty role in the simulation experience. It is as critical for faculty to know how to debrief student experiences as it is to know how to create the scenario and use the equipment to represent human physiological response to the care students provide (Jeffries, 2005). However, strategies to support debriefing processes have received little attention in the simulation literature (Henneman & Cunningham, 2006; Rudolf et al., 2007; Seropian, Brown, Gavalianes, & Driggers, 2004).

Materials, and faculty development strategies, to enhance the facilitation of student debriefing are limited. Many of the debriefing guidelines and strategies that are available have focused on critique and correction of technical components, discussion of cognitive thinking, and attempts to develop evaluation criteria of student performance. Work in this area includes creation and evaluation of tools for students to use to describe feelings about the experience, including perceptions of the effect of going through it, and outcomes of the simulation learning on their developing nursing practice (Decker, 2007). To date, much of this work has centered on student self-report of satisfaction and confidence using the simulation experience for learning the nursing role.

Questions remain such as how to debrief, when to debrief, what to debrief, and who to include in debriefing for best student learning. Research involving debriefing is beginning to demonstrate an association with clinical reasoning that includes student assimilation of the knowledge brought from prior experiences and other coursework. Benner et al. (2010) noted “a central goal of nursing education is for the learner to develop an attuned, response-based practice and capacity to quickly recognize the nature of whole situations” (p. 43). Concurrently, they note that recall and memorization, however popular in nursing education, do not support students’ ability to apply clinical judgment in unfamiliar clinical situations (Benner et al., 2010).

Evidence is beginning to show that clinical reasoning also involves use of a framework and an aspect of accommodation where the knowledge learned from the current simulation experience is applied to subsequent clinical situations the student encounters. Harjai and Tiwari (2009), in describing developing expertise, note that the clinician "is able to locate relevant parts of the knowledge stored, using similarity recognition and use this to develop pattern recognition" (p. 306), a concept that also implies recognition of exceptions to patterns. Debriefing that is structured to promote reflection supports development of these skills that inform clinical judgment and decision-making (Decker, 2007; Kuiper, 2008; Lasater, 2007a).

Debriefing of clinical experiences, noteworthy learning events, and important curricular components is common among nursing faculty and students. Debriefing or *post conference* is a time to review the events and make visible their meaning. It is an opportunity to draw out student thinking and to develop critical thinking and complex decision-making skills in novice nurses. Students need to master complex decision-making skills because patient acuity is rising, the availability of clinical sites and experiences is challenging, and the pool of students is changing.

Students today can have inconsistent exposure to different types of patient situations and may not have opportunities to link classroom content to clinical practice through experiential learning strategies. They can experience less clinical time, less time for interaction with faculty, and fewer opportunities to learn how to reflect, assimilate, accommodate, and transfer learning across contexts.

Reflecting is thought to be an innate learning experience yet not all learners do it consistently or thoughtfully enough to be a significant learning event. Kerdman (2004), also cited by Benner and colleagues (2010), notes that "the prevailing view of 'reflective learning' assumes self-questioning and challenging one's assumptions and prejudgments are activities that students can do or should be taught to do purposively if they can't do it unguided" (Benner et al., p. 55). Following this, facilitating reflection through debriefing then is an essential component of teaching and learning to maximize student learning when simulation is used (Decker, 2007).

Simulation learning supports a constructivist theoretical framework within problem-based curriculum. Constructivist learning is a contextual and experiential process where knowledge is constructed individually and thought about as learning occurs (Richardson, 1997). For faculty and students to get the greatest benefit from the use of simulation, attention to the debriefing process is a critical component.

Unfortunately, optimal ways of debriefing after simulated clinical experiences remains unclear. Likewise, the effect of different debriefing priorities by the facilitator on the development of students' clinical reasoning skills continues to be poorly understood (Dismukes et al, 2006; Dreifuerst, 2009). The preponderance of simulation use throughout nursing education however necessitates the need for faculty to understand and develop best practices for debriefing to facilitate significant student learning during these experiences.

The process of experiential learning requires active engagement. To facilitate meaningful, active learning during debriefing several components are necessary. Students must have an opportunity to "reflect on their experience in the [simulation], have a period of emotional release, receive behavioral feedback, integrate their observations, behavior and feedback into a conceptual framework and create mechanisms and pathways for transferring learning to relevant outside situations" (Warrick et al., 1979). Reflection, emotion, reception, integration, and assimilation are the defining attributes of simulation debriefing that support meaningful learning (Dreifuerst, 2009).

Reflection is the opportunity to re-examine the simulation experience. It can be a chronological review or thinking upon what comes to mind first and working through the experience from that starting point. It is a time to *call out* the thinking processes that were occurring during the events of the simulation experience. Benner et al. (2010) note that "reflection on practice helps the student develop a self-improving practice" (p. 26).

Emotion and emotional release are also important. The emotional response called up through the experience can influence the student's engagement in the simulation resulting in a crossing of the boundary separating the virtual and the reality. A poignant example is the student who cries during debriefing after the simulated patient dies. Emotion enhances learning by the way it frames the experience (Schön, 1983). Emotion can also inhibit learning if it distracts from engagement in the experience. That student who cried could become paralyzed to action and unable to respond in the face of a similar situation if debriefing has not separated the emotion of responsibility for failure from learning better responsive actions to implement. Facilitating the expression of emotions acknowledges the power of the learning experience to set the frame for embedding it in the learner's memory. Emotional release can redirect the attention of the learner to reflective, meaningful learning.

Reception, or openness to feedback, is a primary role for the learner but also may be evident in the simulation facilitator. Because simulation experiences encompass cognitive, affective, and psychomotor skills, this is an opportunity for all participants to provide feedback on those skills. Students need to be coached to be open to receive this feedback in a way that facilitates positive learning rather than a negative response. Student strengths and challenges should be brought forward in a non-threatening manner using elements of formative feedback.

Linking guided reflection to critique and correction, provides an opportunity to make visible the affective and behavioral learning that is occurring through structured or situated cognitive activities during debriefing (Kuiper, 2008). Simulation events that are focused primarily on student performance and summative evaluation, however, should be clearly indicated as such and debriefing should be formatted in a confidential, respectful manner between the facilitator and the learner. Summative evaluation serves a different purpose than a debriefing experience.

Integration of the simulation experience and the facilitated reflection into a conceptual framework is one of the most challenging and least common attributes of debriefing. To be successful, the facilitator models framing and embeds the elements of the experience into a scaffolding that the learner is familiar with, and can call upon, when experiencing future situations. Framing is attribution of meaning to set of facts (Pesut, 2004).

In nursing, there are numerous frames, but the most common is the nursing process. Integrating the elements of the nursing process into debriefing sets the stage for assimilation of the knowledge, skills, and attitudes into practice and provides a path for accommodation and transference into future patient care environments. Integration using the nursing process is commonly found in post-conference debriefing but successful use of this conceptual framework with simulation experiences is beginning to be reported in the literature (Kuiper, 2008).

Assimilation and accommodation are the ultimate goals in a practice profession and the essence of reflection. Nurse educators want students to demonstrate successfully that they can transfer what they have learned and experienced from one situation to the next which they encounter. Harjai and Tiwari (2009) acknowledge that “the difficulty in translating knowledge and theory into practice faced by novice clinicians may be attributed to their lack of exposure to the tools needed to use this knowledge effectively” (p. 307). Those tools include opportunities to use assimilation and accommodation in contextually relevant clinical settings. Simulation, by the nature of its ability to be clinically manipulated and controlled, provides this opportunity.

Additionally, assimilation and accommodation involve anticipation. Anticipation and reflection are both interrelated and paradoxical. While reflection often is considered looking back or looking at, as in reflection-on-action and reflection-in-action (Schön, 1983; Tanner, 2006), it also can be looking forward or reflection-beyond-action (Dreifuerst, 2009). This critical aspect of reflection builds upon the work of Klein (1999) who described “seeing the future while seeing the past” (p. 289) as a component of decision-making and supports the anticipatory nature of reflection.

The ability to anticipate or consider the *what if*, distinguishes the novice nurse from the expert and represents higher order clinical judgment and clinical reasoning based on metacognition (Benner et al., 1996; Pesut, 2004; Tanner, 2006). Assimilation can be modeled or facilitated during debriefing using techniques like Socratic dialog, where the faculty plants ideas using provocative or directed questions and lays the framework for thinking-beyond-action through purposeful discourse. Faculty achieve this through the use of Socratic dialog using what if questions where the details and frame are changed to encourage the student to think beyond the boundaries of this situation and anticipate the next (Benner et al., 2010). This aspect of debriefing takes time not only to develop student thinking but also model anticipatory reflection.

The attributes of debriefing work in tandem, to create the meaningful learning experience for students. When some attributes are neglected or discounted, the debriefing portion of simulation is not optimized, and students may not have an opportunity to experience the assimilation and accommodation learning built upon existing frames that develops critical thinking, clinical judgment, and clinical reasoning (Dreifuerst, 2009). While resources to assist faculty use of the simulation equipment, develop scenarios, and prepare materials are becoming available, debriefing materials and faculty development strategies for facilitation of student debriefing are not as well developed (Decker, 2007; Jeffries, 2005).

Many of the debriefing guidelines and strategies that are available have focused on critique and correction of technical components and skill demonstration, discussion of cognitive thinking, and attempts to develop evaluation criteria of student performance (Rudolph et al., 2007). Early research in this area includes creation and evaluation of tools for students to use to describe their feelings about the experience and their perceptions of the effect and outcomes of the simulation learning on their developing nursing practice, student self-report of satisfaction, and development of confidence in the nursing role from the experience (Decker, 2007; Henneman & Cunningham, 2006; Seropian et al., 2004). While these contribute to students' use of clinical judgment and clinical reasoning, they do not potentiate it through actualizing meaningful learning (Warrick et al., 1979).

When debriefing is structured to promote reflection, encouraging students to analyze their own assumptions and think about how to enhance or develop more skillful nursing practice, reflective practice may be involved. Reflective practitioners who engage in introspection learn to self-correct and assimilate new experiences with prior ones and thus improve their professional competence (Rudolf et al., 2007). Debriefing provides opportunities to foster reflective learning, encompassing the ability to think-in-action as well as think-on-action (Schön, 1983). It is associated with critical thinking, clinical reasoning, and clinical judgment—desired elements as nurses move from novice toward expert practice (Benner et al., 1996; del Bueno, 2005; Kuiper, 2008; Lasater, 2007b).

Scanlon and Chernomas (1997) identified three stages of reflection: *awareness, critical analysis,* and *new perspective*. The importance of using reflective learning to teach students to apply what has been learned in one situation to the next that is experienced through the use of critical thinking and decision making is well documented (Benner et al., 1996; Chalykoff, 1993; Davies, 1995; Facione & Facione, 1996; Ironside, 2003; Kautz et al., 2005; Tanner, 2006). Despite this, debriefing as a teaching-learning strategy continues to be poorly understood (Dreifuerst, 2009). In addition, the impact of different priorities during debriefing on students' clinical reasoning skills remains unclear and challenging (Dismukes et al., 2006).

The practice of debriefing varies considerably by facilitator (Dreifuerst, 2009). With limited clinical time, inconsistent exposure to different types of patient situations, and little time available to interact with faculty, students may have few opportunities to link classroom content to clinical practice through experiential learning. By providing opportunities to review events and make visible the meaning, debriefing offers a way to draw out student thinking and help students develop complex decision-making skills. While reflecting is thought to be an innate learning experience, not all learners do it consistently or thoughtfully enough to be a significant learning event. Thus, facilitating reflection through debriefing is essential for helping students get the greatest benefit when simulation is used (Decker, 2007).

Debriefing for Meaningful Learning

Despite the uncertainty of how to best do it, facilitating debriefing through reflection is accepted as an important faculty role in the simulation experience (Decker, 2007). It is a crucial step in turning experience into meaningful learning since, according to Habermas (1971); there are three ways of knowing and understanding: empirical observation, shared meanings/understanding through language and stories, and critical knowing through experience and action. Each of these elements can be facilitated during debriefing to potentiate student learning from the tacit experience of the simulation using the E–6 components of the DML model.

This is consistent with the literature on experiential learning methods (Boud et al., 1985; Richardson, 1997) and with the literature on clinical learning that facilitates expert nursing practice (Benner et al., 1996; Chalykoff, 1993; Childs & Sepples, 2006). As a result, it can be presumed that debriefing for meaningful learning should include a review of the experience through a narrative sharing of the experience by participants.

Additionally, for meaningful learning, debriefing also should provide a framework that makes apparent to students the links between the simulation, the nursing knowledge, and the outcomes of patient care. Finally, meaningful reflective debriefing challenges students to anticipate future patient encounters.

The literature supports the development of the DML framework and strategy for simulation debriefing and demonstrates how learning theory informs the understanding of the relationship between purposeful reflection and meaningful learning. The literature also supports experiential PBL models like simulation with facilitated debriefing as teaching strategies that can influence students' development of clinical reasoning. There are many unanswered questions regarding best teaching practices for the use of simulation and specifically what debriefing strategies best facilitate student learning. This study will continue to expand on previous work and attempt to make strong links between learning theory, teaching strategies, and meaningful student learning using simulation and debriefing.

Chapter III Methodology

A quasi-experimental, pre-test-post-test, repeated measure, research design was used in this study to test the impact of using the DML strategy on student nurses' learning in simulation. The DML strategy and the associated learning tools developed for this research study are described and evaluated.

The aim of this study was to test the research questions that relate to students' development of clinical reasoning skills and their perception of the quality of debriefing that occurred during a simulation learning experience. This study also tested whether student perception of quality is associated with the development of clinical reasoning skills. These variables were measured using several different instruments including the Health Sciences Reasoning Test (HSRT) (Facione & Facione, 1996), the Debriefing Assessment for Simulation in Healthcare©–Student Version (DASH©–SV) (Simon, Rudolph, & Raemer, 2009), and the Debriefing for Meaningful Learning Supplemental Questions (DMLSQ), which was specifically developed for this study, to explore student response to particular components of the DML strategy. This chapter summarizes the methodology used in this study. It includes the research design, participants, process, intervention, instruments, and the data analysis utilized.

Study Design

This study used a comparison, non-equivalent group, quasi-experimental, pre-test-post-test design to test the impact of using the DML strategy on student nurses' learning during a simulation experience.

Student learning was tested using the HSRT, the DASH©–SV, and the DMLSQ. Subject scores on these tests from the experimental group were compared to subjects who participated in usual and customary debriefing strategies.

Students were assigned to clinical groups prior to recruitment, and those groups were pre-assigned dates and times for simulation experiences. As a result, randomization to the control and experimental arms of the study was not possible. Further, participants were solicited to volunteer their participation, so presumed bias from self-selection also met quasi-experimental design criteria.

Sample

Nursing students in an advanced adult health, medical/surgical course using simulation learning experiences were the purposive, target population for this research. This population was selected because they had prior experience with simulation and were in the final semesters of the curriculum where critical thinking, clinical reasoning, and clinical decision-making are emphasized.

A convenience sample of sixth- and seventh-semester, volunteer, nursing students enrolled in an eight-semester, baccalaureate degree nursing program at a Midwestern university school of nursing in the United States was chosen to represent this population. These students were enrolled in an existing pair of clinical and theory courses covering the complex adult health issues in acute care. Simulation is an existing component of the clinical course.

A priori, the desired sample size was determined according to Lipsey (1990, p. 94) and confirmed using G–Power analysis (Faul, Erdfelder, Buchner, & Lang, 2009). Because there is little prior data reported on this concept, using the recommendations by Lipsey, the alpha or significance level was set at p = .05 and the beta or type 2 error was at .20 or a power of 80%. Based on this, 74 total subjects were estimated to be necessary with 37 in each group for a medium effect size of .50 and 80% power (Table 1). This was considered adequate for the exploratory nature of this study.

Table 1

Power Analysis of Sample

Measure Effect Size	A priori .50 (medium)	Post-hoc .50 (medium)
Alpha (α)	.10	.10
Beta (β)	.20	.01
Power (1- β)	.80	.99
Sample size total	74	238
Sample size per group	37 in each group	122 in group 1 116 in group 2
Critical *t*	1.31	1.28
Degrees of freedom (*df*)	72	238

In the first semester of data collection however, students assigned to particular clinical groups, with previously identified, interested clinical faculty, were only able to be invited to participate, due to time constraints in the semester schedule, and the existing structure of the course calendar. As a result, 52 students were invited to participate, and 35 accepted, which was less than the desired sample (Table 2).

Table 2

Sample

Collection Time	Total Invited	Accept	Decline	Lost to Attrition	# Assigned to DML Experiment Group	# Assigned to Control Group
#1	52	35	17	0	18	17
#2	94	80	14	3	40	40[a] (37)
#3	131	123	8	0	64	59

[a]Three participants lost to follow-up prior to the post-test with final numbers in parentheses.

To attain a sufficient pool of subjects, students in this pair of courses were recruited a second time, in the subsequent semester. During that term, 94 students enrolled in the course were recruited; 80 consented to participate, however, 3 did not complete the study (Table 2). This met the criteria of the desired 74 participants. However, it was determined post hoc that neither the second set nor the combined set of results from the first and second sets demonstrated normally distributed data for any of the instruments used in the study, as determined by use of the 1–sample Kolmogorov–Smirnov test.

Based on these findings, the decision was made to enroll subjects a third time in the next consecutive semester, where more than 100 students were anticipated in the pair of courses. This reasoning followed the assumption that as sample size increases, the sampling distribution becomes more normally shaped and sampling error is reduced (Lipsey, 1990, p. 31).

In the third semester of subject recruitment, 131 students enrolled in the course were recruited to participate in the study, and 123 consented; however once again, using the 1–sample Kolmogorov–Smirnov test, the third data set alone did not demonstrate normality. All the students from the different samples were taking the same set of courses, at the same school, with the same instructors, syllabus, and course content and the time of semester was the only variable. Based on this, the decision was made to determine if the samples could be combined into a single, larger sample to address the normality issue.

Statistical analysis to determine homogeneity of all three sets of data using a Levine statistic mean representation and Analysis of Variance did not reveal homogeneity. The Welch and Brown–Forsythe robust tests of equality of means, however, were significant and supported the ability to combine them into one set of data. Post hoc analysis of desired sample size and effect, based on the actual combined sample size of 238 participants, showed that when the alpha or significance level was kept at $p < .10$, with a medium effect size of .50, the beta or type 2 error became at 0.01 with a power that increased to 99%. As a result of these analyses, the decision to use the combined sets of data a single set was confirmed.

The total participant sample was representative of the undergraduate population attending this Midwestern university baccalaureate program in nursing. The majority of the participants were female (90%; $n = 217$). Participant age ranged from 18 to 50 with an average age of 25.5 years. Seventy-six percent of the participants self-reported as Caucasian ($n = 183$), 7% as African American ($n = 16$), 4% as of Hispanic descent ($n = 10$), and 4% as Asian ($n = 9$). Seven percent ($n = 17$) declined to report their ethnicity (Table 3). All of the demographics were represented in the experimental and control groups consistently (Table 3).

The control group (*n* = 116), who received usual and customary debriefing after the simulation experience, consisted of 88% female (*n* = 104) and 12% male participants (*n* = 14). They self-reported as 70% Caucasian (*n* = 83), 8% African American (*n* = 9), 3% Hispanic (*n* = 3), 6% Asian (*n* = 7), and 3% other (*n* = 4). Ten percent (*n* = 12) of participants in the control group declined to report their ethnicity (Table 3). The ages for this group of participants ranged from 18 to 47 with an average of 26 (*SD* = 6.47) years old (Table 3).

Participants assigned to the experimental group used the DML strategy developed for this research study, following their simulation experience. This group was very similar to the control group and consisted of 93% female (*n* = 113) and 7% male participants (*n* = 9). They self-identified as 82% Caucasian (*n* = 100), 6% African American (*n* = 7), 6% Hispanic (*n* = 7), 2% Asian (*n* = 2), and 1% other (*n* = 1). Four percent (*n* = 5) of the participants in the experimental group declined to report their ethnicity (Table 3). The ages for this group ranged from 18 to 50 with an average of 25.1 years old (Table 4, Figure 3).

