THE EFFECT OF WORKED OUT MODELING IN NURSING SIMULATION

by

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ABSTRACT

This study provides a research framework that incorporates cognitive load theory (CLT) into simulation design and implementation, as well as providing a pilot tool to measure cognitive load specific to nursing simulation. The pedagogy of CLT is based in an understanding of cognitive architecture, which includes working memory, long-term memory, various types of cognitive load, and schema development. A quasi-experimental quantitative design was used with a convenience sample of senior baccalaureate nursing students who participated in simulation as part of their coursework. The treatment group received a worked out modeling intervention, designed upon the CLT instructional intervention of the worked out example. The control group received the usual simulation intervention. Each group was given a pre- and post-simulation knowledge survey and a cognitive load survey post simulation to measure whether the worked out modeling intervention had any effect on cognitive load experienced and knowledge acquired from the simulation experience. Results suggested that students receiving the worked out modeling intervention did have higher knowledge attainment scores related to fall management. No significant differences were found in the level of cognitive load experienced, although additional measures identified that the use of a pre-simulation activity does increase germane load, which is necessary for schema construction.

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CHAPTER ONE: OVERVIEW

Introduction

The discipline of nursing requires professional nurses who are adaptive experts, adjusting their problem solving techniques, based upon the task or situation presented. This creates a need for the professional nurse to transfer knowledge to a variety of situations and to have flexibility with application of skills (Kalyuga, Renkl, & Paas, 2010). Because of the demand for the next generation of nurses to be dynamic, flexible, able to critically think and engage in complex decision making, and the increasing difficulty of finding clinical placements for student nurses the use of simulation as an adjunctive or alternative to clinical placements has grown (Roy & McMahon, 2012). Participation in simulation allows learners to safely practice and apply critical thinking skills and knowledge, and address decision making and collaborative practice skills needed in the modern healthcare setting (Mayrath, Nihalani, Torres, & Robinson, 2011; McGarry, Cashin, & Fowler, 2014; Shinnick & Woo, 2013).

Many schools of nursing utilize simulation as a way to teach and assess clinical nursing skills that the student has been given limited exposure to in the clinical setting. This is a significant change in nursing education and it is important to understand whether nursing students are gaining the knowledge and training needed via simulation, and are also able to create a plan or form a model related to the content (a schema) that can be integrated into a variety of nursing situations. In the clinical educational setting the student is most often paired with a preceptor nurse who has expertise, and through an apprenticeship model of education the precepting nurse imparts knowledge and skills to the student nurse. The preceptor is there for questions and support as well as to monitor the student and provide immediate corrective instruction if needed. The student has the benefit of the preceptor nurse to provide examples of how to perform a skill or to talk them through the critical thinking process of a nursing intervention, as well as how to problem solve if there are situations that do not fit the textbook example (Forneris & Peden-McAlpine, 2009; Happell, 2009).

In contrast, simulation standards of best practice include suggestions that the facilitator provide a prebriefing to the simulation environment and objectives, review rules for a safe learning environment, review roles of the simulation, and then provide time for the student to develop a plan of action prior to participating in the simulation (Franklin et al., 2013). The milieu of nursing simulation is a complex and technically challenging learning situation for the learner and the faculty facilitator, and does not innately have the benefit of modeling and verbal question and answer that is often seen in the preceptor model of clinical education. This leads us to question how effective the use of the nursing simulation model that is currently offered is in the development of schema that can be integrated into the students' long term memory for retrieval in their future nursing practice.

Researchers have used cognitive load theory (CLT) as a way to conceptualize instruction for complex and technically challenging learning situations such as nursing simulation (Danielson et al., 2007; Funke & Galster, 2009; Mayrath et al., 2011). The purpose of this study is to ascertain if the use of worked out modeling, established upon the cognitive load learning intervention of the worked out example, has an impact on the amount of cognitive load the student experiences in the simulation and their post simulation knowledge performance. Worked out modeling is the modeling of a skill or procedure by a nurse paired with verbal and gestural descriptions of critical thinking processes and pathophysiological connections to the content to be used for imitation, comparison, or as a representation of a standard of practice.

Limited amounts of literature are available specific to cognitive load theory and its relationship to nursing simulation education and practice, indicating a knowledge gap concerning application of cognitive load theory to the simulation experience in nursing education. This study will provide an application framework for CLT to nursing simulation. Additional aspects of the study will examine the use of worked out modeling as an intervention to reduce cognitive load and increase knowledge of students participating in the simulation experience.

The concept of worked out modeling has been researched to some degree in nursing education in the form of expert modeling. Much of the concept of expert modeling in nursing is based in the novice to expert model (Benner, Sutphen, Leonard, & Day, 2010) or in Bandura's (1997) observational learning model, in which the student is provided instructive modeling with verbalization of thinking processes or voice over narration. Nursing research has shown expert modeling to be effective early in the curriculum and with complex tasks with novice nurses (Franklin, Sideras, Gubrud-Howe, & Lee, 2014; Johnson et al., 2012; Kardong-Edgren et al., 2015; Lasater, Johnson, Ravert, & Rink, 2014).

Most of this research has been organized in the context of application of critical thinking based in social cognition models rather than in measurement of cognitive load or a CLT framework or schema development. The difference in these models versus worked out modeling is in the transfer of learning. CLT (in which worked out modeling is founded upon) argues that transferability of knowledge into different situations occurs with schema development and transition of the schema into the long-term memory. Observational learning models are based more in an apprenticeship model of training in which the competency learned is transferred once the student is in the work environment and has also engaged in identification with the social role of nurse (Bandura, 1997). This can be problematic, as exposure to some competencies and content may be limited in the clinical environment. CLT and worked out modeling provides a connection with the concept of expert modeling and transferability of knowledge, with the added component of schema development.