Table 3

Sample Demographics

Measure	DML		Control	
	Gender	Age	Gender	Age
Mean		25.1		26.0
Median		23		23
Mode	1	22	1	23
SD	0.26	6.22	0.32	6.71
Range		32		29
Minimum	1	18	1	18
Maximum	2	50	2	47
N valid	122		118	

Race	DML	Control
Not provided	5	12
White, Caucasian	100	83
African American	7	9
Hispanic	7	3
Asian	2	7
Other	1	4

Gender	DML	Control
Female	113	104
Male	9	14

Table 4

Age Distributions

Age	DML	Control
<20	14%	12%
21–30	70%	70%
31–40	12%	11%
41–50	4%	7%

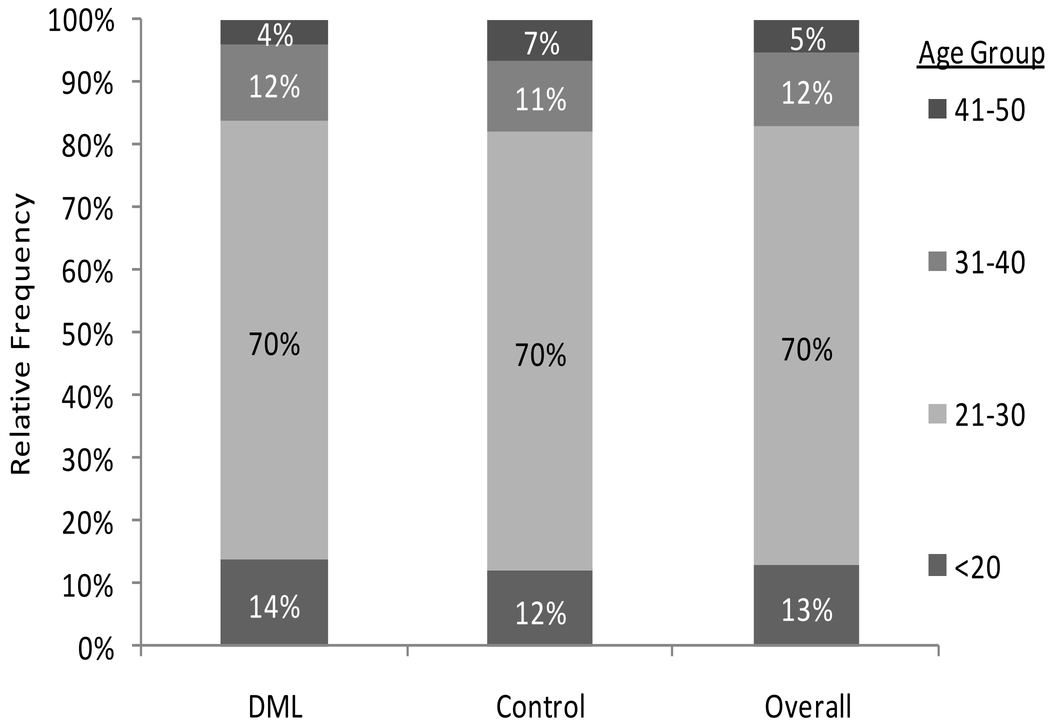


Figure 3. Sample Age Distribution.

Data Analysis to Support the Combined Sample

Quantitative analysis of the data was done systematically using the SPSS/PASW 17.0 program to run statistical tests. The first step in the data analysis was to determine homogeneity of the total sample using Levine's statistic and analysis of variance. These tested the null hypothesis that there is no difference in the mean scores for the pre-test or for the post-test from the different collection times and they can be considered one homogenous total sample. To test this, each set of data from the different samples were analyzed. Sample 1 represents the first semester of data. During the second semester of data collection, the simulation experience times were scheduled over a 8-week period so the pre-test and post-test were made available twice to ensure consistency in timing between testing and simulation for all groups. These data sets, identified as sample 2 and sample 3 were analyzed separately before combining to ensure homogeneity. Sample 4 describes the set of data from the third semester of data collection.

Levene's test for the HSRT combined *experimental* group pre-test, $F(3,118) = 2.68$, $p = .05$, and the post-test, $F(3,118) = 2.28$, $p = .08$, are not statistically different (Table 5), and equal variances are assumed. However, Levene's test for the HSRT combined *control* group pre-test, $F(3,114) = 2.58$, $p = .06$, and the post-test, $F(3,112) = 3.51$, $p = .02$, were significantly different, and the assumption of equal variances between the dependent variable and the independent variable cannot be supported (Table 6, Figure J1).

Table 5

HSRT Experimental Group Sample Means

Data Set	Mean		*SD*	
Sample	Pre-test	Post-test	Pre-test	Post-test
1 (sem 1)	24.00	24.55	2.79	2.88
2 (sem 2a)	23.80	24.75	4.98	5.27
3 (sem 2b)	24.59	25.52	5.71	4.65
4 (sem 3)	22.50	23.56	6.24	5.88

Table 6

Comparison of HSRT Experimental Group Sample Means

DMLGroup		Sum of Squares	*df*	Mean Square	F	Sig.
HSRT Pre-test	Between Groups	96.45	3	32.15	0.985	.40
	Within Groups	3849.72	118	32.62		
HSRT Post-test	Between Groups	80.54	3	26.85	.942	.42
	Within Groups	3364.42	118	28.51		

Since homogeneity of variance was not consistent in both the experimental and control groups for the combined total sample pre-test and post-test results, despite the larger number of participants, pre-test and post-test averages for the experimental and control groups were compared (Table 4). Despite the Levene test results, the averages are not significantly different (Table 7).

A one-way analysis of variance first was conducted to evaluate the relationship between the data from the different collection times for both the experimental and control groups with the pre-test and post-test HSRT scores (Table 5, Table 6). The experimental group pre-test data, $F(3,118) = .98$, $p = .40$, and post-test data, $F(3,118) = .94$, $p = .42$, and the control group pre-test data, $F(3,114) = 1.73$, $p = .16$, and post-test data, $F(3,112) = 1.71$, $p = .17$, are not significantly different (Table 7, Table 8).

Table 7

HSRT Control Group Sample Means

Data Set	Mean		*SD*	
Sample	Pre-test	Post-test	Pre-test	Post-test
1 (sem 1)	22.27	22.00	5.33	5.55
2 (sem 2a)	22.95	23.24	2.90	2.63
3 (sem 2b)	25.79	25.66	5.82	5.76
4 (sem 3)	24.63	23.53	5.70	55.57

Table 8

Comparison of HSRT Control Group Sample Means

Control Group		Sum of Squares	*df*	Mean Square	F	Sig.
HSRT Pre-test	Between Groups	149.13	3	49.71	1.735	0.16
	Within Groups	3265.68	114	28.65		
HSRT Post-test	Between Groups	144.74	3	48.25	1.717	0.17
	Within Groups	3146.32	112	28.09		
	Total	3444.96	121			

To confirm these results, and resolve the discrepancy with the Levene test, robust tests of equality of means were performed. The Welch and Brown–Forsythe tests of homogeneity of variances are alternatives to Levene's test that are more robust, when groups are unequal in size and the absolute deviation scores are highly skewed. The Welch statistic for the experimental group pre-test, $F(3,42.47) = .98$, $p = .41$, and post-test, $F(3, 40.79) = .96$, $p = .42$, as well as the control group pre-test, $F(3,36.50) = 2.28$, $p = .095$, and post-test, $F(3,35.65) = .96$, $p = .21$, have no significant difference of means. The Brown–Forsythe for the experimental group pre-test, $F(3,88.91) = 1.34$, $p = .26$, and post-test, $F(3, 82.50) = 1.25$, $p = .30$, in addition to the control group pre-test, $F(3,57.34) = 1.99$, $p = .12$, and post-test $F(3,51.54) = 1.96$, $p = .13$, confirms this (Table 9). The null hypothesis is accepted and the data will be considered homogeneous enough to be one total sample of 238 subjects.

Table 9

Robust Tests of Equality of Means

DML Group	Measure	Statistic[a]	*df*1	I2	Sig.
HSRT Pre-test	Welch	.985	3	42.468	.409
	Brown-Forsythe	1.345	3	88.904	.265
HSRT Post-test	Welch	.962	3	40.787	.420
	Brown-Forsythe	1.248	3	82.501	.298

Control Group	Measure	Statistic[a]	df1	df2	Sig.
Pre TOTAL	Welch	2.285	3	36.501	.095
	Brown-Forsythe	1.999	3	57.337	.124
Post TOTAL	Welch	1.584	3	35.658	.210
	Brown-Forsythe	1.957	3	51.542	.132

[a]Asymptotically F distributed.

One final variable, age ($M = 25.5$, $SD = 6.5$) was tested for homogeneity. The null hypothesis that there is no difference in mean scores of age from the different data collection times was tested, again using Levene's test, and ANOVA (Table 10, Figure J3). The results, $F(3.236) = 1.36$, $p = .26$, for Levene as well as the ANOVA $F(3.236) = .588$, $p = .62$ were significant and the null hypothesis was accepted, acknowledging that there is no difference in mean scores of age using this criteria, providing further support that the groups could be combined into one large sample.

Table 10

Sample Means for Age

Data Set	*N*	Mean	*SD*	Std. Error	95% CI for Mean *LB*	*UB*	Min	Max
1 (sem 1)	22	24.8	6.2	1.3	22.1	27.6	19	46
2 (sem 2a)	39	25.4	8.1	1.3	22.8	28.0	18	50
2 (sem 2b)	56	24.8	7.0	0.9	23.0	26.7	18	46
4 (sem 3)	123	26.1	5.7	0.5	25.0	27.1	20	47

Note. CI = confidence interval; *LB* = lower bound, *UB* = upper bound.

The next step in this stage of data analysis was to determine normality of the total sample since, historically, the smaller samples did not represent a normal distribution. The sample size was increased to enhance normality, leading to the testing of the hypothesis that the data from the HSRT pre-test and post-test, the DASH©–SV, and the DMLSQ follow a normal distribution. Normality determined which statistical tests to use to analyze the data.

A 1-sample Kolmogorov-Smirnov test was used to evaluate normality. The experimental group pre-test data for the mean total score on the HSRT, $D(122) = .94$, $p = .34$, and post-test data for the mean total score on the HSRT, $D(122) = 1.12$, $p = .16$, were significantly normal, despite the non-significant results of the subscales (Inductive, Deductive, Analysis, Inference, Evaluation) of the tool (Table 11).

The control group pre-test data for the mean total score on the HSRT, $D(118) = 1.04$, $p = .23$, and post-test data for the mean total score on the HSRT, $D(118) = 1.11$, $p = .17$, were also significantly normal with again, non-significant results of the subscales (Inductive, Deductive, Analysis, Inference, Evaluation) of the tool (Table 11). Change in HSRT scores from pre-test to post-test was also analyzed using the Kolmogorov-Smirnov test. The experimental group, $D(122) = 2.3$, $p < 0.001$, and control group, $D(116) = 2.5$, $p < 0.001$, were not significant.

Table 11

Normality for HSRT

		Pre-test Scores					
DML Group	Measure	Induction	Deduction	Analysis	Inference	Evaluation	Total[a]
N		122	122	122	122	122	122
Normal Para-meters	Mean	6.19	5.91	4.06	3.21	4.09	23.31
	SD	1.73	1.83	1.32	1.22	1.37	5.71
Most Extreme Diff-erences	Absolute	.15	.15	.15	.23	.18	.08
	Positive	.09	.08	.13	.22	.12	.06
	Negative	-.15	-.15	-.15	-.17	-.18	-.08
Kolmo-gorov Smirnov Z		1.67	1.66	1.71	2.48	1.97	.94
Asymp.Sig (2 tailed)		.007	.008	.006	.000	.001	.340

[a]Test distribution is normal.

(table continues)

DML Group	Measure	Induction	Deduction	Analysis	Inference	Evaluation	Total[a]
				Post-test Scores			
N		122	122	122	122	122	122
Normal Para-meters	Mean	6.19	6.04	4.27	3.61	4.26	24.28
	SD	1.58	1.68	1.24	1.23	1.22	5.33
Most Extreme Differences	Absolute	.16	.16	.16	.20	.15	.11
	Positive	.11	.09	.16	.20	.16	.05
	Negative	-.16	-.16	-.15	-0.14	-.15	-.10
Kolmo-gorov Smirnov Z		1.77	1.84	1.77	2.20	1.75	1.12
Asymp.Sig (2-tailed)		.004	.002	.004	.000	.004	.16

[a]Test distribution is normal.

(table continues)

		Pre-test Scores					
Control Group	Measure	Induction	Deduction	Analysis	Inference	Evaluation	Total[a]
N		118	118	118	118	118	118
Normal Para-meters	Mean	6.44	6.07	4.31	3.29	4.34	24.42
	SD	1.56	1.93	1.34	1.17	1.294	5.40
Most Extreme Diff-erences	Absolute	.14	.13	.19	.19	.19	.09
	Positive	.11	.09	.11	.19	.11	.05
	Negative	-.14	-.13	-.20	-.17	-.19	-.09
Kolmo-gorov Smirnov Z		1.52	1.39	2.12	2.09	2.10	1.04
Asymp.Sig (2 tailed)		.020	.041	.000	.000	.000	.230

[a]Test distribution is normal.

(table continues)

		Post-test Scores					
Control Group	Measure	Induction	Deduction	Analysis	Inference	Evaluation	Total[a]
N		116	116	116	116	116	116
Normal Para-meters	Mean	6.28	5.88	4.08	3.43	4.19	23.87
	SD	1.68	1.77	1.42	1.18	1.28	5.35
Most Extreme Differences	Absolute	.16	.16	.18	.22	.15	.10
	Positive	.12	.087	.10	.22	.14	.05
	Negative	-.16	-.15	-.18	-.18	-.15	-.10
Kolmo-gorov Smirnov Z		1.8	1.6	1.9	2.4	1.6	1.1
Asymp.Sig (2- tailed)		.004	.008	.001	.000	.010	.171

[a]Test distribution is normal.

The control group pre-test data for the mean total score on the HSRT, *D*(118) = 1.04, *p* = .23, and post-test data for the mean total score on the HSRT, *D*(118) = 1.11, *p* = .17, were also significantly normal with, again, non-significant results of the subscales (Inductive, Deductive, Analysis, Inference, Evaluation) of the tool (Table 9). Change in HSRT scores from pre-test to post-test was also analyzed using the Kolmogorov-Smirnov test. The experimental group, *D*(122) = 2.3, *p* < .001, and control group, *D*(116) = 2.5, *p* < .001, were not significant (Table 12).

Table 12

Change in HSRT Scores

DML Group	Measure	HSRT Change
N		122
Normal Parameters[a]	Mean	.97
	SD	1.89
Most Extreme Differences	Absolute	.21
	Positive	.21
	Negative	-.18
Kolmogorov-Smirnov Z		2.29
Asymp. Sig. (2-tailed)		.00

Control Group	Measure	Change TOTAL
N		116
Normal Parameters[a]	Mean	-.65
	SD	2.53
Most Extreme Differences	Absolute	.23
	Positive	.19
	Negative	-.23
Kolmogorov-Smirnov Z		2.49
Asymp. Sig. (2-tailed)		.00

[a]Test distribution is normal.

The experimental group data for the mean total score on the DASH©–SV, *D*(122) = 1.83, *p* = .002, was not significantly normal and also demonstrated non-significant results of the subscales (Table 13). The control group data for the mean total score on the DASH©–SV, *D*(116) = 1.16, *p* = .13, was significantly normal, but again demonstrated non-significant results for the individual subscales on the DASH©–SV tool (Table 14).

Table 13

Normality for Total Scores for DASH©–SV

DML Group	Measure	Mean_DASH
N		122
Normal Parameters[a]	Mean	5.58
	SD	.48
Most Extreme Differences	Absolute	.17
	Positive	.12
	Negative	-.17
Kolmogorov-Smirnov Z		1.83
Asymp. Sig. (2-tailed)		.002

Control Group	Measure	Mean_DASH
N		116
Normal Parameters[a]	Mean	4.23
	SD	.45
Most Extreme Differences	Absolute	.11
	Positive	.11
	Negative	-.11
Kolmogorov-Smirnov Z		1.16
Asymp. Sig. (2-tailed)		.132

Table 14

Normality of Element Scores for DASH©–SV

DML Group	Measure	DASH1	DASH 2	DASH 3	DASH 4	DASH 5	DASH 6
N		111	111	111	111	111	111
Normal Parameters[a]	Mean	4.58	5.04	6.21	5.67	5.73	6.23
	SD	1.04	0.98	0.74	0.76	0.79	0.79
Most Extreme Differences	Absolute	0.24	0.27	0.28	0.28	0.35	0.26
	Positive	0.16	0.21	0.26	0.22	0.27	0.21
	Negative	-0.24	-0.27	-0.28	-0.28	-0.35	-0.26
Kolmogorov-Smirnov Z		2.53	2.83	2.97	2.9	3.72	2.72
Asymp. Sig. (2-tailed)		0.00	0.00	0.00	0.00	0.00	0.00

Control Group	Measure	DASH 1	DASH 2	DASH 3	DASH 4	DASH 5	DASH 6
N		105	105	105	105	105	105
Normal Parameters[a]	Mean	3.971	4.010	4.286	4.171	4.686	4.267
	SD	0.9752	0.9250	0.8516	0.7527	0.9738	0.8466
Most Extreme Differences	Absolute	0.226	0.248	0.218	0.342	0.207	0.224
	Positive	0.165	0.237	0.212	0.342	0.207	0.224
	Negative	-0.226	-0.248	-0.218	-0.267	-0.179	-0.224
Kolmogorov-Smirnov Z		2.316	2.544	2.236	3.509	2.121	2.295
Asymp. Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.000	0.000

[a]Test distribution is normal.

The individual DMLSQ were also assessed for normality in both the experimental and control groups. The Worksheet question in the control group did not demonstrate a variance since students receiving usual and customary debriefing did not use one. All of the *p* values for the D-scores were less than .05 resulting in no evidence to assume a normal distribution in either the experimental or control groups for any of the questions (Table 15).

Table 15

Normality for DMLSQ

DML Group	Measure	Q1[a]	Q2[b]	Q3[c]	Q4[d]	Q5[e]
N		110	111	122	111	122
Normal Parameters[a]	Mean	4.67	5.57	1.75	5.84	2.94
	SD	1.38	1.13	1.11	1.09	1.57
Most Extreme Differences	Absolute	.15	.22	.26	.23	.18
	Positive	.13	.13	.26	.14	.18
	Negative	-.15	-.22	-.17	-.23	-.17
Kolmo-gorov Smirnov Z		1.549	2.373	2.843	2.473	2.019
Asymp. Sig. (2-tailed)		.016	.000	.000	.000	.001

[a]Worksheet. [b]Knowledge. [c]Time. [d]Reflection. [e]Role. [f]Test distribution is normal. [g]The distribution has no variance for this variable. One-Sample Kolmogorov-Smirnov Test cannot be performed.

(table continues)

Control Group	Measure	Q1[a]	Q2[b]	Q3[c]	Q4[d]	Q5[e]
N		105	105	116	105	116
Normal	Mean	.00	4.32	.93	.88	1.50
Parameters[f]	*SD*	.00[g]	1.16	1.11	1.09	1.57
Most Extreme	Absolute		.18	.31	.23	.16
Differences	Positive		.15	.31	.23	.16
	Negative		-.18	-.22	-.22	-.16
Kolmo-gorov Smirnov Z			1.92	3.29	2.36	1.77
Asymp. Sig. (2-tailed)			.001	.000	.000	.004

[a]Worksheet. [b]Knowledge. [c]Time. [d]Reflection. [e]Role. [f]Test distribution is normal. [g]The distribution has no variance for this variable. One-Sample Kolmogorov-Smirnov Test cannot be performed.

Based on the results of the tests for normality for each of the instruments—HSRT, DASH©–SV, and DMLSQ— three conclusions were made. Normality can be assumed for the total pre-test and post-test HSRT scores in both the experimental and control groups. There is no evidence to assume normally-distributed data for the individual HSRT component scores, the change in HSRT scores from pre-test to post-test, the DMLSQ scores, and for the DASH©–SV scores. The results of the aggregate DASH©–SV scores are mixed and inconsistent. Therefore, the null hypothesis that the total sample represents a normal distribution is not supported completely and only accepted for the HSRT total data. For the rest of the data, the alternative hypothesis is accepted and those data are not considered to represent at normal distribution.

Study Procedure

Students were informed of the research study and consented (Appendix C), using a process approved by the Institutional Review Board at Indiana University–Purdue University Indianapolis (Appendix D). Subjects were assigned a participant number and given instructions for accessing the online test. Students took the pre-test prior to an established simulation experience involving care of a client with pulse-less electrical activity in their clinical course. They took the first version of the 33-item HSRT from any computer with Internet access to establish baseline assessment (Facione & Facione, 2006). The test was available online for at least seven days during specified timeframes before simulation experiences began in the course. In addition to the HSRT items, students were also asked to provide demographic information.

Consenting participants were conveniently and purposively assigned to either the experimental or control group, based on the day they were assigned to be in the simulation experience. During the day of the simulation, students participated in four hour-long scenarios using high-fidelity patient simulators in a high-fidelity simulated clinical environment. The scenarios represented clinical situations formed on the basis of didactic content they had covered in the theory course, and the time was divided with 30 minutes allotted for the simulation and 30 minutes for debriefing. Each of the scenarios was developed using the National League for Nursing's Nursing Simulation Scenarios distributed by Laerdal Medical Corporation.

These simulation scenarios came with prepared faculty information necessary for faculty to run the experience of that patient type. The fidelity and computerized mannequin physiology, student and faculty preparation materials, and debriefing tools were all included. These resources were based on the National League for Nursing/Laerdal Simulation project (Jeffries, 2007). The intervention and data collection for this study were based on only one of the scenarios, *Care of the Client Experiencing Pulse-less Electrical Activity*.

On their assigned day, students participated in the simulation experience. Once students arrived for simulation, they were randomly assigned roles to play in each simulation. For example, one student played the role of the primary nurse, another student had the role of a secondary nurse (one who was delegated to), a third student role was a family member with a scripted role, and two students were assigned to be recorders. Any remaining students in the clinical group participated as observers or other healthcare professionals.

Following the simulation experience, the students and the faculty observer went to a conference room to debrief for the allotted 30 minutes. The experimental group was debriefed by the primary investigator of this study using the DML strategy. The debriefing included the student worksheet (Appendix A) based on the E–6 concepts and DML faculty guide (engage, evaluate, explore, explain, elaborate, extend) for meaningful learning (Appendix B). Study participants in the control group received usual and customary debriefing by following the debriefing tool accompanying this scenario based on the work by Childs, Sepples, and Chambers (2007) (Appendix E).

Three weeks after the simulation experience, the post-test was opened for student access for a seven-day period. The three-week interval was chosen arbitrarily to fit into the student calendar that first semester and carried consistently through the others. A period of at least two weeks is recommended between pre-test and post-test to avoid a familiarity effect where students choose answers on the post-test based on something they remember from the pre-test (Facione & Facione, 2006). In this study, the participants took the second online version of the HSRT. The second version is similar, but not identical to the first. Using two versions of a tool eliminates bias due to familiarity with the items. Additionally, subjects were asked to evaluate the quality of the debriefing by using the student version of the DASH©–SV (Appendix F). Participants were also asked to evaluate the tools and components of the DML strategy and an additional demographic question identifying which role they played in the PEA simulation (Appendix G). All of the DML evaluation questions and the DASH©–SV questions also included an open-ended opportunity for the participant to respond in free-text.

Protection of Human Subjects

Protection of the human subject participants in this study followed the Indiana University–Purdue University Indianapolis Instituional Review Board policies and procedures for exempt research. Approval for the initial proposal (Appendix D) was secured prior to the initiation of the study. An amendment was obtained when the planned location for the study changed due to circumstances beyond the control of the researcher (Appendix D). A second amendment was obtained to include an additional instrument in the data collection for the third semester (Appendix D). This was not utilized when it became necessary to combine all the semesters of data collection into a single sample.

Variables and Instruments

This study used a single intervention variable, DML, and three instruments: the HSRT, the DASH©–SV, and the DMLSQ. These tools were used to test the hypothesis that the intervention would positively impact the development of clinical reasoning skills in nursing students who participated in the experimental arm of this study when compared to those who received usual and customary debriefing.

Study Variable: Developing a Model of Debriefing for Meaningful Learning

Simulation use in nursing education continues to rise. Despite this, nurse educators are not consistently prepared to use this innovative teaching modality. During simulation, students and facilitators regularly debrief the experience, and the literature supports this as an essential component of the learning process. While debriefing is considered the cornerstone of simulation learning, debriefing techniques vary greatly, and there are few resources for faculty development in this area.

The DML debriefing strategy, and associated learning tools (Appendix B, Appendix A), was developed for this research study, to be a framework that nurse educators could use to facilitate debriefing. It utilizes three theoretical models in its design (Figure 1). Gibbs' et al. (1988) Reflective Cycle (Figure 2), the Interactive Nature of Significant Learning (Fink, 2003) (Figure 2), and elements of the E–6 DML Faculty Guide (Appendix B). The E–6 is an adaptation of Bybee's E–5 teaching and learning model (Bybee et al., 1989). Using this strategy, teachers, as debriefing facilitators, assist learners to reflect on the experience through a process where they *engage* by addressing the emotions of the experience, *evaluate* their performance, *explore* options, *explain* alternatives, and *elaborate* thinking-like-a-nurse. Finally, they *extend*—reflecting-beyond-action to consider through assimilation and accommodation how they might respond to the next contextual client situation that is encountered.

This debriefing strategy addresses the dilemma noted by many health professions educators and articulated by Barrows and Pickell (1991) that "students might have knowledge in different relevant subjects that contribute to the practice of medicine but they do not demonstrate or apply that knowledge contextually and they are not able to solve problems they face in the clinical setting" (pp. 89–90). Nursing students also struggle in this area and many teaching strategies address this including case studies, PBL scenarios, thinking-out-loud activities, discussion groups, standardized patients, reflective journaling, and concept mapping (Rowles & Russo, 2009).

Designing innovative teaching to address the disparity between students' knowledge and their ability to apply it contextually is not limited to faculty in healthcare professions. Fink (2003) articulates that new paradigms for college teaching span the learning experience in all disciplines, and that that significant learning requires innovative strategies like those described above by Rowles and Russo (2009). Fink further defines four components of teaching for significant learning as "knowledge about subject matter, teacher-student interactions, course management involving being organized and ready for course activities and finally the design of instruction" (pp. 22–23). While all of these are foundationally evident in the DML debriefing strategy, the last, defined by Fink as "significantly re-thinking and reconstructing the set of teaching and learning activities to engage students in *active thinking about learning* and *active learning about thinking* [emphasis added]" is most prevalent (pp. 23, 31).

In order to engage students actively in thinking during debriefing, the DML strategy also uses a student worksheet as a visual representation of the reflective process (Appendix A). The worksheet guides the E–6 process using a concept mapping approach. Concept mapping is used in both the DML strategy and worksheet (Appendix A) to help develop reflective thinking in students. This follows Novak and Gowin's (1984) theory of meaningful learning and the importance of using concept maps as visual schemas that represent thinking and action, to demonstrate for learners, the relationships between the patient's story, assessment findings, interventions and outcomes. In this manner, two or more concepts are linked in a linear or, more commonly in health sciences, a circular fashion (August-Brady, 2005).

Concept mapping helps students to develop reflective thinking and frames, or representations, that form the scaffolding for understanding not only by demonstrating what is not known but also what is known. This leads to actionable knowledge that can be applied to the clinical context. Concept maps visually represent the story of the patient and the framework of decision-making. They also provide an opportunity for faculty to discern errors and lapses in thinking and reasoning that can be reviewed and reconstructed for student learning (August-Brady, 2005; Novak & Gowin, 1984). In the DML strategy concept mapping can be either an individual or a group activity where the critical aspects of the simulation are mapped through the process of reflection-on-action (Schön, 1983), and future clinical experiences can be anticipated visually using reflection-beyond-action (Dreifuerst, 2009).

The worksheet concept maps direct the student to “fill in the blanks” as they debrief the experience. This iteration of concept mapping visually guides the learner through the process of understanding the patient and the contextual circumstances that are influencing the decision-making process by the nurse. Each section of the worksheet represents an element in the E–6 DML Faculty Guide that provides the debriefer with a structure to guide the process as the debriefing unfolds.

Structure in the debriefing process is an empirical referent for best educational practices (Dreifuerst, 2009). Structured debriefing requires a facilitator to guide students in reflection to promote clinical reasoning as well as meaningful learning. Affective and behavioral learning outcomes also are strengthened when structured debriefing using a reflective framework occurs within the teaching-learning arena (Dreifuerst, 2009).

Using the DML structure, students and faculty debrief the simulation by beginning with the things all participants are initially focused on: “What went right?” “What went wrong?” and “Given the opportunity, what would you do differently?” This actively engages all the participants in the debriefing process and begins the evaluation process. By getting these down on paper immediately following the simulation, they are immediately addressed, along with the emotion attached to them. While emotion can potentiate learning, it can also be inhibitive by distracting learners (Taylor, 2006).

Once the initial elements are recorded, the facilitator goes back to the start of the worksheet and reminds the students of the patient's name, and together the group recounts the details of the patient's story. Patient story is also an antecedent of debriefing and a meaningful component of simulation (Dreifuerst, 2009, p. 112). *Naming* and *patient story* not only identify this patient for future reference, they provide the scaffolding to which all the debriefing information can be attached through mental modeling or framing.

Frames, or representations, form the scaffolding for understanding, not only by demonstrating what is not known but also what is known. This leads to actionable knowledge that can be applied to the clinical context. Concept maps visually represent the story of the patient and the framework of decision-making that is remembered through the identification of the patient name and context: essential elements of the frame.

Using the DML worksheet, debriefing next turns to *exploring options* and *explaining* alternatives. This is done through mapping out the patient assessment and superimposing what went right and what went wrong. Careful attention is paid to dialog and discussion as the group comes to consensus on the central patient issue or *focused key problem*. "Concept maps can be used to help students identify key concepts and relationships which in turn will help them interpret the events and objects they are observing and experiencing" (Novak & Gowin, 1984, p. 48).

Concept maps also provide an opportunity for faculty to discern errors and lapses in thinking and reasoning which can be reviewed and reconstructed for student learning (August-Brady, 2005; Novak & Gowin, 1984). Finally, concept mapping in the DML strategy can be either an individual or a group activity where the critical aspects of the simulation are mapped through the process of reflection-on-action (Schön, 1983). In the final section of the DML student worksheet (Appendix A), future clinical experiences can be anticipated using activities to make evident, reflection-beyond-action (Dreifuerst, 2009). This makes evident the relationship between anticipation and reflection for novice nurses and teaches the importance of this element of thinking-like-a nurse. In this manner, debriefing becomes an active learning exercise that teaches through example, anticipation; an important characteristic of experienced nurses and novices (Benner et al., 2010; Dreifuerst, 2009).

The DML strategy for facilitating simulation debriefing was developed to provide a structure and process that faculty can use to maximize student learning. It particularly focuses on fostering clinical reasoning skills, a hallmark of developing expertise in nursing practice. This study tested this debriefing method and associated tools.

Instruments

Several instruments were used to measure evaluation outcomes. The HSRT developed by Facione and Facione (2006) was selected first. Like many of the instruments reviewed in Chapter II, this test measures clinical reasoning, critical thinking, and clinical decision-making. It differs in two ways from the other tools: CCTSI, the Cornell Critical Thinking Test, and the CCTDI also developed by Facione and Facione (1989, 1990). The first difference is the clinical context of this tool. All of the items are related to contextual clinical care. Second, this tool measures reasoning skills in addition to critical thinking skills.

The HSRT. The HSRT measures clinical reasoning, critical thinking, and clinical decision-making in a health-clinical context. It is, however, not specific to the domain of nursing. This copyrighted tool uses 33 questions that require clinically reasoned responses in five areas: analysis, evaluation, inference, and inductive and deductive reasoning. Analysis is defined as the ability to “organize, classify, categorize and prioritize variables”. It also involves the “ability to identify implications, alternatives and possible consequences” (Dexter et al., 1997, p. 164). Additionally, analysis means “to identify the intended and actual inferential relationships among statements, questions, concepts, descriptions or other forms of representation” (Facione & Facione, 2006, p. 9).

Evaluation is the process of “assessing credibility, relevance, significance, value and applicability of information/arguments in relation to a specific situation” (Dexter et.al, 1997, p. 164). It also involves the assessment of the logical strength of actual or intended inferential relationships among statements, descriptions, questions or other forms of representations. Additionally, evaluation means “to state the result of one’s reasoning and to justify that reasoning in terms of the criteria upon which it was based" (Facione & Facione, 2006, p. 9).

Inference is defined as "to conjecture alternatives, formulate hypotheses or draw conclusions based on premises or evidence. It is the ability to demonstrate principles of logic, and apply rules of induction and deduction to familiar and unfamiliar situations" (Dexter et al., 1997, p.164; Facione & Facione, 2006, p. 9). According to Facione and Facione, "analysis, evaluation and inference represent the core elements of critical thinking" (2006, p. 9). The HSRT looks at more than critical thinking. It also measures clinical reasoning by measuring inductive and deductive reasoning within a clinical context. This distinction is the primary difference between the HSRT and previous tests by Facione and Facione that looked at similar concepts with similar constructs.

Inductive reasoning moves from the specific to the general and includes arguments based on experience or observation. This means that "an argument's conclusion is purportedly warranted, but not necessitated by the assumed truth of its premises" (Facione & Facione, 2006, p. 10). Ideas can be discovered but not proven with inductive reasoning. As a result, "conclusions based on induction do not have the same degree of certainty as those based on deduction" (Caine & Caine, 2006, p. 58).

Deductive reasoning begins with the general thinking and ends with the specific conclusions. This means that "the assumed truth of the premises purportedly necessitates the truth of the conclusion" (Facione & Facione, 2006, p. 10). "Arguments based on laws, rules, or other widely accepted principles are examples of deduction and demonstrate a great deal of certainty "(Caine & Caine, 2006, p. 58).

The HSRT measures clinical reasoning, critical thinking, and clinical decision-making by interpreting the responses to 33 questions that reflect these five domains: analysis, evaluation, inference, and inductive and deductive thinking. "HSRT test items are set in clinical and professional practice contexts and supply the necessary content for applying one's thinking skills without presupposing specialized knowledge. Questions in the HSRT present necessary informational content in text-based and diagrammatic formats. Questions invite test takers to draw inferences, to make interpretations, to analyze information, to draw warranted inferences, to identify claims and reasons, and to evaluate the quality of arguments. The HSRT Total Score targets the strength or weakness of one's skill in making reflective, reasoned judgments about what to believe or what to do" (Facione & Facione, 2006, p. 3).

Internal consistency reliability of the overall HSRT tool using Kuder-Richardson-20 calculation for dichotomous multidimensional scales is estimated at 0.81 (N = 444) indicating a high level of reliability since it is greater than 0.70 (Facione & Facione, 2006). The test authors report that the subscales of inductive reasoning (0.76), deductive reasoning (0.71), and evaluation (0.77) had high level internal consistency. Analysis (0.54) and inference (0.52) had lower scores, indicating less internal consistency.

Test-retest analysis of the HSRT using interclass correlation demonstrated substantial agreement (0.61–0.80) in all subscales and for the overall instrument (0.79), supporting strong reliability (Facione & Facione, 2006; Landis & Koch, 1977). Content and construct validity were established by correlating test items to the Delphi Report (The APA Delphi Report,1990) with consultation and consensus from participants and item analysis by graduate students developing and testing questions associated with the Delphi Report components (Facione & Facione, 2006). Criterion validity has not been published for this instrument but data collection related to demographics of test takers is in development and will be reported when available. Due to constraints imposed by the test developers, a copy of the tool is not provided in this paper but access is available through purchase (Appendix H).

DASH©–SV. The second instrument used in this study is the DASH©–SV (Appendix F). The DASH©–SV uses a behaviorally anchored rating scale to identify the extent to which students perceive that the facilitator demonstrated six elements of effective debriefing following simulation experiences (Simon at al., 2009). This new instrument, in the pilot testing phase, is a variation of the Debriefing Assessment for Simulation in Healthcare© (DASH©) (Simon et al., 2009).

The DASH© is a tool designed to be used by peer-faculty to evaluate the quality of debriefing. Criterion and content validity for the DASH© have been established by the authors who, collectively, have twenty years' experience debriefing medical students. Reliability has not been published but is anticipated by December, 2010 (D. Raemer, personal communication, December 12, 2009). The DASH©–SV addresses issues in evaluation not met by the DASH©, which was designed to be used by teachers evaluating other teachers' teaching. The DASH–SV© uses the same six criterion and *effectiveness scale* as the DASH© but reports the data from the student perspective. Items for the DASH–SV© have been reviewed by the developers of the DASH© for content and construct validity (D. Raemer, personal communication, June 12, 2009). Initial reliability was established with data derived in this investigation and determined to be 0.82 (N = 6, M = 29.537, variance = 24.259, SD = 4.925) demonstrating acceptable internal consistency between the items on the tool and supporting the assumption of unidimensionality using Cronbach's alpha analysis (Table 5) (Netemeyer, Bearden, & Sharma, 2003).

DMLSQ. The third set of data came from DMLSQ that explore the participant's perceptions of the debriefing strategy and its associated tools (Appendix G). Because this is a new debriefing strategy, it was important to get user feedback and to compare it with responses from participants who received usual and customary debriefing. New teaching strategies and pedagogies typically are evaluated by faculty and students to determine the influence on learning and how successfully the objectives and outcomes of the design were met (Nilson, 2003).

Four DMLSQ questions were asked specifically concerning elements of DML: (a) the usefulness of the student worksheet (Appendix A), (b) the participants' perception of their ability to *know what to do* when they encounter another patient with pulse-less electrical activity, (c) the participants' perception of the amount of time allotted for debriefing, and (d) their awareness of reflective thinking being evident during the simulation and debriefing experience. Participants were instructed to use a 7-point Likert scale (Appendix G) that corresponded to the responses requested by the DASH©–SV. Additionally, participants were asked to identify the role they played during the PEA simulation. Finally, participants had the option of providing open-ended comments following each of the DASH©–SV and DMLSQ items.

Research Aims and Hypotheses

The aim of this study was to test the impact of a faculty-facilitated, guided reflection teaching strategy during simulation debriefing on the development of clinical reasoning skills of undergraduate nursing students. Three research questions were used to test the null hypothesis that there would be no difference in the clinical reasoning skills of students in the experimental group receiving the DML intervention and students in the control group receiving usual debriefing:

1. Does the use of the DML debriefing strategy positively impact the development of clinical reasoning skills in undergraduate nursing students, as compared to usual and customary debriefing?
2. Do nursing students perceive a difference in the quality of debriefing when the DML strategy is used compared to usual and customary debriefing?
3. Is there a correlation between the quality of debriefing as evaluated by nursing students and a change in clinical reasoning skills?

Data Analysis for Research Questions

There are three research questions in this study. The determination of normally distributed and non-normally distributed data necessitated the use of a variety of parametric and non-parametric statistical tests to analyze the data addressing these questions (Table 16). Using SPSS/PASW version 17, parametric statistical tests were used to analyze the HSRT total scores and non-parametric tests were used to analyze the DASH©–SV and the DMLSQ data in this study. Data from the pre-test and post-test was downloaded directly from the Insight Assessment website (http://.www.insightassessment.com) into an spreadsheet and imported into SPSS version 17 for analysis. Participant identification numbers were removed from the database used for analysis.

The first question, "Does the use of the DML debriefing strategy positively impact the development of clinical reasoning skills in undergraduate nursing students, as compared to usual and customary debriefing," was tested using analysis of covariance on the mean scores from the HSRT pre-test and post-test total mean scores as well as the Mann-Whitney-Wilcoxon *W* on the sub-scores.

The second question, "Do nursing students perceive a difference in the quality of debriefing when the DML strategy is used compared to usual and customary debriefing," was addressed next using the scores from the DASH©–SV and the DMLSQ that were collected after the intervention with the post-test HSRT data. The Mann-Whitney-Wilcoxon *W* and Kruskal-Wallis statistical tests were used to evaluate this data.

Finally, regression analysis was used to test the data from the HSRT, the DASH©–SV, and the DMLSQ for the third question, “Is there a correlation between the quality of debriefing as evaluated by nursing students and a change in clinical reasoning skills?” The data analysis and statistical tests used to address each of the research questions are summarized in Table 16. The findings and implications of those results are described in detail in Chapter IV.

Summary

This chapter described the methodology used in this research. It described the development of the DML strategy for simulation debriefing. A detailed account of the participant recruitment and statistical methodology of determining homogeneity of the sample was provided. Each of the instruments used in this study: the HSRT, the DASH©–SV, and the DMLSQ were described. The justification for the planned statistical data analysis based on an analysis of sample normality was presented and the tests used to address each question were outlined. Results of the data analysis and implications for the research questions are presented in the following chapter.

Table 16

Relationship between Research Questions, Instruments, and Analysis

Research Question	Instrument	Variable	Method
1. Does the use of the DML debriefing strategy positively impact the development of clinical reasoning skills in undergraduate nursing students, as compared to usual and customary debriefing?	HSRT	Pre-test and post-test scores Age of participant Role played in simulation	ANCOVA Mann-Whitney Wilcoxon W
2. Do nursing students perceive a difference in the quality of debriefing when the DML strategy is used compared to usual and customary debriefing?	DASH©–SV DMLSQ	Control group and experimental group	Mann-Whitney Wilcoxon W Kruskal-Wallis
3. Is there a correlation between the quality of debriefing as evaluated by nursing students and a change in clinical reasoning skills?	HSRT DASH©–SV DMLSQ		Regression Analysis

Chapter IV Findings

This study investigates the impact of DML, a reflective strategy for debriefing simulation, on clinical reasoning skills in nursing students. A change in clinical reasoning exemplifies meaningful learning from the simulation experience. The impact of using DML was explored using three instruments: the HSRT, the DASH©–SV, and the DMLSQ. This chapter will describe the findings from this study and address each of the three research questions.

Descriptive Statistics

The HSRT was used to measure a change in clinical reasoning by the student nurses who participated in this study. It was administered to participants prior to the simulation experience and again three weeks after. Two hundred forty nursing students took the pre-test and 238 completed the post-test. The pre-test data for the total sample (N = 240, M = 23.9, SD = 5.6) depicts the baseline for all participants and is comprised of both the experimental group (N = 122, M = 23.3, SD = 5.7) and the control group (N = 118, M = 24.4, SD = 5.4). The post-test data for the total sample (N = 238, M = 24.1, SD = 5.3) depicts the scores after the simulation and debriefing experience for all participants and is comprised of both the experimental group (N = 122, M = 24.3, SD = 5.3) and the control group (N = 116, M = 23.9, SD = 5.3). Table 14 also reports the mean percentages and standard deviations for each of the items on the instrument (see also Figure J4).

Table 17

HSRT Descriptive Statistics for Pre-test and Post-test

	Elements	*N*		Min		Max		*M*		*SD*	
		DML	Control	DML	Control	DML	Control	DML	Control	DML	Control
Pre-test	Induction	122	2	9	6.2	1.7	118	2	10	6.4	1.6
	Deduction	122	1	9	5.9	1.8	118	0	10	6.1	1.9
	Analysis	122	1	6	4.1	1.3	118	1	7	4.3	1.3
	Inference	122	1	6	3.2	1.2	118	1	6	3.3	1.2
	Evaluation	122	1	6	4.1	1.4	118	0	6	4.3	1.3
Post-test	Induction	122	2	9	6.2	1.6	116	2	10	6.3	1.7
	Deduction	122	1	9	6.0	1.7	116	1	9	5.9	1.8
	Analysis	122	1	6	4.3	1.2	116	1	7	4.1	1.4
	Inference	122	0	7	3.6	1.2	116	0	6	3.4	1.2
	Evaluation	122	2	6	4.3	1.2	116	1	6	4.2	1.3
	Valid *N*	122					116				

The DASH©–SV was used to measure the quality of the debriefing in the pulse-less electrical activity patient scenario simulation by the student nurses who participated in this study. It was administered to the study subjects three weeks after the experience along with the second HSRT test; 238 completed the DASH©–SV. The data for the total sample (*N* = 216, *M* = 4.92, *SD* = .82) depicts the scores rating the debriefing experience for all subjects and is comprised of both the experimental group (*n* = 111, *M* = 5.58, *SD* = 2.90) and the control group (*n* = 105, *M* = 4.23, *SD* = .46). Table 18 also reports the mean percentages and standard deviations for each of the items on the DASH©–SV (see also Figure J5).