Theoretical Foundation

An essential premise of CLT is the relationship between the learner's cognitive architecture and instructional design. Cognitive architecture is comprised of a variety of informational processing components including working memory, long-term memory, schema, and cognitive load. Working memory is finite, used during the initial learning process, and can be affected by various types of cognitive load. Long-term memory stores knowledge gained for retrieval when needed. Schema development and use is an integral part of long-term memory function; as schema is the cognitive structure that assists the learner to organize situations and their related solutions (Bennell, Jones, & Corey, 2007; Driscoll, 2000; Mayrath et al., 2011; Sweller, 1988). Without consideration of cognitive architectural features, including cognitive load, working, and long-term memory, on the part of the instructional designer, instructional design is likely to be ineffective (Paas, Tuovinen, Tabbers, & Van Gerven, 2003). See Figure 1.1

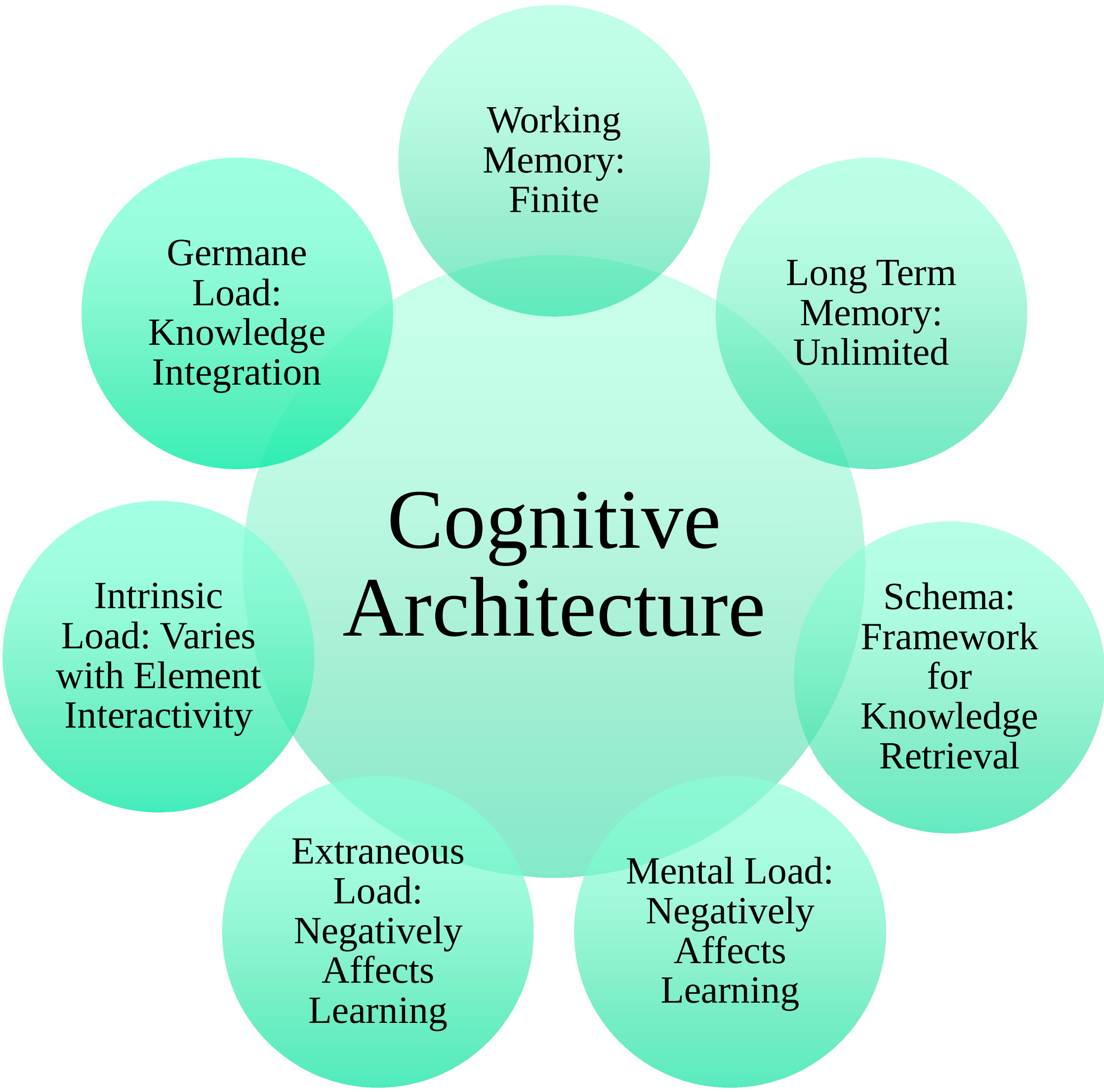

Figure 1.1. Conceptual Model of Cognitive Architecture and Cognitive Load Theory

An instructional design strategy based on CLT that may alleviate some of these inherent cognitive load issues in simulation is that of the worked-out example. In this instructional strategy the learners are given the goal and an example of the solution to the problem situation. The use of the worked-out example has been shown to decrease cognitive load and to enhance the ability of learners to focus on the problem and steps to the solution. If learners are provided a visual example of how to problem solve a situation by a competent nurse, paired with explanation of choice of intervention and decision making processes, a framework is provided in which learners can connect concepts and combine them with appropriate interventions. This enables learners to create a schema related to the problem situation for future application in their nursing practice (Bennell et al., 2007; Van Merrienboer, Kirschner, & Kester, 2003).