Table 18

DASH©–SV Descriptive Statistics

Elements	*N*		Min		Max		*M*		*SD*	
	E[a]	C[b]	E[a]	C[b]	E[a]	C[b]	E[a]	C[b]	E[a]	C[b]
DASH_1	111	105	2.0	1.0	6.0	6.0	4.58	3.971	1.040	.975
DASH_2	111	105	2.0	1.0	7.0	6.0	5.04	4.010	.981	.925
DASH_3	111	105	3.0	2.0	7.0	6.0	6.21	4.286	.740	.852
DASH_4	111	105	3.0	3.0	7.0	6.0	5.67	4.171	.767	.753
DASH_5	111	105	2.0	2.0	7.0	7.0	5.73	4.686	.797	.974
DASH_6	111	105	3.0	2.0	7.0	6.0	6.23	4.267	.797	.847

[a]Experimental. [b]Control.

The DMLSQ were three question designed to measure the participant response to some of the tools and processes used in the DML simulation debriefing strategy (Table A). In addition to these questions, a demographic question about the role that the participant played in the pulse-less electrical activity patient scenario simulation was also asked. One of the questions, asking about the DML Student Worksheet (Appendix A), was only presented to the experimental group. The DMLSQ was included with the DASH©–SV and HSRT post-test administered to participants three weeks after the experience.

Two hundred sixteen participants completed the DMLSQ. The data for the *Know Question* (*N* = 215, *M* =5.0, *SD* =1.3) depicts the scores for all participants, rating the perception that the participant will know what to do if encountering this clinical situation again and is comprised of both the experimental group (*N* = 111, *M* = 5.6, *SD* = 1.1) and the control group (*N* = 105, *M* = 4.3, *SD* = 1.2) on a 7-point scale (Appendix G).

The data for the *Worksheet Question* (*N* = 111, *M* = 4.7, *SD* = 1.4) depicts the scores for the participants in the experimental group only who used this tool. It rates the perception of the usefulness of this tool by the *participants* (Appendix G). Table 19 and Figure 4 report the detailed DMLSQ data.

The data for the *Reflection Question* (*N* = 216, *M* = 5.1, *SD* = 1.3) depicts the scores for all participants, rating the participant awareness of reflection in the pulse-less electrical activity patient scenario debriefing experience. This score is comprised of both the experimental group (*N* = 111, *M* = 5.8, *SD* = 1.1) and the control group (*N* = 105, *M* = 4.3, *SD* = 0.9) (described in Chapter III) on a 7-point scale (Appendix G).

Table 19

DMLSQ Descriptive Statistics

Elements	*N*		Min		Max		*M*		*SD*	
	E[a]	C[b]	E[a]	C[b]	E[a]	C[b]	E[a]	C[b]	E[a]	C[b]
Worksheet	111	105	1	0	7	0	4.7	.0	1.4	.0
Know	111	105	2	--	7	--	5.6	--	1.1	--
Reflection	111	105	2	2	7	6	5.8	4.3	1.1	.9

[a]Experimental. [b]Control.

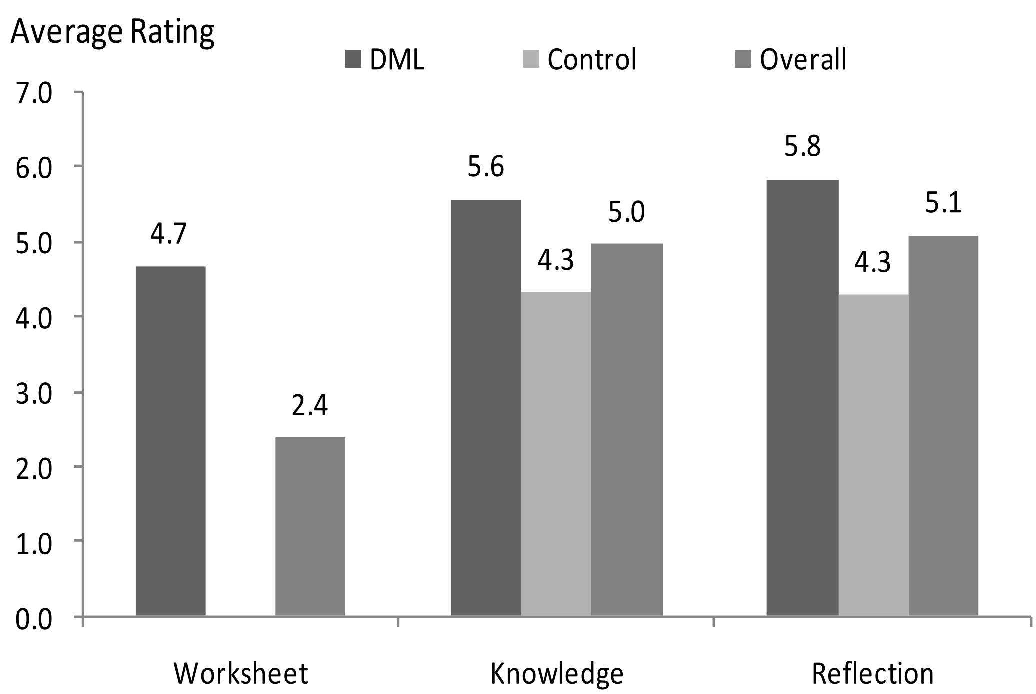


Figure 4. Distribution of DMLSQ Mean Scores.

Testing the Research Questions

Descriptive and inferential statistics were used to examine the three research questions in this study. To explore the first question, analysis of variance and then also analysis of covariance were used to compare the mean total HSRT pre-test and post-test scores as well as the variable of role between the experimental group receiving the DML intervention and the control group receiving usual and customary debriefing. The non-parametric

Mann-Whitney-Wilcoxon tests were used to compare the component scores and the change in total score on the HSRT between the experimental and control groups.

The second question also used the non-parametric Mann-Whitney-Wilcoxon tests to describe participants' perceptions of the quality of debriefing based on the DASH©–SV. The experimental group, which received the DML intervention, and the control group, receiving usual and customary debriefing, were compared. Additionally, the Kruskal-Wallis test used Chi-Square to determine the differences and variability in the elements on the DASH©–SV between the experimental and control groups. Finally, because the DML tools and strategies may influence this perception of quality debriefing, the non-parametric Mann-Whitney-Wilcoxon tests were also used to test the effect these elements (Worksheet, Know, Time, and Reflection) from the DMLSQ had on participant perception of quality debriefing.

Question 3 in this study asked about the correlation between the quality of debriefing as determined by the responses on the DASH©–SV and the DMLSQ to the change in clinical reasoning skills based on the HSRT scores. Simple Linear Regression Analysis with scatter plots was used to describe these trends and associations.

Research Question One

Question 1: Does the use of the DML debriefing strategy positively impact the development of clinical reasoning skills in undergraduate nursing students, as compared to usual and customary debriefing?

The total HSRT pre-test and post-test scores were compared between the experimental group that received the DML intervention and the control group receiving usual and customary debriefing. An analysis of variance showed that the effect of DML on the *total* HSRT scores was not significant: $F(1,238) = 2.40$, $p = .123$.

A Mann-Whitney-Wilcoxon test was conducted to evaluate the hypothesis that the experimental group receiving DML debriefing would have a greater positive change in post-test scores for the element components of the test (Inductive, Deductive, Analysis, Inference, and Evaluation) than the control group. The *Z* scores, however, were all negative and the *p* values for all of the elements were greater than .05 and no significant difference was established (Table 20).

Table 20

HSRT Element Scores

Pre-test Statistics					
Measure	Inductive	Deductive	Analysis	Inference	Evaluation
Mann-Whitney U	6721.500	6863.500	6336.000	6813.000	6475.500
Wilcoxon W	14224.500	14366.500	13839.000	14316.000	13978.500
Z	-.902	-.630	-1.644	-.743	-1.377
Asymp. Sig. (2-tailed)	367.000	.529	.100	.457	.168

(table continues)

Post-test Statistics					
Measure	Inductive	Deductive	Analysis	Inference	Evaluation
Mann-Whitney U	6784.500	6771.500	6654.500	6554.000	6908.500
Wilcoxon W	14287.500	13557.500	13440.500	13340.000	13694.500
Z	-.560	-.582	-.813	-1.021	-.324
Asymp. Sig. (2-tailed)	.575	.560	.416	.307	.746

Note. Grouping variable: Debriefing method.

Despite these results, there was however a visible difference between the HSRT pre-test and post-test mean scores and the change in those mean scores from pre-test to post-test (Table 21). To discern the statistical relevance of this difference, the relative difference between mean scores was calculated and a Mann-Whitney-Wilcoxon test was performed, U = 3973.5, W = 10759.5, Z = -6.059, p = 0.000, which was significant, indicating that there was an effect from the DML intervention (Table 21, Figure J6).

Table 21

HSRT Total Scores

Instrument	Measure	Sum of Squares	df	Mean Square	*F*	Sig.
Pre-test	Between Groups	74.206	1	74.206	2.399	.123
	Within Groups	7360.977	238	30.928		
	Total	7435.183	239			
Post-test	Between Groups	10.300	1	10.300	.361	.549
	Within Groups	6736.019	236	28.542		
	Total	6746.319	237			

Table 22

Change in HSRT Element Scores

Pre-test[a]	Inductive	Deductive	Analysis	Inference	Evaluation
Mann-Whitney U	6721.50	6863.50	6336.00	6813.00	6475.50
Wilcoxon W	14224.50	14366.50	13839.00	14316.00	13978.50
Z	0.902	-0.630	-1.644	-0.743	-1.377
Asymp. Sig. (2-tailed)	.367	.529	.100	.457	.168
Post-test[a]					
Mann-Whitney U	6784.50	6771.50	6654.50	6554.00	6908.50
Wilcoxon W	14287.50	13557.50	13440.50	13340.00	13694.50
Z	-0.560	-0.582	-0.813	-1.021	-0.324
Asymp. Sig. (2-tailed)	.575	.560	.416	.307	.746

[a]Grouping variable: Debriefing method.

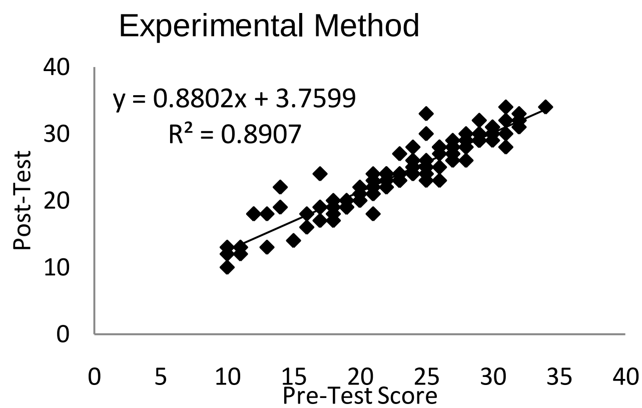
The results from these different tests were not clear, so an analysis of covariance (ANCOVA) was performed to control for the performance on the pre-test in order to demonstrate differences on the post-test between groups. In this model the pre-test is the covariate and the debriefing method and post-test mean scores are the dependent variables. The hypothesis was that when pre-test scores were accounted for there would be no difference in post-test scores for the experimental and control groups. An analysis of covariance showed that the test of between-subjects effect of DML on the *total* HSRT scores was now significant, $F(1, 237) = 28.55$, $p = <.05$, and the covariate was significantly related to the debriefing method: $F(1, 237) = 623.91$, $p = <.05$ with a large effect size of 0.84 (Table 23). This is interpreted to mean that given a pre-test score, a student debriefed using the DML intervention will have a better score on the post-test than a student debriefed using the control method of usual and customary debriefing. The scatter plots (Figure 5) and regression lines (Figure 6) confirm this relationship.

Table 23

HSRT Analysis of Covariance

Tests of Between-Subjects Effects (Before Covariate in Model)						
Source	Type III Sum of Squares	*df*	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	10.300[a]	1	10.30	.361	.55	.002
Intercept	137,901.846	1	137,901.84	4,831.46	.00	.953
Debriefing Method	10.300	1	10.300	.361	.54	.002
Error	6,736.019	236	28.542			
Total	144,796.0	238				
Corrected Total	6,746.319	237				
Tests of Between-Subjects Effects (With Covariate)						
Corrected Model	5677.149[b]	2	2,838.575	623.909	.000	.842
Intercept	108.044	1	108.044	23.748	.000	.092
HSRT_Pre_ TOTAL	5,666.849	1	5,666.849	1,245.554	.000	.841
Debrief_Method	129.910	1	129.910	28.554	.000	.108
Error	1,069.170	2	4.550			
Total	144,796.000	2				
Corrected Total	6,746.319	2				

Note. Dependent variable: HSRT post-test.
[a]R Squared = .002 (Adjusted R Squared = -.003). [b]R Squared = .842 (Adjusted R Squared = .840).



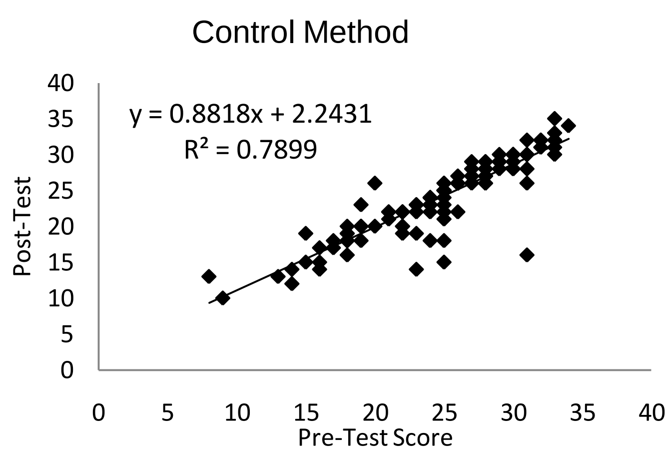


Figure 5. HSRT ANCOVA Scatter Plots

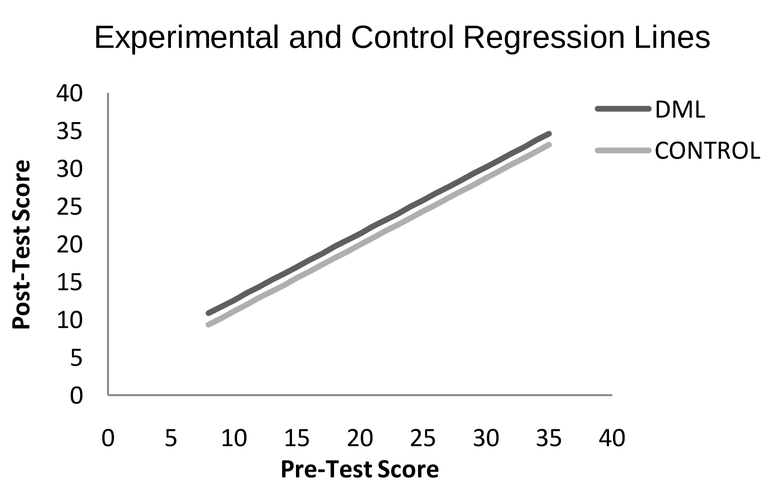


Figure 6. HSRT ANCOVA Regression Lines

Another variable was considered for this research question. Because experiencing the simulation and participating in the debriefing are interrelated components of the learning experience, the impact of role that the student assumed in the simulation, was considered as a variable. The hypothesis, based on the literature by Jeffries and Rizzolo (2006), was that students who function in a response-based role in simulation in which they are not an active participant—such as an observer or a recorder—will have no difference in learning outcomes when compared to students who perform in a process-based role where they are an active, decision-making participant.

Based on this definition, students who functioned in the nurse role as the primary nurse, the second nurse, or the charge nurse role for the pulse-less electrical activity patient scenario simulation were grouped together (group 1). Students who functioned in the response-role of family member or as the recorder/observer were also grouped together (group 2). The role that the student assumed during the simulation was compared to HSRT mean scores using analysis of variance for pre-test and post-test to see if different learning occurred based on this role.

The data from the experimental group pre-test, $F(1, 120) = 1.42$, $p = 0.24$, and the post-test, $F(1, 120) = 1.30$, $p = 0.26$, was compared to the data from the control group pre-test, $F(1, 114) = 1.39$, $p = 0.24$, and the post-test, $F(1, 114) = 1.28$, $p = 0.26$. Therefore, no significant difference was found for the role assumed by the student in either the experimental or the control groups and the hypothesis is rejected (Table 24). The role that the student assumed during the simulation did not significantly impact meaningful learning demonstrated through a change in clinical reasoning.

Table 24

Role Effect on HSRT Total Scores

HSRT	Role		*N*		*M*		*SD*	
Pre-test	DML	C[a]	DML	C	DML	C	DML	C
	1	1	73	71	22.808	24.056	6.1501	5.5572
	2	2	49	45	24.061	25.267	4.9515	5.0919
Post-test	1	1	73	71	23.836	23.423	5.8405	5.3256
	2	2	49	45	24.959	24.578	4.4533	5.3703

[a]C = Control.

HSRT	DML	Sum of Sq.		df		Mean Sq.		F		Sig.	
		DML	C[a]	DML	C	DML	C	DML	C	DML	C
Pre-test	Between[b]	46.033	40.348	1	1	46.033	40.348	1.416	1.393	.236	.240
	Within	3900.131	3302.575	120	114	32.501	28.970				
Post-test	Between	37.013	36.759	1	1	37.013	36.759	1.303	1.288	.256	.259
	Within	3407.946	3254.302	120	114	28.400	28.547				

[a]C = Control. [b]Between groups/within groups.

Further analysis of the effect of role was performed by comparing role group impact on HSRT elements. A Mann-Whitney-Wilcoxon test was conducted to evaluate the hypothesis that the role a participant played would have no impact on the change in the HSRT element (Inductive, Deductive, Analysis, Inference, and Evaluation) scores (from pre-test to post-test) for either the experimental or control group. The Z scores were all negative and the p values for all of the elements were greater than .05 indicating that the hypothesis is accepted and role did not create a significant difference for either the experimental or control group (Table 25).

The effect of role on the change in total mean HSRT scores was also explored. A Mann-Whitney-Wilcoxon test was performed. This is a nonparametric test denoted by Z that is used to determine if a difference exists between two groups. The hypothesis was that there is no difference in mean scores. The data for the experimental group, $Z = -.33$, $p = .74$, and the control group, $Z = -1.10$, $p = .27$, demonstrate no significant difference on the change in HSRT mean scores for either the experimental or control groups and the hypothesis is accepted (Table 26).

Table 25

Role Effect on HSRT Element Scores

Element	Inductive		Deductive		Analysis		Inference		Evaluation	
	Pre[a]	Post[b]	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Mann-Whitney U	1740.50	1714.00	1588.50	1733.00	1638.500	1732.000	1616.500	1425.500	1636.500	1700.000
Wilcoxon W	4441.50	4415.00	4289.50	4434.00	4339.500	4433.000	4317.500	4126.500	4337.500	4401.000
Z	-.255	-.397	-1.059	-.294	-.802	-.303	-.934	-1.959	-.812	-.475
Asymp. Sig. (2-tailed)	.799	.692	.290	.768	.422	.762	.350	.050	.417	.635

Note. Grouping variable: Role-group.
[a]Pre = Pre-test. [b]Post = Post-test.

Table 26

Role Effect on Change in HSRT Total Scores

Measure	HSRT Change	Change Total
Mann-Whitney U	1727.500	1411.500
Wilcoxon W	2952.500	2446.500
Z	-0.330	-1.1010
Asymp. Sig. (2-tailed)	0.742	0.271

Note. Grouping variable: Role-group.

In conclusion, the analysis of Question One has mixed results. There was no statistical difference between the experimental and control HSRT data, including review of the element scores and role played in the simulation experience, except when *change* in total score was compared where a statistical difference was evident. The hypothesis that the DML intervention strategy positively effects the development of clinical reasoning skills cannot be completely accepted.

Research Question Two

Question 2: Do nursing students perceive a difference in the quality of debriefing when the DML strategy is used compared to usual and customary debriefing?

The second research question examined the results of the DASH©–SV and the DMLSQ. The DASH©–SV is a 6-element instrument that is derived from the DASH©. The DASH© is an instrument created to guide the evaluation of debriefing. It "assesses the evidenced and theoretically sound instructor/facilitator behaviors that facilitate learning and change in experiential contexts" (Simon et al., 2009, p. 3). Both the DASH© and DASH©–SV use a "behaviorally anchored rating scale that describes and reflects the six key elements describing behaviors necessary to execute an effective debriefing" (Simon et al., 2009, p. 3). These include assessing the ability of the debriefing facilitator to achieve the following elements:

1. Establishes an engaging learning environment.
2. Maintains an engaging learning environment.

3. Structures debriefing in an organized way.

4. Structures debriefing in an organized way.

5. Provokes engaging discussions.

6. Identifies and explores performance gaps.

7. Helps simulation participants achieve or sustain good practice. (Simon et al., 2009, p. 3)

Elements are high-level concepts that describe a whole area or concept of debriefing behavior. Each element also includes dimensions that are parts of elements used to describe parts of the element. Examples are also provided as further explanation for the rater using the tool (Appendix E). Raters score each element using their best judgment of the extent to which the debriefing facilitator demonstrated the element as a whole. A 7-point *effectiveness scale* (R. Simon, personal communication, February 16, 2010) is used to capture the rater's assessment (Appendix E).

The DMLSQ also asked about the quality of the debriefing. Specifically, participants were asked the extent to which the worksheet was useful (experimental group only), their perception of their knowledge of how to respond the next time they encounter a patient with pulse-less electrical activity, their perception of the amount of time allotted for this debriefing, and their perception of the presence of reflective thinking in the simulation and debriefing. A 7-point Likert scale was used to record responses (Appendix E).

Statistical analysis for this research question used non-parametric tests, necessary because this data did not demonstrate normality. A Mann-Whitney-Wilcoxon test again was used to evaluate the hypothesis that there would be no difference in mean scores on the DASH©–SV when comparing the experimental group who received the DML intervention and the control group receiving usual and customary debriefing. The *Z*-values for each of the mean scores from the six elements measured by the DASH©–SV and the four questions from the DMLSQ are significant with $p < .05$ (Table 27). The mean aggregate DASH©–SV score was also significant, $Z = -11.99$, $p = < .001$ (Table 27, Figure J7). This demonstrates that there is a difference between the experimental and control groups and the hypothesis is rejected.

Table 27

Analysis of DASH©–SV and DMLSQ Scores

Measure	Work-sheet	Know	Time	Reflection	D-1[a]	D-2	D-3	D-4	D-5	D-6	Mean DASH
Mann-Whitney U	.00	2594.50	3769.50	1605.00	3913.50	2523.00	630.00	1150.50	2349.00	657.00	334.00
Wilcox-on W	5565.00	8159.50	10555.50	7170.00	9478.50	8088.00	6195.00	6715.50	7914.00	6222.00	5899.00
Z	-13.52	-7.23	-6.66	-9.45	-4.35	-7.51	11.64	10.58	-8.00	-11.55	-11.99
Asymp. Sig. (2-tailed)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

Note. Grouping variable: Debriefing method.
[a]D- = DASH

A second analysis compared mean scores from the experimental and control groups using the DASH©–SV and the DMLSQ data. Mean scores for the experimental group who received the DML intervention were higher for all of the items in both instruments than the control group who received usual and customary debriefing (Table 28, Figure J8). The Kruskal-Wallis was used to test the equality of medians for the DASH©–SV elements. This non-parametric test, denoted by *H,* is an alternative to the independent group ANOVA when the assumption of normality or equality of variance is not met. It is used to compare three or more independent groups of sampled data. The hypothesis that no difference between the means of the elements from the experimental and control groups exists, was tested. The experimental group, $H(5, n = 122) = 234.3$, $p = < .001$, and the control group, $H(5, n = 116) = 36.65$, $p = < .001$, indicate that there is evidence of a significant difference between groups for the DASH©–SV elements and the hypothesis is rejected. The experimental group also demonstrated higher variability in mean scores (Table 28, Figure J9).

Table 28

Comparison of DASH©–SV and DMLSQ

Measure	Score Between Groups	
	DML[a]	Control[b]
Chi-Square	234.370	36.651
df	5	5
Asymp. Sig.	.000	.000

Note. Kruskal Wallis Test
[a]Grouping variable DASH element DML. [b]Grouping variable: DASH element control

Research Question Three

Question 3: Is there a correlation between the quality of debriefing as evaluated by nursing students and a change in clinical reasoning skills? The third research question examined the relationships between the HSRT, the DASH©–SV, and the DMLSQ. The purpose of this step in the analysis was to test the hypothesis that there is an association between changes in the quality of debriefing that also can be explained by changes in participants' reasoning skills. This question addresses the relationship between teaching and learning.

Based on the results from the first research question, the change in HSRT mean scores was used as the predictor variable for this third question, and each of the elements from DASH©–SV, including the aggregate score, and each of the DMLSQ were outcome variables in the regression analysis.

Simple linear regression was used to determine the linear relationship between predictor and outcome variables. The hypothesis for this analysis was that there is no linear relationship between the predictor variable and each of the outcome variables. To analyze the data for this question, eleven simple regression models were developed, one for each item on the DMLSQ and each element on the DASH©–SV: (a) *Worksheet*, $t(1, 108) = .60$, $p = .439$, and (b) DASH©–SV Element 1, $t(1, 214) = .684$, $p = .409$, were not statistically significant; however, (c) *Knowledge*, $t(1, 108) = 30.99$, $p =< .05$, (d) *Time*, $t(1, 236) = 3.94$, $p = .048$, (e) *Reflection*, $t(1, 214) = 38.82$, $p = .010$, (f) DASH©–SV Element 2, $t(1, 214) = 9.53$, $p = .002$, (g) DASH©–SV Element 3, $t(1, 214) = 10.95$, $p =< .001$, (h) DASH©–SV Element 4: $t(1, 214) = 18.74$, *p* < .05, (i) DASH©–SV Element 5: *t*(1, 214) = 3.59, *p* = .059, (j) DASH©–SV Element 6, *t*(1, 214) = 8.76, *p* =.003, and (k) the DASH©–SV Aggregate Total Score, *t*(1, 214) = 14.36, *p* =< .001 were statistically significant and the regression lines support these interpretations (Appendix I).

Table 25 summarizes the simple regression analysis results. These findings indicate that student perception of changes in the quality of debriefing can be explained by changes in reasoning skills measured by the change in HSRT scores from pre-test to post-test. The hypothesis for each of the outcome variables, except *Worksheet* and *Dash Element 1,* is rejected.

Table 29

Regression Analysis Results

Dependent Variable	R2 (effect size)	Regression *p*-value
DMLSQ Worksheet	.006	.439
DMLSQ Knowledge	.026	.017
DMLSQ Time	.016	.048
DMLSQ Reflection	.031	.010
DASH©–SV Element 1	.003	.409
DASH©–SV Element 2	.043	.002
DASH©–SV Element 3	.049	.001
DASH©–SV Element 4	.081	.000
DASH©–SV Element 5	.017	.059
DASH©–SV Element 6	.039	.003
DASH©–SV Total (Aggregate)	.063	.000

Note. Independent variable: HSRT change

Additional Analyses

There is additional data from the DASH©–SV and the DMLSQ that has not yet been accounted for. Each of the elements in the DASH©–SV and each question in the DMLSQ offered an opportunity for the study participant to comment in a free-text format. The comment option was included following feedback from focus groups that were utilized in the development phase of the DASH©–SV and the DASH© (R. Simon, personal communication, March 3, 2009).

During the focus groups, participants offered many comments relevant to their thinking about the score they gave on the elements, which added insight and information to the quantitative data. As a result, participants were offered the option of providing free-text comments with the six DASH©–SV elements and four DMLSQ items on the post-test.

Sixty-four percent of the 238 total participants provided at least one free-text comment (*N* = 153). Seventy-nine percent of those participants who commented were from the experimental group (*N* = 120) and 21% were from the control group (*N* = 33). It is noteworthy that the total sample size for the experimental group is 122 participants and 120 of them provided free-text comments.

There were 844 total comments and 55% included more than 4 sentences in the response. Elements 1 and 4 from the DASH©–SV received the most comments. The questions about worksheet and time received the most comments on the DMLSQ.

Element 1 on the DASH©–SV states, “the instructor sets the stage for an engaging learning environment before the simulation takes place” (Appendix E). There were a variety of comments related to this element but the most consistency regarded the idea that students from both the experimental and control groups perceived the simulation experience as a *performance* where they were being judged, rather than a learning environment where they could experiment with different options and outcomes. More than half of the comments mentioned that the instructor said "simulation is a safe learning environment," but that it was difficult to feel safe there.

Element 4 on the DASH©–SV states, "the debriefer provokes engaging discussions that lead me to reflect on my performance." There was a range of free-text responses to this question; however, 100 of the respondents from the experimental group addressed this question and 100% were favorable responses. Those comments contained a consistent thread—asking for additional opportunities to discuss patient care situations in a similar format to the DML debriefing strategy.

There were 62 comments regarding the worksheet from study participants in the experimental group. About half commented favorably on it and half negatively. Fifteen participants commented that during the debriefing they did not find the worksheet useful but thought differently about it when they went back to study the concepts for an exam several weeks after the simulation experience.

The amount of time allotted for debriefing also received significant comments from participants in both the experimental and control groups. Eighty-one students commented on this topic and 54 went into detail about how the value of time is related to the learning that is occurring, their engagement in the situation, and the relevance of the topic. Half of the comments suggested more time be available for debriefing when a specific structure and/or learning objectives are used, and half the comments suggested less time or no time for debriefing if the primary purpose was to critique student performance.

The intent of providing an opportunity for participants to comment in free-text following the DASH©–SV elements and DMLSQ items was to capture information relevant to their thinking about their score. These responses added insight and information to the quantitative data. The rate of return on the open-ended questions was much greater than anticipated. The comments were also more comprehensive and lengthy than foreseen in the study design.

Summary

In this chapter, the plan for data analysis was provided. A description of the instruments (the HSRT, the DASH©–SV, and the DMLSQ) and the analysis of the data derived from them was given. Each of the three research questions was addressed.

Results from the first question revealed that there was no significant difference between the experimental and control groups for total or item scores on the HSRT that measured clinical reasoning skills in undergraduate nursing students. The role a student played in the simulation also had no significant effect for either the experimental or control group. There was, however, a significant difference in the change in scores between the pre-test and the post-test between the experimental and control groups.

The findings from the second question demonstrated that there was evidence of a significant difference between the experimental and control methods of debriefing on all of the variables from both the DASH©–SV and the

DMLSQ. There appears to be evidence that students do perceive a difference in the quality of debriefing between the DML strategy and usual and customary debriefing.

The conclusions from the third question that explored the correlation between students' perception of the quality of debriefing and a change in clinical reasoning skills were not consistent. There was evidence to support a correlation between these two concepts with all the variables tested except for the worksheet and the first element in the DASH©–SV related to the presetting of the stage for an engaging learning environment by the course instructor (not the debriefing facilitator) before the simulation takes place. Both of these two variables were particularly addressed in the free-text comments by participants from both the experimental and control groups.

The next chapter will summarize and discuss these findings in the context of simulation learning nursing education and provide implications for nursing education.

Chapter V Summary, Discussion, and Conclusions

Chapter V consists of a summary of this study, a discussion of the findings, an overview of the limitations, the implications for nursing education, and recommendations for further research. The intent of this chapter is to further explain the findings and to relate them to prior and future research in simulation learning, within the context of nursing education.

Summary

The purpose of this study was to describe the relationship and test the effect of a faculty-facilitated, guided reflection, debriefing strategy on the development of clinical judgment and clinical reasoning skills of undergraduate nursing students. Debriefing has been identified as a critical component of simulation learning yet little research is available to describe best debriefing practices within the discipline and context of nursing and nursing education.

The DML strategy was developed and tested in this research study. This strategy supports critical thinking, complex decision-making, and clinical reasoning as anticipated and desired outcomes in new graduates and practicing nurses. The DML strategy addresses the effective and efficient use of simulation pedagogy in nursing education by highlighting the role of debriefing to teach and facilitate reflective thinking skills.

The DML model (Figure 1) includes the elements of simulation learning: clinical context and client story; nursing process, knowledge, skills, and attitudes; thinking-in-action, thinking-on-action, and thinking-beyond-action; and facilitated debriefing to enhance clinical reasoning in student nurses through meaningful learning. Debriefing using DML combines theoretical and conceptual elements from constructivism, models of reflection described by Gibbs et al. (1988), and a framework for significant learning articulated by Fink (2003) with the E–5 framework for effective teaching (Bybee et al., 1989) in its design.

Despite the rising use of simulation pedagogy, nursing faculty are not consistently prepared to use this cutting edge teaching modality effectively (Jeffries, 2005) and frequently report a lack of preparation for the facilitator role (Dreifuerst, 2009). The DML strategy addresses this by providing faculty with a process and student tools to facilitate debriefing and reflective learning.

This study looked at three questions. The first asked, “Does the DML debriefing strategy have a positive effect on the development of clinical reasoning skills in undergraduate nursing students as compared to usual and customary debriefing?” The results to this question demonstrated no significant difference between the experimental and control groups for total or item scores on the HSRT that measured clinical reasoning skills in undergraduate nursing students. There was, however, a significant difference in the change in scores between the pre-test and the post-test between the experimental and control groups.

The second question inquired if nursing students perceive a difference in the quality of debriefing when the DML strategy is used compared to usual and customary debriefing? Results from the DASH©–SV and the DMLSQ questions demonstrated that there was evidence of a significant difference between the experimental group that used DML debriefing strategies and the control group that used usual and customary debriefing strategies, in all of the variables from both the DASH©–SV and the DMLSQ. There appeared to be evidence that students did perceive a difference in the quality of debriefing between the two debriefing methods.

A third and final question in this study addressed the relationships between the results of the different instruments and asked, “Is there a correlation between the quality of debriefing as evaluated by nursing students and a change in clinical reasoning skills?” Regression analysis found that there was evidence to support a correlation between these two concepts with all the variables tested, except for the student worksheet tool used in the DML strategy and one element in the DASH©–SV regarding the establishment of a learning environment by the course instructor (not the debriefer) prior to simulation. Each of these two variables received a significant number of free-text comments by participants from both the experimental and control groups.

Discussion

The goal of nursing curriculum and learning activities is to not only impart knowledge, skills, and attitudes but also integrate these contextually in the clinical setting so students can apply them to patient care. This patient care involves clinical reasoning. While critical thinking, clinical reasoning, and clinical decision-making in nursing have been studied extensively (Barrows & Pickell, 1991; Bowle, 2000; Day & Williams, 2002; del Bueno, 2005; Harjai & Tiwari, 2009; Pesut, 2004; Pesut & Herman, 1999; Pless & Clayton,1993; Tanner, 2006), there are only a few studies that looked at these concepts related to simulation learning (Childs & Sepples, 2006; Kuiper, 2008; Lasater, 2007a; Ravert, 2008).

The goal of this study was to develop and test a reflective debriefing strategy for simulation, DML, that would foster meaningful learning in students, represented by a change in clinical reasoning skills. Three questions were used to test the impact of DML on clinical reasoning.

The first question, “Does the use of the DML debriefing strategy positively influence the development of clinical reasoning skills in undergraduate nursing students as compared to usual and customary debriefing?” was an important initial step. Teaching-learning strategies need to be evaluated for their effectiveness, especially new techniques. This question measured the impact of DML using the HSRT (Facione & Facione, 2006), an instrument that measures clinical reasoning. The findings from this question revealed a significant difference in scores for the experimental and control groups, and a significant difference in the change in scores from pre-test to post-test between groups, demonstrating that use of the DML debriefing strategy impacts development of clinical reasoning skills by student nurses as measured by this tool.

This is important because it represents the incremental impact of learning by students from one debriefing intervention. The DML intervention did not teach students the content on the HSRT test, or how to take the test, but rather how to think about clinical information and decision-making within the context of simulated patient care. By actively modeling reflection-in-action, reflection-on-action, and reflection-beyond-action, the student not only debriefs the clinical experience but also anticipates how to use this knowledge and information in other clinical contexts and builds clinical reasoning skills.

The outcomes of this research question suggest that there was a difference in the change in clinical reasoning between the experimental and control groups. The positive change in the experimental group is explained by the intervention; what is difficult to understand is the negative change in the control group. One possible explanation is that students in the control group became confused or less confident in their decisions.

This is not uncommon in nursing education. Beers (2005), Johnson and Mighten (2005), and Eley (2006), review the phenomenon of student's having success on formative (interval tests) and not on summative, midterm, or final exams that many nurse educators have experienced and wondered about. Often it is attributed to a lack of true understanding of the material and an ability to apply it consistently. In this research study, the two versions of the HSRT used for the pre-test and post-test are similar enough in design, and clinical context, that it is anticipated that test takers minimally demonstrate consistency in reasoning skills (Facione & Facione, 2006).

Another possible reason for the difference in scores between the experimental and control groups could be the confounding variable of the debriefer. Paget (2001), notes that "the important role played by the facilitator of reflective practice cannot be underestimated". "Many factors contribute to the influence of the debriefer including: personality, style, knowledge, familiarity, perception of effectiveness, and development of relationship with participants" (p. 206).

Most importantly, there was a statistically significant, positive change in scores demonstrated by the experimental group despite the fact that the study design involved only one intervention. The literature on learning offers two possible explanations. The DML strategy may have been either so innovative that it stimulated learning and adoption, or so credible that it affirmed how students were already reasoning and supported their ability to be confident in how they reason through clinical situations (Beers & Bowden, 2007). Clearly though, the education literature supports a model of repetitiveness and continually building new content on foundational lessons. For these reasons, the sustainability of the learning from DML cannot be determined or surmised from these results and those questions are beyond the scope of this study.

The second question, "Do nursing students perceive a difference in the quality of debriefing when the DML strategy was used, compared to usual and customary debriefing, is another important consideration?" The DASH©–SV measured student opinion of the merit of the debriefing they experienced. Students often evaluate teaching (Fardanesh, 2002). It is a common piece of the educational environment. In this study, the elements in the DASH©–SV represent best practices in debriefing (Rudolf, Simon, Dufresne, & Raemer, 2007). Traditionally, teaching effectiveness is defined by the instructor's degree of success in facilitating student learning (Fink, 2003; Richardson, 1997) and also by how positively the students' perceive the teaching/teacher. The DASH©–SV is a comprehensive tool that gives students seven scoring options along an effectiveness scale to represent their assessment of the debriefer and debriefing experience in six elements. Because each element includes detailed descriptors, there is clarity even with elements that appear to overlap each other. What is not able to be discerned is the impact of a halo effect as a confounding variable because the investigator was delivering the intervention. This is always a concern in research where there is an overlap between the researcher and the intervention since subjects' perceptions of the researcher can impact the results and interfere with construct validity (Shadish, Cook, & Campbell, 2002).

A second set of items also address this research question. The DMLSQ were questions developed specifically to ask students about their perceptions of elements of the DML. When faculty creates or utilizes new teaching strategies, it is common to ask for student feedback (Onwuegbuzie et al., 2007)

Participants in experimental group rated the DASH©–SV and the DMLSQ items higher than those in the control group rated them. These are also important findings. Scores for the experimental method of debriefing were higher for all items from both tools. This not only provides support for the effectiveness of the debriefing method but also demonstrates that students perceived consistently high quality from the DML debriefing through all data collection times.

Each of the elements of the DASH©–SV were rated significantly higher in the experimental group than the control. This lends support for DML effectiveness as a teaching strategy. A positive learning environment is a goal of educators (Mayer, 2002). Further, good debriefing enhances learning from simulation (Rudolf et al., 2007). Evidence-based faculty resources for debriefing are scarce and in demand as simulation use expands in schools of nursing. Educators are particularly interested in tools and strategies that have positive student response.

The data from the DMLSQ also demonstrates that reflection, a central component of DML, was significantly more evident to the students in the experimental group than those in the control group. Reflection and reflective learning are not consistently demonstrated by students, and strategies that support these traits are particularly desirable (Harjai & Tiwari, 2009; Horton-Deutsch & Sherwood, 2008). This is especially true for student nurses who need to learn not only knowledge, skills, and attitudes but also how to think-like-a-nurse (Tanner, 2006). Clinical reasoning and critical thinking are elements of that thinking which can be enhanced through reflection-in-action, reflection-on-action, and reflection-beyond-action (Dreifuerst, 2009; Schön, 1983).

The third question, “Is there a correlation between the quality of debriefing as evaluated by nursing students and a change in clinical reasoning skills?” follows the first two by combining them. It is another critical piece of information for evaluating and understanding the effect of DML on development of clinical reasoning and its impact as a teaching-learning strategy. The data demonstrate that the students’ determination of quality debriefing using the DASH©–SV and

DMLSQ were explained by changes in clinical reasoning skills on the HSRT for all but two of the ten quality items.

Consistency between perception of a positive learning environment by students and demonstration of positive learning is the essence of teaching and embodies the significant learning experience described by Fink (2003). Consistency is also a goal of simulation learning (Forneris & Peden-McAlpine, 2006).

There are two items that were not significant on the DASH©–SV and DMLSQ: the first element addresses the way the instructor sets the stage for simulation and creates a safe learning environment, and the second is the item related to the usefulness of the worksheet. These were both addressed extensively in free-text comments by students from both the experimental and control groups. The former involves the course instructor in this study and not the debriefer or the DML strategy. Students commented heavily on the perception that simulation was not a safe learning environment but rather a stage on which they were expected to perform.

More than 10 students from the experimental group noted in the free-text comments that this was dispelled through debriefing. No participants from the control group made that acknowledgement. Clearly more information is needed to make further assumptions but this is an area of concern since creating a safe learning environment is a principle tenant of simulation pedagogy (Dismukes et al., 2006; Jeffries, 2006; Rudolf et al., 2006).

The worksheet used in DML also had a mixed response from students in the experimental group. The worksheet is intended to provide structure for the debriefing, a visual representation of relationships between concepts for students, and a place to organize the reflections and discussion during debriefing. It is not surprising that some students did not find it useful. Students gravitate toward different tools and structures to organize their learning (Johnson & Mighten, 2005).

It is, however, noteworthy that five students commented on the worksheets in the free-text noting that while they did not score the usefulness in debriefing high, they found the worksheets useful days later when they were studying for an exam. One student noted that although the worksheet seemed cumbersome during debriefing, it was useful to think about during clinical the following week when encountering an unfamiliar patient situation. This comment represents the essence of thinking-on-action and thinking-beyond-action and demonstrates a successful learning strategy and tool.