CLT proposes that various types of cognitive load can negatively or positively affect the learning process. Extraneous load or items that are irrelevant or detract from the learning process such as a poor instructional design can negatively affect learning. Germane load relates to the process of schema construction and automaticity. Germane load can be manipulated through a solid instructional design. Intrinsic load relates to the difficulty and complexity of the concepts. Intrinsic load often cannot be changed due to the content required but learning can be enhanced with instructional manipulation of extraneous and germane cognitive load (Sweller, 1994).

In reference to nursing simulation, one way the worked-out example can be addressed is by the use of worked out modeling prior to the simulation experience. In this situation learners are shown step-by-step solutions prior to the simulation, ideally alleviating the effects of cognitive load. This method has been shown to be effective with novice learners and could be applied to varying levels of students who participate in nursing simulation (Ayres & Paas, 2012). The use of worked out modeling is thought to positively affect extraneous and germane load as well as provide a framework for schema development, and thus knowledge transference from the working memory into the long-term memory for ease of retrieval and use in multiple situations. See Figure 1.2.

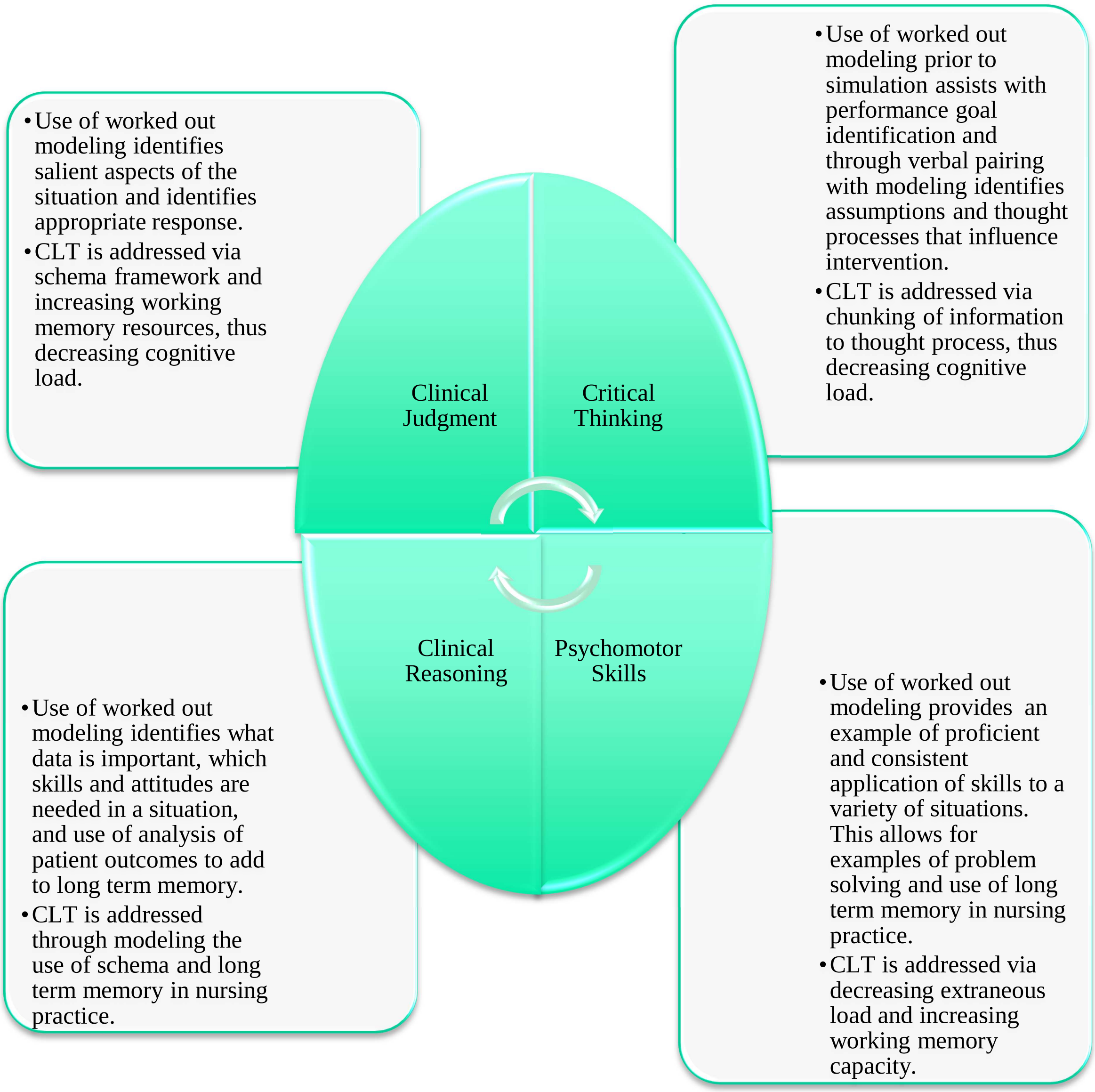

Figure 1.2. Application of Worked out Modeling to Nursing Simulation - Theoretical application of worked out modeling with a CLT framework to nursing simulation goals and objectives.

Problem Statement

Due to the technical and complex nature of simulation the cognitive load level students experience may interfere with schema development and translation of the instructional activity into their long-term memory and nursing practice. There are few studies examining cognitive load and nursing simulation outcomes or the use of interventions to decrease cognitive load in the simulation experience. This study will address this gap in the existing literature. The research problem is to investigate the use of worked out modeling, defined as the modeling of a skill or procedure by a nurse paired with verbal and gestural description of critical thinking processes and pathophysiological connections to the content to be used for imitation, comparison, or as representation of a standard of practice, and whether this assists with decreasing extraneous cognitive load, increasing intrinsic and germane cognitive load, and increasing knowledge attainment in students participating in the simulation experience.