The results from each of the research questions support continued use and evaluation of the DML strategy in simulation. Further development, evaluation, and testing of this debriefing method might address the inconsistent outcomes and enhance its usefulness across settings in nursing education where simulation learning is utilized.

Implications for Nursing Education

As nursing education continues to experience calls for reform, three areas are particularly relevant: (a) a renewed focus on the importance of developing foundational critical thinking, clinical reasoning, and clinical decision-making skills in students that will transfer into practice; (b) expanded use of different pedagogies that incorporate advancing technology; and (c) faculty resources to integrate both of these into the curriculum.

The DML model and simulation debriefing strategy addresses each of these. The literature supports problem-based, experiential learning strategies to foster critical thinking, clinical reasoning, and clinical decision-making in students. Simulation learning, when comprehensively crafted to encompass the elements of DML (patient story and clinical context; nursing process, knowledge, skills, and attitudes; opportunities for thinking-in-action, thinking-on-action, and thinking-beyond-action; and use of facilitated debriefing process) can address each of these needs. This is a shift away from simulations that are focused on a-contextual task-training and skill-development and calls upon faculty to actively teach thinking skills with the same vigor as patient care skills.

Concurrently, debriefing as a component of simulation needs to be re-conceptualized and reconnected to the learning process. It cannot be assumed that nursing faculty know how to debrief in a manner that fosters meaningful learning or that open-ended dialog involving evaluation and critique of the simulation is effective. With increased use of simulation technology and the recognition of the importance of debriefing to simulation learning, faculty development in this area is essential. Additionally, availability of student resources to link the delivery of patient care in simulation to debriefing is important to meet the differing learning needs of students and to foster reflection at a later time. Development of tools like the DML Student Worksheet (Appendix A) and the E–6 DML *Faculty Guide* (Appendix B) are examples of essential resources.

The DML model and strategy were developed to address the need to actively develop clinical reasoning skills in students that would transfer into practice. Integrated with simulation, an advancing technology for teaching nursing, DML fosters meaningful learning through experiential learning within the clinical context. It provides faculty and student resources to facilitate the debriefing process. While the outcomes from this research were mixed, this study lays the foundation for future research in this area.

Limitations

Several limitations were identified within this study. As noted in the review of literature, it was challenging to find quantitative, objective instruments that measure clinical reasoning in nursing students. The HSRT, while intended for assessment of healthcare professionals, is not specific to the discipline of nursing. As a result, the items in the instrument may not measure change in reasoning in nursing students experiencing a clinically contextual, problem-based, experiential situation that calls for thinking-like-a-nurse.

Additionally, this tool may not be specific enough to measure incremental change in reasoning skills after a single intervention but rather development of reasoning for healthcare situations in general, over a period of time. Finally, the theoretical foundation of the tool is grounded in the historical context of assessing critical thinking. While many of the questions do assess clinical reasoning, others appear to focus instead on critical thinking and may not measure the intended variable thoroughly. Another limitation to the use of this instrument is cost. There is a fee charged per use.

A second limitation in this study was selection bias. Students were not able to be randomized completely to the control or experimental groups; simulation experiences at the university where this study was conducted are scheduled by clinical group cohorts. There were likely to be differences in students assigned to each group that could not be accounted for. In the first and second semesters of data collection, not all of the cohorts were invited to participate, further limiting the sampling process.

Finally, the ability to generalize the process and outcomes from this study may not be possible in other schools of nursing or with other nursing students. Students volunteered to participate in this research, and those who declined to participate may be different than those who accepted. Also, the DML method uses both Socratic dialog to facilitate student engagement in the debriefing and the student worksheets, incorporating the nursing process as a visual representation of thinking-like-a nurse. Students in this study were familiar with both of these types of teaching strategies prior to the debriefing. Students from other schools who are unfamiliar with these may find this problem-based, experiential teaching and learning strategy challenging and difficult to understand without background preparation with it. Furthermore, the debriefing facilitator in this study designed the tools and process and is very comfortable with teaching using the Socratic dialog method; other facilitators who are not as familiar with this teaching style may have different results. Also, it is not clear if student perceptions of the quality of debriefing were due to the debriefing strategy or the debriefer.

Recommendations for Further Research

The goal of this study was to develop and test a simulation debriefing strategy to be used in nursing education. Future research in this area is needed. Several recommendations for future work can be derived from this work. The first is in the design. This study used a single school of nursing for participant recruitment and a single simulation experience for the intervention. A multi-site, repeated measures design over a longer period of time would add breadth and depth to the information that has been gathered thus far. Learning clinical reasoning skills may be enhanced with multiple interventions and multiple facilitators involving several simulation experiences. Time to understand, apply, and evaluate developing clinical reasoning skills might yield different results.

Disseminating the DML strategy will be necessary to ensure further use. Repeating this study using other debriefers trained to use DML might eliminate individual faculty characteristics and the unintended halo effect that could be a confounding variable. It would also allow for DML use to become more standardized.

Another recommendation is consideration of the measurement tools. The instruments used in this study were the HSRT (Facione & Facione, 2006), the DASH©–SV, and DMLSQ—questions created specifically about the process and tools used for the intervention. A tool other than the HSRT may measure clinical reasoning within the discipline of nursing with greater specificity and also may be more sensitive to change resulting from this type of intervention.

The DASH©–SV was a good choice for this study. In the future it would be important to use the DASH© where peer faculty evaluate debriefing concurrently with the DASH©–SV and correlate the results. This would not only validate the assessment of debriefing from both the perspective of faculty and students, it would add strength to the evaluation of the debriefing intervention and development of faculty skills. Further, this data could help to determine if the perceptions of the quality of debriefing were the result of the debriefing strategy or the debriefer. This information also would contribute to the validity and reliability findings of both tools.

Conclusion

The findings from this research study contribute to the work of previous researchers in the area of simulation learning in nursing education. They expand on previous work describing teaching interventions to facilitate critical thinking and clinical reasoning as well as best practices for simulation learning. This investigation revealed that the use of a debriefing strategy that used a consistent process for reviewing the simulation experience which incorporated concept mapping and emphasized reflection contributes to the development of clinical reasoning skills in undergraduate nursing students. It also revealed that students identify differences in the quality in debriefing and that meaningful learning, evidenced by change in clinical reasoning skills, is related to that perception.

In conclusion, despite the limitations, this study uncovered useful information about simulation debriefing and student nurses' development of clinical reasoning skills. It contributes to the growing body of knowledge supporting the use of simulation learning in nursing education and the development of best teaching practices.

Appendix A Debriefing for Meaningful Learning Student Worksheet

DML Student Worksheet

1. What is the first thing that comes to mind about the simulation experience?	2. What went right and why?	3. What would you do differently and why?

Framing: (What is the client's story?)

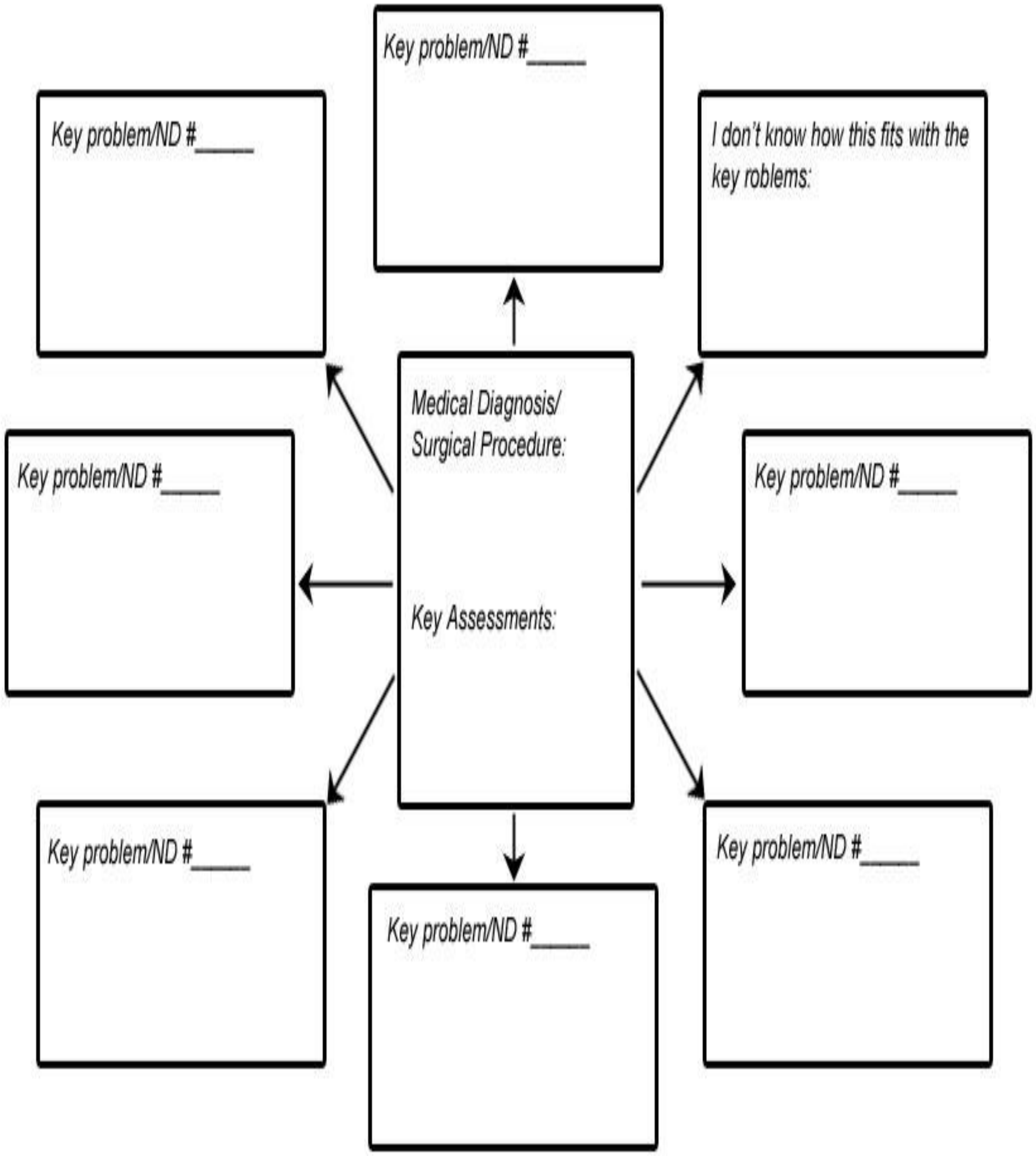
Focused Key Problem/ND:

Problem # ___________:
General Goal:

Desired Client Outcome:

Nursing Inteventions:	Associated Client Responses:

Evaluation and Summary of Client Progress Toward Desired Outcome:


Key problem/ND #_____
Key problem/ND #_____
I don't know how this fits with the key roblems:
Medical Diagnosis/ Surgical Procedure:
Key Assessments:
Key problem/ND #_____
Key problem/ND #_____
Key problem/ND #_____
Key problem/ND #_____
Key problem/ND #_____

Reflective Thinking

Thinking-in-Action

Thinking-on-Action

Thinking-beyond-Action

Appendix B E–6 Debriefing for Meaningful Learning Faculty Guide

Engage

A. **A**nticipate client care priorities before the simulation experience based on the “brief” including preparation materials. **A**fter simulation, begin with welcome to debriefing and introduce students to the worksheets and guidelines for discussion. **B**egin with the initial concepts of emotion and self-reflection.

Evaluate

B. **B**reak down the clinical scenario as individuals and also a clinical group: Evaluate “What happened?” and “What comes to your mind as you think about the experience you just had?” (Links Thinking-in-Action with the patient story and frames the cues within the clinical context).

C. **C**ritique the clinical scenario as individual participants using the student tool and as a clinical group through discussion. Guided Reflection is based on open-ended questions addressed to each student: “What went well? “What would you do differently and why?” Make visible consensus as well as disagreement (Thinking-on-Action).

Explore

D. **D**iscuss/Debrief and review the experience from each participant’s perspective and the faculty involved (Guided Reflective Thinking). Use the concept mapping strategy to visually represent nursing assessments and decision-making points.

Explain & Elaborate

E. **E**xperience (of the simulation) is integrated into the nursing process using the DML concept mapping tools based on Schuster's format (Schuster, 2008). Assessment and actions are linked to patient response and outcomes. Audiovisual review of the simulation may be included but is not required. Prior student knowledge is made explicit and tacit knowledge is recognized through dialog and discussion. Knowledge, skills, and attitudes are reviewed contextually as the worksheets are completed. Students are guided into praxis through discussion and reflection to provide a frame for meaningful learning and assimilation (Thinking-on Action).

Extend

F. **F**rame the clinical situation differently. Anticipate (Thinking-Beyond-Action) how the cues, assessment data, and client clinical responses would be similar or different if the frame, client's assessment, or clinical diagnosis were changed. Use assimilation and accommodation to move the actionable behaviors, clinical thinking, and decision-making from the meaningful frame already learned to the anticipated situation ahead. (Clinical Reasoning).

Adapted from: Bybee, et al. (1989).

Appendix C Student Consent Form for Study Participation

INFORMED CONSENT STATEMENT FOR

Developing and Testing the DML Method of Debriefing Simulation Experiences

You are invited to participate in a research study of the use of simulation in nursing education. You were selected as a possible subject because you are a student in Nursing *S471 Restorative Health Related to Multi-system Failures: Practicum* at Indiana University School of Nursing. We ask that you read this form and ask any questions you may have before agreeing to be in the study.

The study is being conducted by Daniel Pesut PhD, RN a faculty member at Indiana University School of Nursing and Kristina Dreifuerst MS, RN; a doctoral student at Indiana University School of Nursing. It is not a funded study.

STUDY PURPOSE

The purpose of this study is to look at how simulation is being used in nursing education and to discover if there are teaching strategies in simulation that impact student learning.

NUMBER OF PEOPLE TAKING PART IN THE STUDY:

If you agree to participate, you will be one of fifty (50) subjects who will be participating in this research.

PROCEDURES FOR THE STUDY:

If you agree to be in the study, you will need to know the following:

1. Students will be assigned to an experimental or a control group. The simulation experience is the same for both groups. Different teaching and debriefing strategies may be used in each group.
2. You agree to have your pre-simulation and post-simulation assessment scores included in the database for this study.
    a. Every student in the course, regardless if they agree to study participation will complete the online assessment tool that includes 33-item multiple choice items and 8 short answer items. This will be completed twice in the semester and it will be available online during specified times before simulation experiences begin in this course and after the last one is finished.
    b. You can access this online tool from any computer with special instructions that are attached to this consent form.
    c. ***You agree to complete it independently without help from other people, books, articles or online resources.***
3. All pre-simulation and post-simulation online assessments will be coded by the co-investigator with an assigned 10-digit I.D. number that will replace your name. These will be used for data analysis.
    a. At all times the data will be kept secure and the co-investigator will maintain student confidentiality.
    b. Note that this pre and post assessment will not be graded, will not impact your grade and individual scores or answers will not be shared with the course instructors or faculty.

4. Prior to your scheduled simulation, you will receive preparation materials about the simulation including the objectives and information about when to come and how to participate.
    a. All students in the course whether they are study participants or not receive this information. Per the usual simulation instructions in this school of nursing, once you arrive for simulation, students will be assigned roles to play in the simulation.
    b. For example, one student will play the role of the primary nurse, another student will have the role of a secondary nurse (one who will be delegated to), and the third role will be a family member with a scripted role and two students will be a recorders, any remaining students in the clinical group will participate as observers.
    c. The participants will be put in a realistic, simulated clinical setting to provide nursing care to a simulated patient.
5. Once the simulation has ended, you will go to a specified place to debrief.
    a. You will be asked to participate in debriefing as an expectation of this course.
    b. During the debriefing you may be asked to complete paperwork that corresponds to the debriefing.
    c. This is not a graded assignment and will not be submitted to the instructor or the study investigators.
6. Student grades will not be negatively impacted if you refuse to participate in this study. To ensure this the course faculty will be blinded to the identity of consenting students in both the experimental and control groups throughout the semester.

RISKS OF TAKING PART IN THE STUDY:

While on the study, there are no identified risks to you as a participant.

BENEFITS OF TAKING PART IN THE STUDY:

The benefits to participation which you might expect include the experience of participating in nursing care of (simulated) patients with particular diagnoses that might positively impact how you care for other patients you encounter in clinical situations or how you respond to questions about caring for patients.

ALTERNATIVES TO TAKING PART IN THE STUDY:

Instead of being in the study, you can choose not to have your assessment scores included in the data collection. You will still take the pre-assessment and post-assessment and participate in all of the simulation activities and assignments to meet the requirements of the course but your information will not be used in the research project.

CONFIDENTIALITY

Efforts will be made to keep your personal information confidential. We cannot guarantee absolute confidentiality. Your personal information may be disclosed if required by law. Your identity will be held in confidence in reports in which the study may be published and databases in which results may be stored.

Organizations that may inspect and/or copy your research records for quality assurance and data analysis include groups such as the study investigator and his/her research associates, the IUPUI/Clarian Institutional Review Board or its designees, state or federal agencies, specifically the Office for Human Research Protections (OHRP) and the University who may need to access research records.

COSTS

Taking part in this study will not result in any costs to you as a participant.

PAYMENT

You will not receive payment for taking part in this study.

CONTACTS FOR QUESTIONS OR PROBLEMS

For questions about the study or a research-related injury, contact the Co-investigator:
Kris Dreifuerst MS, RN at 608-444-9688 or kdreifue@iupui.edu
For questions about your rights as a research participant or to discuss problems, complaints or concerns about a research study, or to obtain information, or offer input, contact the IUPUI/Clarian Research Compliance Administration office at (317) 278-3458 or (800) 696-2949.

VOLUNTARY NATURE OF STUDY

Taking part in this study is voluntary. You may choose not to take part or may leave the study at any time. Leaving the study will not result in any penalty or loss of benefits to which you are entitled. Your decision whether or not to participate in this study will not affect your current or future relations with Marquette University College of Nursing. Your participation may be terminated by the investigator without regard to your consent in the following circumstances:

a) You do not complete the online 30-item multiple choice assessment tool before and/or after the simulation.
b) You do not participate in the simulation experiences or an alternative assignment that has been pre-arranged by the course faculty.
c) You withdraw from the course.

This is your copy of this document. Complete and sign it as well as the copy on the next page. This copy is yours to keep for your records.

Choose 1 option below and complete fully:

SUBJECT'S CONSENT TO PARTICIPATE

In consideration of all of the above, I give my consent to participate in this research study.

I have been given a copy of this informed consent document to keep for my records. I agree to take part in this study.

Subject's Printed Name:____

Subject's Signature:____**Date**:________________

(must be dated by the subject)

OR

SUBJECT'S REFUSAL TO PARTICIPATE

In consideration of all of the above, I refuse to participate in this research study.

I have been given a copy of this informed consent document to keep for my records. I refuse to take part in this study.

Subject's Printed Name:____

Subject's Signature:____**Date**:________________

(must be dated by the subject)

This is the research study's copy of this document. **<u>Complete and sign it and submit it to the designated envelope that is provided to the classroom</u>**.

<u>Choose 1 option below and complete fully:</u>

SUBJECT'S CONSENT TO PARTICIPATE

In consideration of all of the above, I give my consent to participate in this research study.

I have been given a copy of this informed consent document to keep for my records. I agree to take part in this study.

Subject's Printed Name:____

Subject's Signature:____**Date**:___________________

(must be dated by the subject)

<u>OR</u>

SUBJECT'S REFUSAL TO PARTICIPATE

In consideration of all of the above, I refuse to participate in this research study.

I have been given a copy of this informed consent document to keep for my records. I refuse to take part in this study.

Subject's Printed Name:____

Subject's Signature:____**Date**:___________________

(must be dated by the subject)

Appendix D IRB Approvals

IRB Approval Letter

INDIANA UNIVERSITY

OFFICE OF RESEARCH ADMINISTRATION

Date:	January 22, 2009
To:	Dr. Daniel Pesut Nursing NU 136
From:	Regina Wininger Research Compliance Administration, IUPUI UN 618
Subject:	IUPUI/Clarian Institutional Review Committee - Exempt Review of Human Study
Study Number:	EX0901-12B
Study Title:	"Developing and Testing the DML Method of Debriefing Simulation Experiences"

Your application for approval of the study named above has been accepted as meeting the criteria of exempt research as described by Federal Regulations [45 CFR 46.101(b), paragraph 2]. A copy of the acceptance is enclosed for your file.

Although a continuing review is not required for an exempt study, prior approval must be obtained before change(s) to the originally approved study can be initiated. When you have completed your study, please inform our office in writing.

If the research is conducted at or funded by the VA, research may not be initiated until approval is received from the VA Research and Development Committee.

Please contact the Office of Health Care Billing and HIPAA Programs at 317-278-4891 for information regarding a Data Use Agreement, if applicable.

Enclosures: ☒ Copy of acceptance

Phone: 317-274-8289 • Fax: 317-278-8744 • Email: resrisk@iupui.edu • Website: http://research.iupui.edu

IRB Approval of Amendment

INDIANA UNIVERSITY

OFFICE OF RESEARCH ADMINISTRATION

Date:	May 28, 2008
To:	Dr. Daniel Pesut Nursing NU 136
From:	Regina Wininger Research Compliance Administration UN 618
RE:	IUPUI Institutional Review Board - Proposed Changes to an Exempt Study
Study Number:	EX0901-12B
Study Title:	Developing and Testing the DML Method of Debriefing Simulation Experiences

Your request to change the location of this study, to extend the duration of the project, and to revise the study design and process for this study was received. It was determined that the exempt status of this study will not be altered by these changes. Therefore, the changes you have proposed are accepted and may be initiated immediately.