Purpose and Significance of Study

The purpose of this quasi-experimental quantitative study (Creswell, 2008) is to answer the research question related to the use of worked out modeling and its affect on cognitive load and performance in nursing simulation. The wider issue is that of the increasing use of simulation as an adjunctive or replacement to clinical education in nursing programs and how to utilize simulation to its maximum potential while ensuring the students are experiencing maximum learning that can be translated into their future nursing practice.

This study will add to the discipline of nursing education, specifically the use of simulation, through providing evidence that may support the use of worked out modeling as a pre activity for nursing simulation and providing a tool to measure cognitive load in simulation. The area of nursing education related to the use of simulation research, especially the use of human patient simulation in undergraduate programs, is really just beginning. Much of the research conducted concerning simulation use has been in the medical field or in nurse anesthesiology programs and has been applied to nursing simulation (Hughes, 2008). Simulation in nursing education is widely used but the best use of simulation time and instructional methodology is still understudied. Although there are many benefits identified with the use of simulation in nursing education, such as enhancing skills training and student self report of a positive experience there is little research examining the amount or type of cognitive load experienced by a student during the simulation experience and what sort of knowledge the student acquires that they can take into their future nursing practice.

With the burgeoning growth of human patient simulation use in nursing education simulation faculty must discover how best to present a simulation to enhance student learning; beyond a self-reported positive experience. If it is found that the use of worked out modeling does indeed affect cognitive load and enhance schema development, which is essential for critical thinking and clinical judgment, then this study potentially could support the use of worked out modeling as a nursing simulation standard of practice.

CLT has not been applied extensively to simulation or the discipline of nursing. In order to ensure our learners are getting an optimum simulation experience that enhances schema and knowledge development, research is needed to ascertain what the common causes of cognitive overload or under load are in simulation. CLT instructional interventions such as the worked out example could be researched for effectiveness and viability in the nursing simulation environment. As simulation grows in use educators are called to examine the premises of their simulation design and create simulations that meet learner cognitive architectural needs.

Research Questions and Hypotheses

Research Questions

- Is knowledge acquisition affected by worked out modeling?
- Is self-reported cognitive load affected by worked out modeling?

Hypotheses

- Null Hypotheses: Use of worked out modeling of the nursing skills desired prior to the simulation experience has no effect on knowledge acquisition and/or cognitive load with senior nursing students participating in simulation.
- Alternative Hypothesis: Use of worked out modeling of the nursing skills desired prior to the simulation experience has a positive effect on knowledge acquisition and/or cognitive load with senior nursing students participating in simulation.

Research Design

This study is based in CLT, as it is believed that by nature, simulation carries a high cognitive load whether it is intrinsic, extraneous, germane, or mental load (Schlairet, Schlairet, Sauls, & Bellflowers, 2015). The ultimate goal of simulation in nursing is to provide the student experiences in the clinical judgment process, which encompasses observation, perception, reasoning, and establishing relationships (schemas) with data gathered through analysis and interpretation (Phaneuf, 2008). An additional goal of simulation is exposure to collaborative practice skills and schemas that encompass not only teamwork, but also communication and exercising professional values for positive patient outcomes (Interprofessional Education Collaborative Expert Panel, 2011). The student will need to master these skills, in order to be successful and safe practitioners in the modern healthcare setting. This study surmises that the inherent cognitive load and tax on working memory in the simulation setting may detract from the students' ability to gain knowledge, develop schemas, and transfer knowledge to their long term memory for future retrieval and application.

This being the research premise, a key variable to be examined is the use of worked out modeling prior to simulation participation. The use of worked out modeling is a common occurrence in nursing, as the discipline is based on an apprenticeship model of training. In addition, the conceptual framework of Benner (1994) of the novice nurse to expert nurse supports the use of experiential learning and role modeling to assist in the transition to practice from student nurse to graduate nurse. Worked out modeling in this study is based on the concept of the worked out example, which enables learners to create a schema related to the problem and context (Bennell et al., 2007; Van Merrienboer et al., 2003).

Assumptions

Little research has been conducted to substantiate if there is high cognitive load with nursing simulation participation or efficacy of standard nursing simulation instructional design and practice related to knowledge retained and knowledge transferability. The basic assumption of this research is that nursing simulation practice based in the current constructivist pedagogy by design/nature carries a high cognitive load and this may negatively affect the ability of the student to transfer knowledge from the working memory into the long-term memory as well as inhibit schema development for knowledge transferability (Beischel, 2013; Fraser et al., 2012; Van Merrienboer & Sweller, 2010; Vogel-Walcutt, Gebrim, Bowers, Carper, & Nicholson, 2011). CLT asserts that schema development is necessary for knowledge translation into the clinical setting. Using this as a research basis, it is assumed that the constructivist, social learning approach, currently being used in nursing simulation could be enhanced by introduction of cognitive architecture needs and CLT into the simulation design and application (Clark, Nguyen, & Sweller, 2006; Meakim et al., 2013).

Limitations of Study

When conducting the literature review to identify the significance of this research it became apparent there was limited research specific to CLT and nursing simulation (LoBiondo-Wood & Haber, 2006). This being the case, many articles and books were reviewed and applied to the research design from other disciplines. Although this does provide a more holistic view of CLT, it does limit application of the theory to the primary investigator's best analysis and application of key CLT concepts to nursing simulation. The lack of CLT applied to nursing simulation research requires the primary investigator's explication, which may introduce potential bias into the interpretations and research design developed.

In addition, the study has a quasi-experimental design due to the fact that students self selected the time they participated in the simulation experience so the study sample was not truly randomized (Creswell, 2008). To address this issue as well as provide for comparison of knowledge growth post simulation (outcome measure) a pre test (baseline measure) will be given to all students prior to the simulation to evaluate whether there were significant pre knowledge differences between groups (Polit & Beck, 2004).