If you make any other changes to this study, please contact our office. Also, when you have completed your study, please let us know in writing.

If you have any questions, please contact our office.

Phone: 317-274-8289 • Fax: 317-274-5932 • Email: resrisk@iupui.edu • Website: http://research.iupui.edu

IRB Approval of Revision

INDIANA UNIVERSITY

OFFICE OF RESEARCH ADMINISTRATION

Date: September 24, 2009

To: Dr. Daniel Pesut
Environments For Health
NU 485

From: Regina Wininger
Research Compliance Administration
UN 618

RE: IUPUI Institutional Review Board - Proposed Changes to an Exempt Study

Study Number: EX0901-12B
Study Title: Developing and Testing the DML Method of Debriefing Simulation Experiences
Amendment Number: 2

Your request to change the location of this study and to use two additional methods of data collection for this study has been received. It was determined that the exempt status of this study will not be altered by these changes. Therefore, the changes you have proposed are accepted and may be initiated immediately.

If you make any other changes to this study, please contact our office. Also, when you have completed your study, please let us know in writing.

If you have any questions, please contact our office.

Phone: 317-274-8289 • Fax: 317-274-5932 • Email: resrisk@iupui.edu • Website: http://research.iupui.edu

Appendix E Usual and Customary Debriefing for

Pulseless Electrical Activity Simulation

Debriefing / Guided Reflection Questions for This Simulation

(Remember to identify important concepts or curricular threads that are specific to your program)

George Fisher

1. Questions to ask the group
    a. How did you feel throughout the simulation experience?
    b. How did you designate the roles to carry out a plan of care?
    c. What were the key assessments and interventions?
    d. How did you apply the ACLS Guidelines to the plan of care?
    e. Did you have the knowledge and skills to meet the objectives?
    f. Were you satisfied with your ability to work through the simulation?
    g. If you were able to do this again, how could you have handled the situation differently?
2. What are potential causes for the initial dysrhythmia (PEA)? Relate this to the client's history.

    H's: **H**ypovolemia, **H**ypoxia, **H**ydrogen ion (acidosis), **H**ypokalemia, **H**yperkalemia, **H**ypoglycemia,**H**ypothermia

    T's: **T**oxins, cardiac **T**amponade, **T**ension pneumothorax, **T**hrombosis (coronary or pulmonary),**T**rauma

    Client:
    A. Metoprolol (Toprol XL) 50 mg qd (recently increased dose)

        Beta 1 blocker – decreased conduction, decreased heart rate, decreased conduction, decreased force of contraction, decreased afterload, decreased BP client c/o of increased tiredness, syncope / fainting spells
    B. Lasix with no potassium intake for last few days – hypokalemia, client c/o of leg cramping
    C. Hypoxia – SpO_2 82% when scenario began, Respirations 0
    D. Acidosis development with decreased / absent perfusion
    E. Consider leg cramps – DVT – PE?

3. Differentiate the treatment for symptomatic bradycardia vs. pulseless electrical activity using the ACLS Guidelines.
4. Is there anything else you would like to discuss?

Appendix F DASH©–SV

Center for Medical Simulation

Debriefing Assessment for Simulation in Healthcare (DASH) Student Version©

Directions Rate how this debriefing felt to you using the following seven-point scale. You will be rating six "Elements" of the debriefing. Each Element comprises specific behaviors, described below. If a listed behavior is impossible to assess (e.g., how they handle upset people if no one got upset), don't let that influence your evaluation. The debriefer may do some things well and some things not so well within each Element. Do your best to summarize your impression of ***overall effectiveness* for the whole Element,** guided by your observation of the individual behaviors that define it.

Please resist scoring individual behaviors and then averaging them for the Element score. Think holistically about your assessment. It's possible that one especially bad move could sour the effect of an otherwise good performance; likewise, stellar performance in one area could outshine mediocrity in others.

Rating Scale

Rating	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Descriptor	Extremely Ineffective / Abysmal	Consistently Ineffective / Very Poor	Mostly Ineffective / Poor	Somewhat Effective / Average	Mostly Effective / Good	Consistently Effective / Very Good	Extremely Effective / Outstanding

Element #1	
The instructor sets the stage for an engaging learning environment before the simulation takes place.	**Overall Rating Element #1**

- The instructor introduced him or herself (if not already known to me), and described the simulation environment and what would be expected of me during the case.
- The instructor explained the strengths and weaknesses of the simulator, and what she or he and I would need to do to get the most out of simulated clinical cases.
- The instructor showed concern for my physical comfort well-being by telling me about logistical matters such as breaks, food, bathroom locations, etc.
- The instructor let me know we would be debriefing the simulation sometime after the case.
- The instructor made me feel safe yet stimulated to ask questions and share my thoughts about the upcoming simulation and debriefing without fearing that I would be shamed or humiliated.

Element #2	
The debriefer maintains an engaging context for learning during the debriefing.	**Overall Rating Element #2**

- At the outset, the instructor clarified the point of the debriefing, what was expected of me, and his or her role in the debriefing.
- The debriefing challenged me, yet felt like a safe place for sharing thoughts and emotions without being shamed or humiliated.
- I felt the debriefer respected participants; the focus was on learning and not on "catching" people in a mistake.
- The instructor helped me learn even though the cases were simulated; s/he acknowledged people's concerns about how realistic or unrealistic things were.
- The instructor made people feel heard by using non-verbal actions like eye contact, nodding, paraphrasing, trying to include everyone, etc.

Element #3	
The debriefer structures debriefing in an organized way.	Overall Rating Element #3

• The debriefer organized the debriefing with a start, middle, and end. The conversation had a logical progression and felt focused, rather than jumping from point to point randomly.
• I was encouraged to share my genuine reactions to the simulated case at the beginning and the instructor took my perspective and concerns seriously.
• The instructor then helped me analyze actions and thought processes as we reviewed the case.
• There was a summary phase where the instructor helped tie our observations together and relate the case to ways I can improve my future clinical practice.

Element #4	
The debriefer provokes engaging discussions that lead me to reflect on my performance.	Overall Rating Element #4

• The debriefer used concrete examples of things we did—not just abstract or generalized comments—to get me to think about my performance.
• The debriefer made his or her reasoning clear; I didn't have to guess what s/he was thinking.
• The discussions were in depth; the debriefer did not focus only on whether I knew facts.
• The debriefer used the video effectively to help students analyze and learn from the simulated case.
• If someone got upset during the debriefing, the debriefer tried to help them deal with it the debriefer validated the person's concerns rather than just ignoring them.

Element #5	
The debriefer identifies what I did poorly or well—and why.	Overall Rating Element #5

• I received concrete feedback on my team's or my performance based on the debriefer's accurate and honest description of the performance during the simulation.
• The debriefer helped me explore what I was thinking or trying to accomplish at key moments in the case.

Element #6 –	
The debriefer helps or inspires me to improve and/or shows me how to sustain excellence.	Overall Rating Element #6

• The debriefer helped me learn how to improve weak areas or how to repeat good or excellent performance.
• The debriefer was knowledgeable and able to use that knowledge to help me understand the things we discussed.
• The debriefer made sure we covered the topics important in this course.

Permission to Use DASH©–SV

Kristina Thomas Dreifuerst

February 16, 2010

Robert Simon, Ed.D, CHFP
Instructor in Anaesthesia
Harvard Medical School & Massachusetts General Hospital
Education Director
Center for Medical Simulation
65 Landsdowne St.
Cambridge, MA 02139

Dear Dr. Simon:

This letter confirms our ongoing communication regarding the *Debriefing Assessment for Simulation in Healthcare* (DASH©) and the *Debriefing Assessment for Simulation in Healthcare-Student Version* (DASH©-SV). As you are aware, I am completing a doctoral dissertation at Indiana University entitled " Debriefing for Meaningful Learning: Fostering Development of Clinical Reasoning through Simulation."

I would like permission to reprint in my dissertation, the DASH©-SV tool in the attached format.

The requested permission extends to any future revisions and editions of my dissertation, including non-exclusive world rights in all languages, and to the prospective publication of my dissertation by UMI. These rights will in no way restrict republication of the material in any other form by you or by others authorized by you. Your signing of this letter will also confirm that you own the copyright to the above-described material.

If these arrangements meet with your approval, please sign this letter where indicated below and return it to me electronically as a PDF document. Thank you very much.

Sincerely,

Kristina Thomas Dreifuerst PhD(c), RN

PERMISSION GRANTED FOR THE
USE REQUESTED ABOVE:

Date: March 9, 2010

Robert Simon Ed.D, CHFP
On behalf of the Center
for Medical Simulation

Appendix G Debriefing for Meaningful Learning Supplemental Questions

On a scale of 0–7using the criteria listed below; please respond to each of the first four statements below. Each of the statement is followed with an open-ended free-text box with the instructions.

Feel free to provide any additional information or confidential comments to the researcher.

0 = Not Applicable
1 = Strongly Disagree
2 = Disagree
3 = Mostly Disagree
4 = Unsure
5 = Mostly Agree
6 = Agree
7 = Strongly Agree

Questions:

1. The worksheet was useful for debriefing.

2. I will know what to do the next time I encounter a patient with PEA.

3. The time allotted for debriefing was appropriate.

4. Reflective thinking was evident in this simulation and debriefing experience.

Using the scale provided below; please respond to the fifth statement:

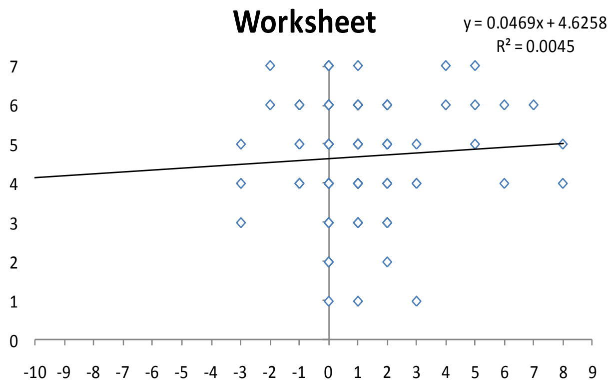
5. The role I played in the PEA simulation.

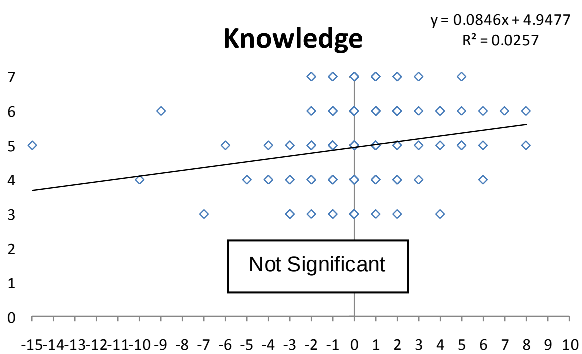
1 = Primary Nurse
2 = Second Nurse
3 = Charge Nurse
4 = Family Member
5 = Observer/Recorder

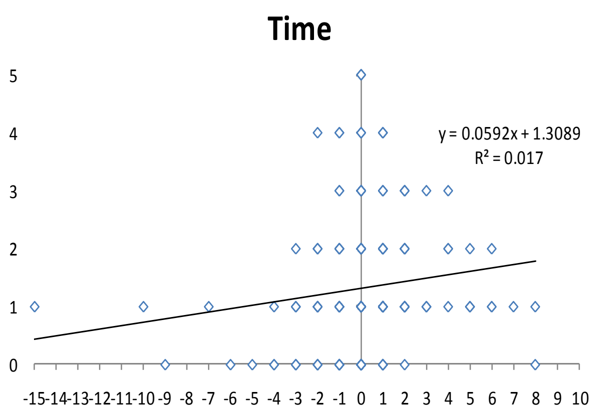
Appendix H Health Sciences Reasoning Test

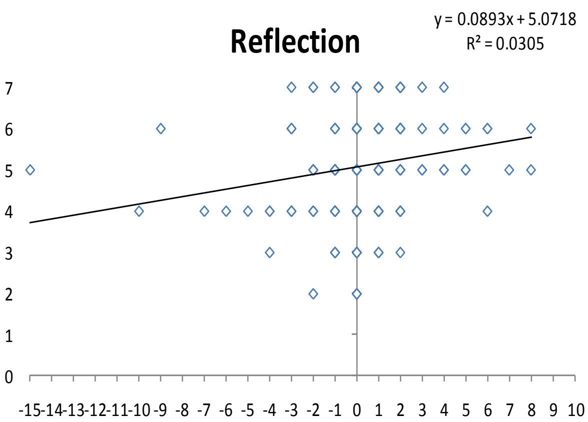
The Health Sciences Reasoning Test is copyright-protected, fee-for-use, intellectual property of Insight Assessment, a division of California Academic Press. Publication of the items is prohibited. Information regarding use of this instrument can be obtained from the company at their website: http://www.insightassessment.com/home.html

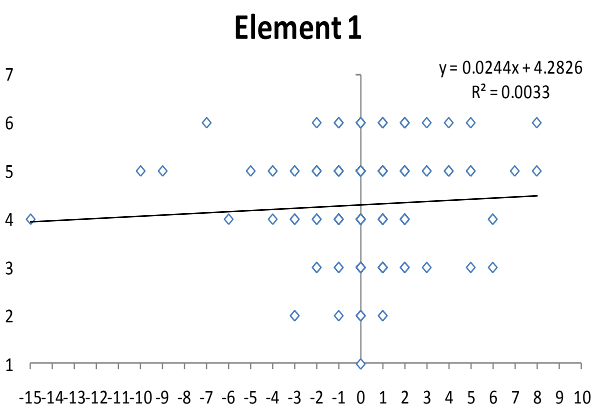
Appendix I DASH©–SV and DMLSQ with HSRT Change: Regression Analysis

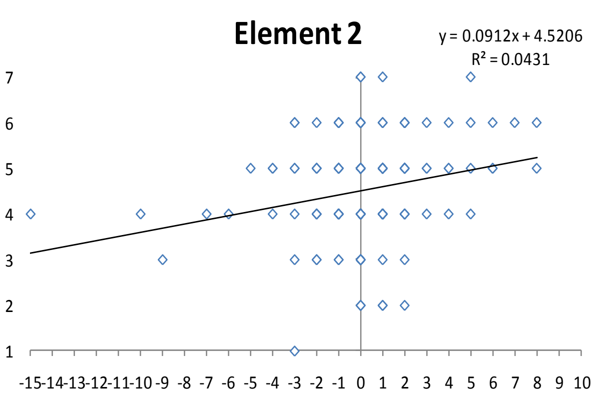


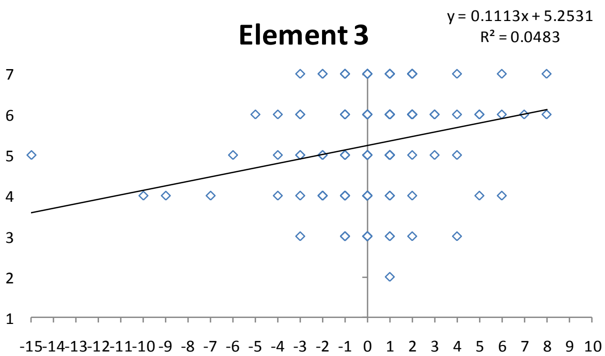


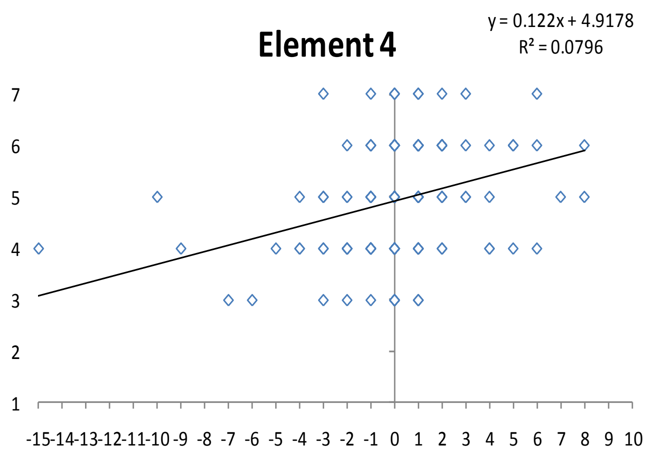


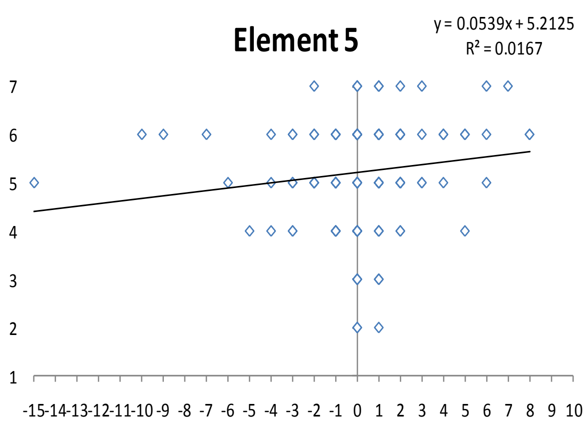

Reflection
y = 0.0893x + 5.0718
R² = 0.0305
7
6
5
4
3
2
1
0
-15-14-13-12-11-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10

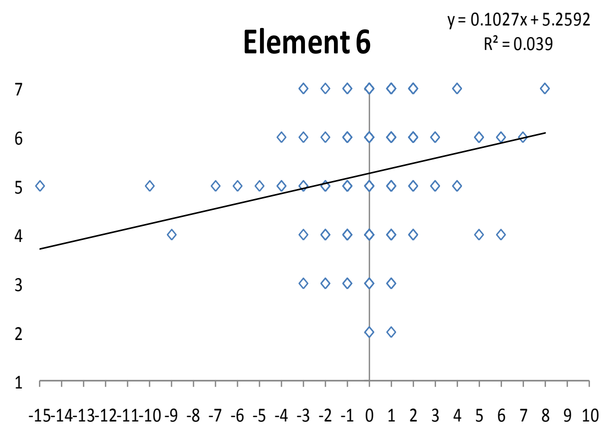

Element 1
y = 0.0244x + 4.2826
R² = 0.0033
7
6
5
4
3
2
1
-15-14-13-12-11-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10

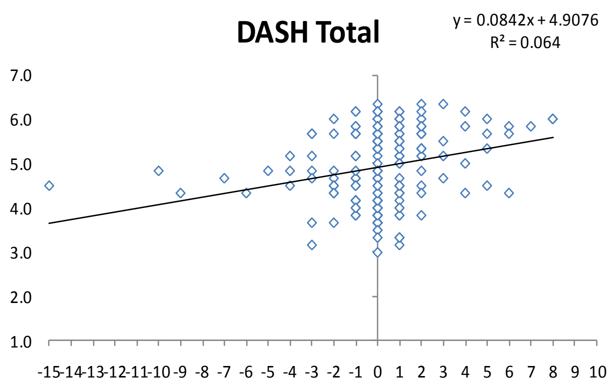

Element 2
y = 0.0912x + 4.5206
R² = 0.0431
7
6
5
4
3
2
1
-15-14-13-12-11-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10


Element 3
y = 0.1113x + 5.2531
R² = 0.0483
7
6
5
4
3
2
1
-15-14-13-12-11-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10


Element 4
y = 0.122x + 4.9178
R² = 0.0796
7
6
5
4
3
2
1
-15-14-13-12-11-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10


Element 5
y = 0.0539x + 5.2125
R² = 0.0167
7
6
5
4
3
2
1
-15-14-13-12-11-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10


Element 6
y = 0.1027x + 5.2592
R² = 0.039
7
6
5
4
3
2
1
-15-14-13-12-11-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10


DASH Total
y = 0.0842x + 4.9076
R² = 0.064
7.0
6.0
5.0
4.0
3.0
2.0
1.0
-15-14-13-12-11-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10

Appendix J Supporting Charts and Graphs

Chapter III

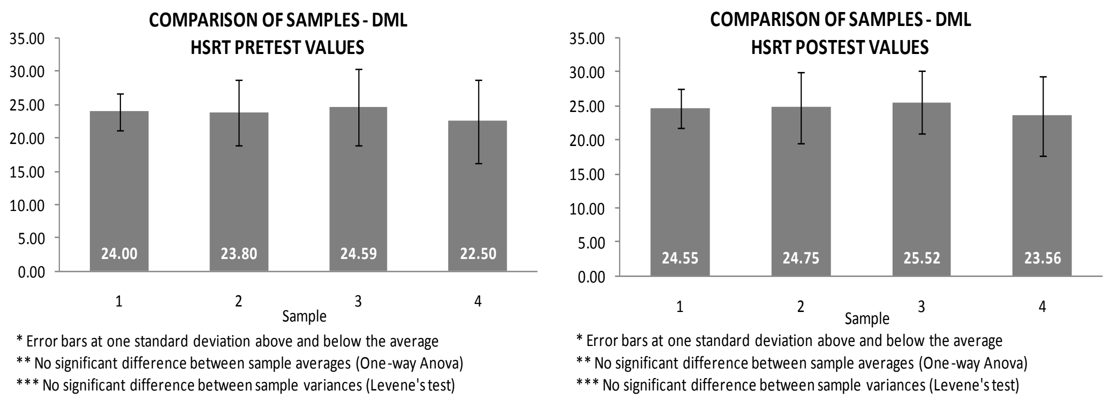


Figure J1. Comparison of HSRT Experimental Group Means.