Definitions

Apprenticeship Model: An educational model that provides the student an opportunity to practice theoretical skills and knowledge. The learning environment is authentic and the student does much the same work as a graduating nurse but without the same responsibilities. The culture of the discipline of nursing is shared and experienced and the student is allowed opportunities for critical reflection of the learning experience (Driscoll, 2000).

Chunking: "A technique in which information in long-term memory is used to chunk or group together multiple elements of information into a single element that can be easily processed in working memory" (Clark et al., 2006, p. 342).

Clinical: The assessment and care of individuals, families, or groups in health care settings either real or simulated, distinguished from theoretical assessment and care. The experience allows opportunities for application and evaluation of knowledge, skills, and thinking processes.

Clinical Judgment: "The art of making a series of decisions to determine whether to take action based on various types of knowledge. The individual recognized changes and salient aspects in a clinical situation, interprets their meaning, responds appropriately, and reflects on the effectiveness of the intervention. Clinical judgment is influenced by the individuals' previous experience, problem-solving, critical-thinking, and clinical reasoning abilities" (Meakim et al., 2013, p. S4).

Clinical Reasoning: “The ability to gather and comprehend data while recalling knowledge, skills (technical and non technical), and attitudes about a situation as it unfolds. After analysis, information is put together into a meaningful whole when applying the information to new situations” (Meakim et al., 2013, p. S4).

Cognitive Load: The amount of mental effort being used by the working memory.

Cognitive Load Theory: “A universal set of instructional principles and evidence based guidelines that offer the most efficient methods to design and deliver instructional environments in ways that best utilize the limited capacity of working memory” (Clark et al., 2006, p. 342).

Constructivism/Constructivist: Educational theory that views knowledge as something that is constructed through interaction with peers and the environment. Learning is contextual and is best when it is personally relevant to the learner. Simulation is based upon constructivist principles (Meakim et al., 2013).

Critical Thinking: “A disciplined process that requires validation of data, including any assumptions that may influence thoughts and actions, and then careful reflection on the entire process while evaluating the effectiveness of what has been determined as the necessary action(s) to take” (Meakim et al., 2013, p. S5).

Debriefing: “An activity that follows a simulation experience and is led by a facilitator. Participants’ reflective thinking is encouraged, and feedback is provided regarding the participants’ performance while various aspects of the completed simulation are discussed. Participants are encouraged to explore emotions and question, reflect and provide feedback to one another. The purpose of debriefing is to move toward assimilation and accommodation to transfer learning to future situations" (Meakim et al., 2013, p. S5).

Expert Nurse: The expert nurse has an intuitive grasp of each situation and zeros in on the accurate region of the problem without wasteful consideration of a large range of unfruitful, alternative diagnoses and solutions. The expert nurse operates from deep understanding of the total situation. His/her performance becomes fluid, flexible and highly proficient (Benner, 1984).

Human Patient Simulation: Realistic adult or child simulators that respond physiologically to interventions. The simulators have realistic features such as palpable pulses and they allow for procedures to be performed such as urinary catheter insertion.

Long-Term Memory: "A relatively permanent mental repository of knowledge and skills in the form of schema that provide the basis for expertise. The schemas in long-term memory interact directly with working memory to influence the virtual capacity of working memory" (Clark et al., 2006, p. 347).

Prebriefing: "An information or orientation session held prior to the start of the simulation-based learning experience in which instructions or preparatory information is given to the participants. The purpose of the prebriefing or briefing is to set the stage for a scenario and assist participants in achieving scenario objectives. Suggested activities in prebriefing or briefing include an orientation to the equipment, environment, mannequin, roles, time allotment, objectives, and patient situation" (Meakim et al., 2013, p. S7).

Preceptor: The preceptor has many roles such as role model, socializer, and educator. They model and demonstrate nursing skills and help the student or new nurse with these skills. They observe the student and evaluate their competence to perform a skill independently. They provide information on policy and documentation. Precepting is a time intensive process and requires well-defined goals and objectives.

Psychomotor Skill: “The ability to carry out physical movements efficiently and effectively, with speed and accuracy. Psychomotor skill is more than the ability to perform: it includes the ability to perform proficiently, smoothly, and consistently under varying conditions and within appropriate time limits” (Meakim et al., 2013, p. S8).

Schema: “A memory structure located in long-term memory that is the basis for expertise. Allows the chunking of many elements of information into a single element. Schemas are also called mental models. Schemas can be large or small and grow over time as learning progresses” (Clark et al., 2006, p. 350).

Schemata: A pattern imposed on complex reality or experience to assist in explaining it, mediate perception, or guide response.

Simulation: “A pedagogy using one or more typologies to promote, improve, or validate participants’ progression from novice to expert” (Meakim et al., 2013, p. S9).

Worked Out Example: “A step by step demonstration used to illustrate how to complete a task. Replacing some practice exercises with worked examples has been shown to increase learning efficiency” (Clark et al., 2006, p. 352).

Worked Out Modeling: The modeling of a skill or procedure by a nurse paired with verbal and gestural description of critical thinking processes and pathophysiological connections to the content to be used for imitation, comparison, or as representation of a standard of practice.

Working Memory: "A central element of human cognition responsible for active processing of data during thinking, problem solving, and learning. Working memory has a limited capacity and storage duration for information. Cognitive load theory is a set of instructional principles designed to accommodate the limits and exploit the strengths of working memory" (Clark et al., 2006, p. 352).

Chapter Summary

The use of nursing simulation as an adjunctive instructional intervention paired with clinical placements has grown in use and application due to the decreasing availability of clinical placements and the increasing acuity of patients in the healthcare setting. Students are often not exposed to many aspects of nursing that are needed for safe patient care in the clinical setting, depending on their clinical experience and precepting nurse. Thus, simulation has been introduced as a way to augment clinical education and to present life threatening or emotionally taxing patient events to students in a safe environment where there is no danger to them or danger to a live patient.

As the use of simulation has increased in the discipline of nursing so have questions concerning the best ways to introduce and apply simulation in the nursing education setting. There has been research addressing the use of simulation but not in the context of CLT. Additionally, there has been research concerning worked out modeling in nursing but not in the context of CLT either. This represents a research gap in the nursing discipline.

CLT has been applied to complex learning situations in a variety of other disciplines and has provided a variety of instructional strategies that can positively affect student cognitive architecture, learning, and schema development. One such intervention is that of the worked out example, which has great application to the concept of worked out modeling in nursing education. The purpose of this study is to examine the application of worked out modeling prior to the simulation experience and the impact of its use on self reported cognitive load and post knowledge performance. The hypothesis of this research is that the use of worked out modeling prior to the simulation experience has a positive impact on decreasing the amount of cognitive load experienced by the student during the simulation experience and also on the post simulation knowledge performance testing.

CLT provides a framework that can be applied to nursing simulation design and implementation as well as student evaluation. When considering the aspects of cognitive architecture, it is clear that CLT has a place in application to nursing simulation design and theory as simulation inherently carries a high cognitive load. In addition, ultimately the goal is for the student to develop schemas that they can retrieve and apply to a variety of nursing situations with the goal of safe and appropriate patient care.

Nursing as a discipline has been founded in the apprenticeship model when looking back at the historical roots of Florence Nightingale. Moreover, Nightingale’s theory of the environment and connection to the mind-body and healing was the impetus to today’s nursing process and the beginnings of a critical thinking/clinical judgment model in nursing (Finkelman & Kenner, 2013). This model had historically been based in a diploma program in which nursing students lived at the hospital and trained under the watchful eye of registered nurses. This model has all but been disbanded and nurses today are trained in academic environments in which the students are expected to attain their clinical modeling from expert nurses in the clinical setting. The dilemma then, is that if these clinical placements and hours are dwindling and being replaced by simulation time, nursing educators are obligated to provide the opportunities for students to view modeling and understand clinical judgment processes in context. It is surmised that the provision of this worked out modeling in simulation will decrease cognitive load and increase schema development, which is essential for exercising appropriate clinical judgment.

Once offered worked out modeling prior to the simulation experience, students will be offered a survey to ascertain cognitive load experienced as well as a post knowledge test to examine whether learning was enhanced during the instructional intervention. Limitations of the study surround the quasi-experimental design (Creswell, 2008). This will decrease generalizability of the findings, but the study will also provide a framework for other nursing researchers to examine application of CLT and cognitive load to nursing simulation.

CHAPTER TWO: LITERATURE REVIEW

Introduction

CLT provides a conceptual and theoretical framework that supports the examination of cognitive architecture and cognitive load in complex learning situations, such as nursing simulation. The purpose of this research is to examine use of worked out modeling in reference to nursing simulation as a pre-activity and the impact on post simulation performance testing and self-reported cognitive load. This section will review the central pedagogical tenets of CLT and provide suggestions for theoretical and practical application to nursing simulation. A framework for how CLT can be utilized in simulation to meet common simulation objectives will also be reviewed.

Literature Review Strategy

Due to the limited amount of literature discovered upon an initial review related to cognitive load and nursing simulation, an integrative approach was utilized. For the purposes of this review, theoretical and empirical literature was included to provide a broad base of information concerning CLT. Additionally, the domain of simulation was reviewed for connections with the theoretical underpinnings of CLT. In order to maximize access to available literature, numerous databases were searched. These included Academic Search Premier, CINAHL with full text, Education Research Complete, Education Resource Information Center, Health Source Nursing/Academic Edition, MEDLINE Professional Development Collection, Psychology and Behavioral

Sciences Collection, PsycARTICLES, Teaching Reference Center, and the Vocational and Career Collection. Keywords utilized for the literature search were cognitive load theory, simulation, nursing and variations of each concept. The search was limited to peer reviewed articles. In addition, several books in the field of cognitive load theory were reviewed for theoretical foundation.

Literature Overview

Although use of simulation has grown as an instructional strategy in nursing education, the literature specific to simulation in nursing is limited in comparison with medicine or advanced nursing training programs such as nurse anesthesiology. The research conducted in nursing education tends to be focused on specific applications of simulation in a specific setting rather than research that can be broadly generalized (Hughes, 2008). Of the studies completed, many are focused upon measuring student confidence levels post simulation or self reported appreciation of the simulation experience. In fact, faculty and student enjoyment of the simulation learning experience is often touted as an advantage of simulation (Hughes, 2008; Radhakrishnan, Roche, & Cunningham, 2007).

Many nursing educators view simulation as a solution to the gap in clinical placements and the lack of ability to practice skills and techniques on “live” patients. Based upon the constructivist learning theory, simulation is seen as a way for students to construct new knowledge, practice psychomotor skills, and reflect upon the experience in a safe learning environment. Unfortunately research concerning nursing simulation use has also been criticized as often being inconsistent and varying in focus and methodological rigor (Alison et al., 2013; Yuan, Williams, & Fang, 2011).

Qualitative and quantitative studies in simulation have found that student self-reported confidence levels often increase post simulation experience, especially in student confidence related to dealing with critically ill patients or patients in crisis (Yuan et al., 2011). Enhanced self-confidence may relate to higher self-efficacy ratings and may be related to performance measures as well. Self-efficacy may influence decision-making abilities related to data gathered and factors weighed (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001). This suggests that perceived self-efficacy has a positive role in critical thinking abilities.