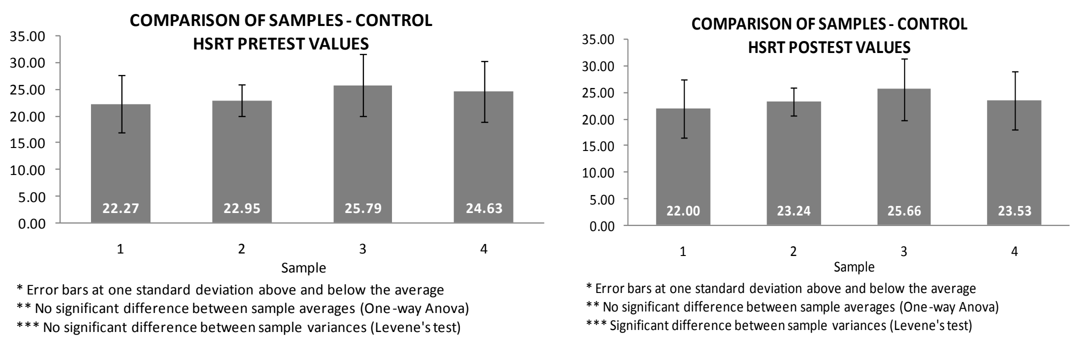


Figure J2. Comparison of HSRT Control Group Means.

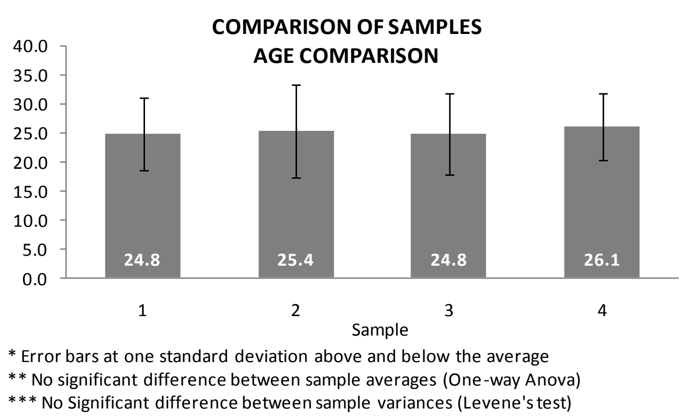


Figure J3. Comparison of Sample Ages.

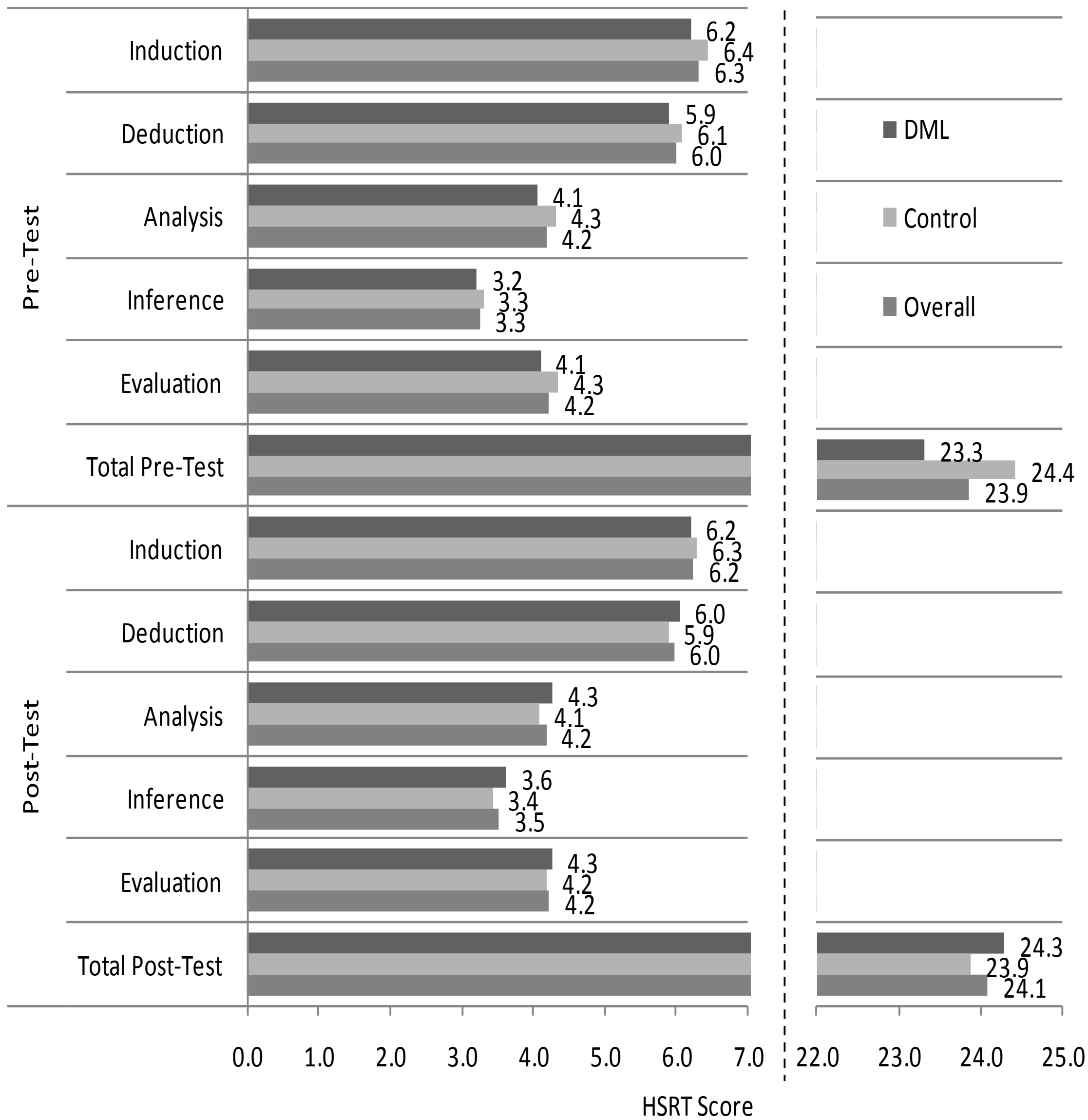


Figure J4. Distribution of HSRT Mean Scores.

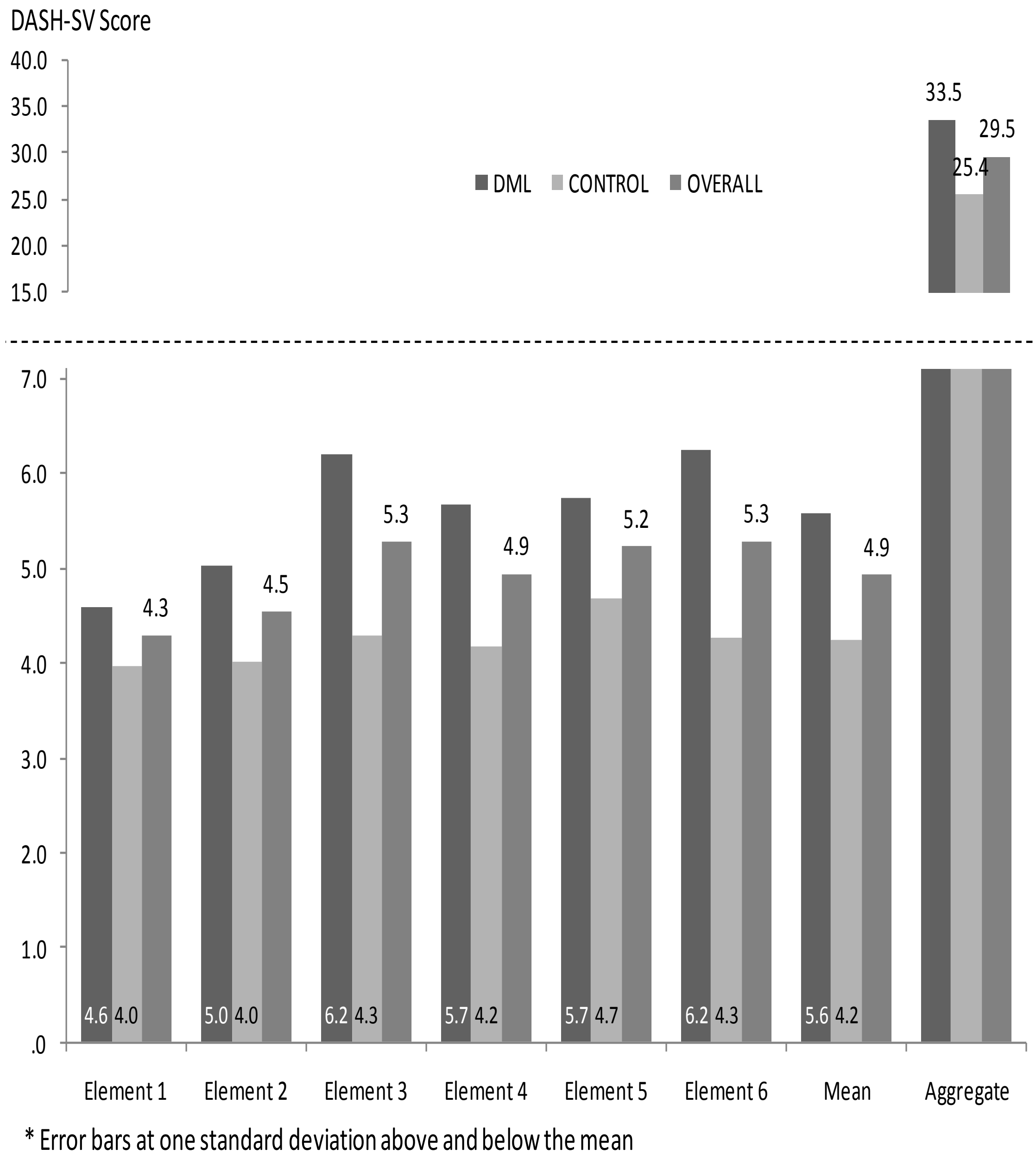


Figure J5. Distribution of DASH©–SV Mean Scores.

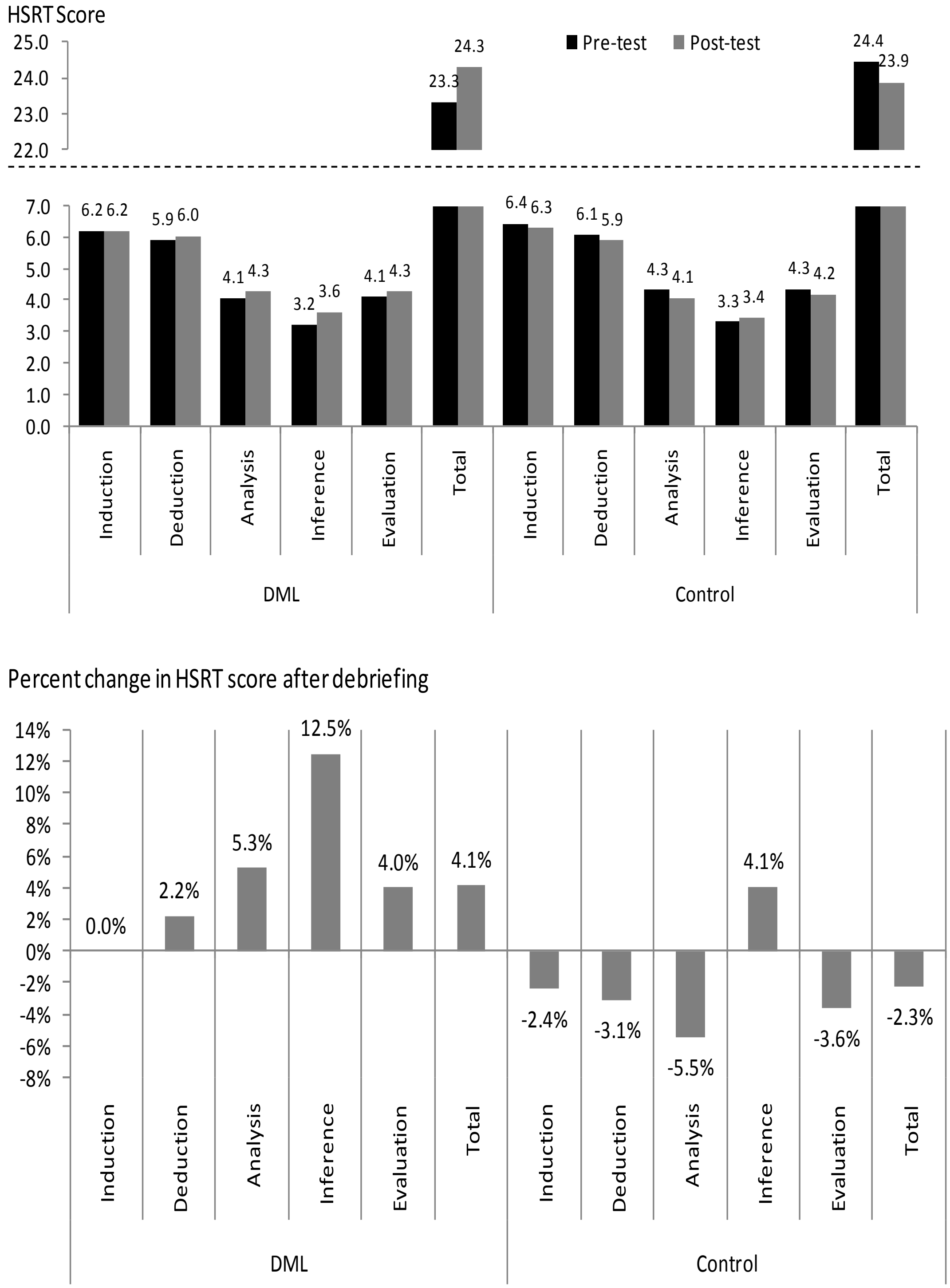
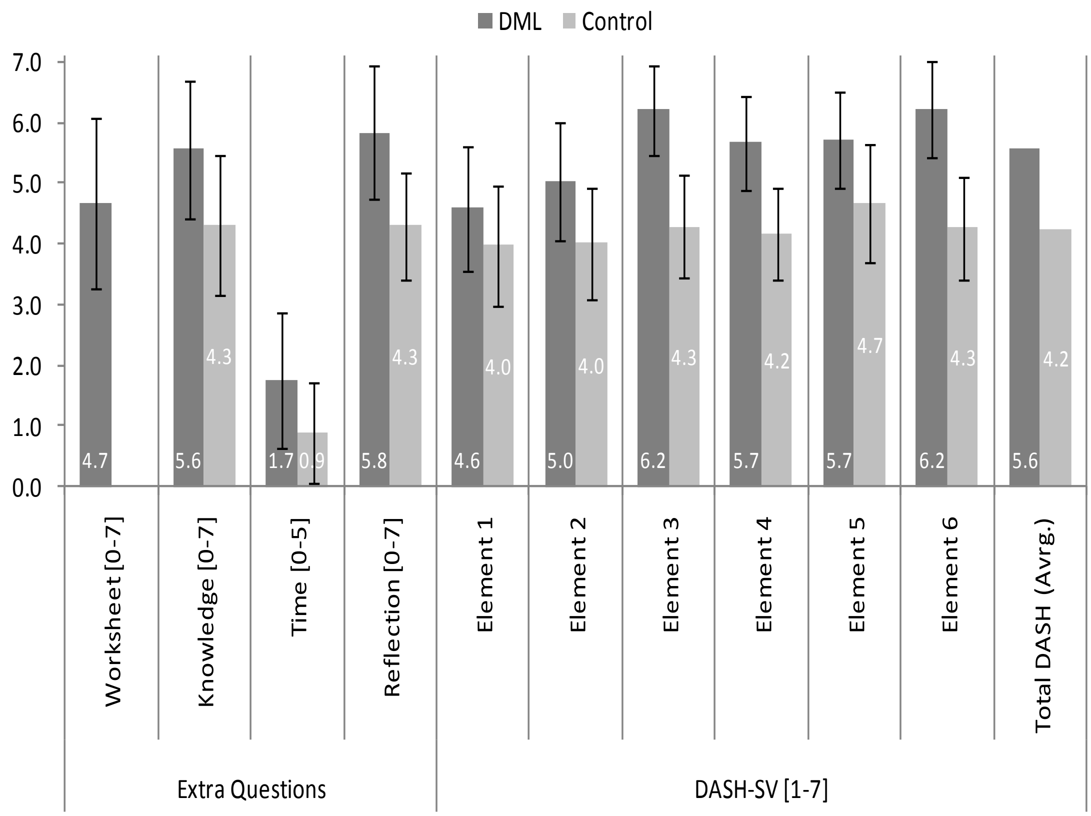


Figure J6. Change in HSRT Mean Scores.



* All variables are significant different at 0.05. Mann-Whitney test.

** Error bars at one standard deviation above and below the average

Figure J7. Distribution of DASH©–SV and DMLSQ Mean Scores.

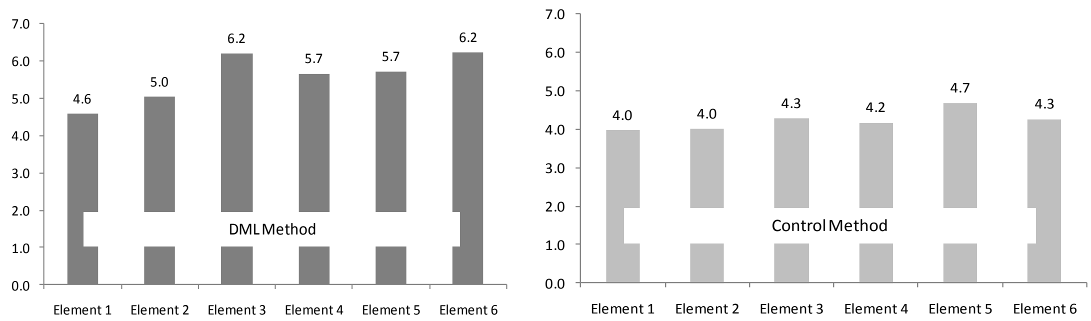


Figure J8. Comparison of DASH©–SV and DMLSQ Mean Scores.

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Curriculum Vitae

Kristina Thomas Dreifuerst

Education

PhD Nursing Science	Indiana University Indianapolis, IN	2010
Post-MS Certificate Wound, Ostomy, Continence Nursing	Harrisburg Area WOC Nursing Education Program Harrisburg, PA	1994
MS Nursing	University of Wisconsin–Madison Madison, WI	1989
BA Nursing	Luther College Decorah, IA	1985

Academic Appointments

Place	Title/Rank	Dates
Madison Area Technical College Associate Degree Nursing Program Nursing Program Madison, WI	Nursing Instructor (part-time)	2009–2010
Indiana University School of Nursing Indianapolis, IN	Teaching Associate (part-time)	2007–2010
University of Wisconsin–Oshkosh College of Nursing Oshkosh, WI	Clinical Associate Professor	2007–2008

University of Wisconsin–Madison School of Nursing Madison, WI	Clinical Assistant Professor	2004–2007
University of Wisconsin–Madison School of Medicine and Public Health Department of Family Medicine Department of Medical Rehabilitation Madison, WI	Clinical Instructor (Non Funded)	2001–2004
University of Wisconsin–Madison School of Nursing Madison, WI	Clinical Instructor (Non Funded)	1997–2004
Hope–Calvin Nursing Program Calvin College Grand Rapids, MI	Clinical Instructor (Adjunct)	1995–1996

Clinical Appointments

Place	Title	Dates
Fort Health Care Wound and Edema Center Johnson Creek, WI	Clinical Coordinator	2008–2009
University of Wisconsin Hospital and Clinics Madison, WI	Clinical Nurse Specialist Wound, Ostomy Continence Nursing	1997–2004
University of Wisconsin Hospital and Clinics Madison, WI	Education Specialist (per diem)	1996
Butterworth Hospital Grand Rapids, MI	Clinical Nurse Specialist Women's Health Services	1995
Foote Memorial Hospital Jackson, MI	Patient Education Coordinator	1994–1995
University of Wisconsin Hospital and Clinics Madison, WI	Acting Clinical Nurse Specialist Medical-Surgical- Oncology Nursing	1994

University of Wisconsin Hospital and Clinics Madison, WI	Nurse Clinician	1985–1994

Licensing and Credentialing

Registered Nurse (State of WI)
Advanced Practice Nurse Prescriber (State of WI)
Certified Adult Clinical Nurse Specialist (ANCC)
Board Certified Wound, Ostomy, Continence Nurse (WOCNCB)
Certified Nurse Educator (NLN)

Research Interests

Reflective Debriefing in Simulation to Foster Meaningful Student Learning
Development of Clinical Reasoning, Clinical Judgment and Critical Thinking
Metacognition, Self-Regulation, and Reflective Learning
Curriculum Innovation and Pedagogical Reform in Nursing Education

Grants and Fellowships

Sigma Theta Tau International Joan K. Stout Research Grant	2009
Indiana University Research Incentive Fund	2009
Wisconsin Nurses Foundation Research Grant	2009
International Nursing Association for Clinical Simulation Learning Debra Spunt Mini Research Grant	2009

Awards

Florence Nightingale Scholarship Indiana University	2008, 2009

Dagna Simpson Scholarship Indiana University	2007, 2008
Michele White Scholarship Indiana University	2009
Nurse in Washington Internship Recipient	2005
Wound, Ostomy, Continence Society: North Central Region Annual Nurse Excellence Award	2002, 2001
Sigma Theta Tau Inductee: *Beta Eta Chapter* Madison, WI	1998