In fact, some have promoted the use of self-efficacy ratings as a substitute measure for actual performance in simulation (Andrade et al., 2012). Simulation is also often advertised as a way to bridge the theory practice gap, in which nursing theory and nursing practice are found to be in conflict in the clinical setting (Cook, 1991; Hughes, 2008). This may be a misleading research result as simulation is often used with novice student nurses. These students may be self-reporting perceptions of efficacy based upon their personal theory practice gap, which may translate into misplaced confidence for performance in the clinical setting (Josephsen & Martz, 2014; Shinnick & Woo, 2013).

Alternately, nursing simulation research may focus on a specific skill set, examining whether use of simulation can enhance skill accuracy, such as medication administration or catheter insertion. These studies are often based in a constructivist and/or contextual theoretical framework with positive research outcomes indicating that because simulation is contextual and “realistic” it likely facilitates skill competency and ultimately would lead to improved patient safety and outcomes (Harris, Pittiglio, Newton, and Moore, 2014; Hughes, 2008; Josephsen & Butt, 2014; Seropian, 2003). The need for contextual or in situ simulations is advocated for in nursing simulation education and it is felt that provision of in situ simulations are beneficial as they may enhance transferability of learning (Clapper, 2013). An additional benefit seen in the use of in situ simulation is the ability to enhance automaticity of the human-machine/equipment interaction. The standardization of equipment and layout, which is recommended in simulation practice, may also decrease cognitive load and enhance patient safety due to increased predictability of equipment placement and function thus increasing automaticity of clinician response in critical situations (Pati, Cason, Harvey, & Evans, 2010).

Other studies have investigated the effect simulation participation has on critical thinking and clinical judgment development (Hughes, 2008; Johnson et al., 2012). The lack of consistent evidence identifying that simulation participation does improve clinical judgment has promoted the development and use of more focused debriefing models and research using these models to evaluate student performance (Cato, Lasater, & Peeples, 2009; Tanner, 2006). The development of these types of tools has enhanced the argument that the use of simulation as an instructional strategy can also be used as an evaluative strategy with nursing students (Hughes, 2008).

While there have been many studies concerning nursing simulation few have involved CLT. Specific to CLT and nursing simulation Fraser et al. (2012), found a direct relationship between increased emotions and cognitive load in the simulation. This study fits well with the importance debriefing is given in nursing simulation. Debriefing is often seen as the time when students are able to explore assumptions and emotions and reflect upon the experience and feedback received, so that knowledge gained can be internalized (Davis, Josephsen, & Macy, 2013). Ultimately, although there is a significant research agenda in nursing simulation the overall basis is looking at performance outcomes either in clinical or leadership skills rather than examining how or if students learn identified objectives during their simulation experience and how whatever learning that is gained is translated into their future nursing practice. This is where CLT can provide a useful lens; in perceiving issues in simulation design and implementation that may be hindering learning and long term schema development related to the simulation content.

Theoretical Foundation

An essential premise of CLT is the relationship between the learner's cognitive architecture and instructional design. Cognitive architecture is comprised of a variety of informational processing components including working memory, long-term memory, schema, and cognitive load. Working memory is finite, used during the initial learning process, and can be affected by various types of cognitive load. Long-term memory stores knowledge gained for retrieval when needed. Schema development and use is an integral part of long-term memory function; as schemata are the cognitive structure that assists the learner to organize situations and their related solutions (Bennell et al., 2007; Driscoll, 2000; Mayrath et al., 2011; Sweller, 1988). Without consideration of cognitive architectural features, including cognitive load, working, and long-term memory, instructional design is likely to be ineffective (Paas et al., 2003).

Working Memory

Central to working memory function is the amount and type of cognitive load the instructional strategy creates. Cognitive load affects the ability to effectively use and control the working memory in learning. Cognitive load theorists argue that during complex learning situations the amount of information that must be processed simultaneously can overload the amount of working memory one holds. Cognitive load can be decreased by an instructional design that promotes schema development so the working memory system is not overburdened in the learning process (Cook, 2006; Kalyuga, 2011). In its broadest sense, learning according to CLT is the increase and transfer of knowledge into the long-term memory from the working memory and cognitive load control so that this transfer can occur (Hessler & Henderson, 2013; Paas et al., 2003).

Working memory is considered to be limited to approximately 15 to 20 seconds of attention, during which time it must filter non-relevant information and manage pertinent information for learning (Goldstein, 2010). Working memory allows for the processing of about seven single elements or pieces of information that need to be stored, manipulated, or learned at one time. If a learner is to analyze the information and engage in critical thinking during a problem situation, the number of elements that can be processed at one time decreases to 3-5 from approximately seven elements (Bennell et al., 2007; Hessler & Henderson, 2013; Paas & Sweller, 2012; Schnotz & Kurschner, 2007). Learner prior knowledge and negative emotions experienced during the instructional task also affect working memory capacity (Cook, 2006; Fraser et al., 2012; Kalyuga, 2006). Other factors that can affect working memory capacity include information presented in a decontextualized manner, and extraneous media or pictures included in instruction for an “interest” factor (Clark et al., 2006; Kalyuga et al., 2010).

Long Term Memory

The relationship between working memory and long-term memory allows for problem resolution and storage of knowledge. The limits of working memory are controlled when information becomes familiar and is organized into schemas in the long-term memory. When information and knowledge are stored in the long-term memory it frees up the working memory to learn new tasks and acquire knowledge (Paas & Sweller, 2012). Long-term memory has unlimited capacity and allows the learner to become proficient in any given subject due to the accumulation and storage of knowledge (Bennell et al., 2007; Kalyuga, 2006). As individual pieces of information are acquired they are "chunked" together with like and/or connected elements, into a single higher-level element or schema. When the learner gains more expertise with concepts, their ability to retrieve and apply these chunks of information becomes more automatic and reduces cognitive load on the working memory (Plass, Moreno, & Brunken, 2010; Sweller, 1988; Vogel-Walcutt et al., 2011).

Schema

These chunks of information are moved from the working memory into the long-term memory and establish a schema related to the subject and situation. Once created the schema allows storage of knowledge in the long-term memory, integrating multiple elements into one higher-level solution based element (Hessler & Henderson, 2013; Schnotz & Kurschner, 2007). Schema expansion allows expertise to develop through the building of more complex schemas to incorporate large amounts of information or complex situations as "…schemas allow problem solvers to recognize a problem state and the best moves associated with that state." (Paas & Sweller, 2012, p. 29). Novice learners often do not have the schema development necessary to address cognitive load and this may result in an inhibited working memory due to cognitive overload (Sweller, 1988). Schema development and use is considered a positive predictor of transfer of knowledge and critical thinking and problem solving skills (Kalyuga et al., 2010).

Mental Load

Mental load must also be considered in instructional design as it can contribute to cognitive overload and diminish learning as well. Simulation often creates an atmosphere of situational anxiety that can create mental load, meaning the "excessive burden in relation to a learner's emotional and cognitive resources" (Page & Thorsteinsson, 2009, p. 9)." The structures and tasks involved in nursing simulation may cause an excessive mental load that decreases working memory and learning capacity, thus inhibiting critical thinking abilities (Roy & McMahon, 2012). Examples of instructional issues that may contribute to mental load include poor group process, inadequate or defective materials and equipment, inadequate orientation, learner prior knowledge, the subject itself, and heightened emotions (Fraser et al., 2012; Paas et al., 2003; Page & Thorsteinsson, 2009). Current simulation practice standards attempt to address some aspects of mental load and call for a pre-briefing activity that orients the learner to the manikin and environment, and a debriefing that will encourage the learner to engage in self-reflection and knowledge development (Franklin et al., 2013).

Extraneous Load

In addition to mental load there are three other identified types of cognitive load that also affect learning; extraneous, intrinsic, and germane load. Extraneous load entails learner engagement in activities that are not related to the instructional goal. Excessive extraneous load can lead to split-attention and/or redundancy effect. Split-attention is when the learner divides attention among multiple sources of information and then is required to combine the information to problem solve. Redundancy effect occurs when the learner is presented with the same information multiple times. Split-attention and redundancy take a toll on working memory and decrease learning through increasing extraneous load (Ayres & Paas, 2012; Chandler & Sweller, 1991; Schnotz & Kurschner, 2007; Torcasio & Sweller, 2010). More often than not, the presence of these effects is reflective of poor instructional design (DeLeeuw & Mayer, 2008; Kalyuga, 2011).

Intrinsic Load

Intrinsic cognitive load involves learner engagement with material essential for learning. The number of interconnecting elements that have to be addressed in the working memory (i.e. element interactivity) affects intrinsic load. Element interactivity that is low assists the learner to learn the content with minimal orientation to other elements. Element interactivity that is high consists of material that cannot be learned in isolation from other elements that closely interrelate (Sweller, 2010). Thus, the more complex the content with increasing numbers of interconnecting elements there is also an increase in intrinsic load and a greater impact on working memory. The nature of nursing simulation contains a high number of interacting elements contributing to simulation generally carrying a high intrinsic load; especially with novice learners (Fraser et al., 2012).

Some intrinsic load is necessary for learning. The learner should be challenged and motivated by the learning experience, but the intrinsic load should also be individualized and adjusted in complexity in relation to the learner's level of expertise. Advanced learners do not always benefit from the instructional design used with novice learners. Ultimately, intrinsic load is affected by the learner's level of prior knowledge and the complexity of the subject (Mayrath et al., 2011). Intrinsic load conceptually pairs well with the idea of the zone of proximal development, in which the gap between learner's actual abilities and their potential development is identified by the educator and challenged in the learning environment (DeLeeuw & Mayer, 2008; Driscoll, 2000).

Germane Load

Germane cognitive load involves learner engagement in deep cognitive processes such as integration, organization, and schema development (Stull & Mayer, 2007). To maximize germane load, the instructional design should assist the learner in creating and automating the use of schemas in their learning. In addition, the instructional design should include intentional learning activities that go beyond the skill or problem at hand (Schnotz & Kurschner, 2007). These planned activities should provide strategies for the learner to engage in "metacognitive processes or intentional search for patterns" (Kayluga, 2011, p. 9). For germane load to be effective, the simulation design is required to reduce extraneous load so that working memory is freed to engage in the processing of germane load and schema development (Clark et al., 2006). Ideally, the cognitive load of the task will balance with the intrinsic load and the working memory capacity of the learner, thus meeting the learner in his/her zone of proximal development (Schnotz & Kurschner, 2007).

Each aspect of cognitive architecture and all types of cognitive load, whether mental, extraneous, intrinsic, or germane, are additive in their effect on working memory function and learning; as such, the educator is obliged to address each area in their instructional design for optimum learning (Plass et al., 2010). Learners must develop schemas that assist in cognitive load management so they can focus their attention on essential aspects of the problem at hand in order for learning to be effective. This is vital to understand in nursing simulation, as high element interactivity is present in simulation. If learners are already experiencing high cognitive load they may not have the capacity to process the elements successfully or may have decreased inhibition of their initial responses to the situation (Fitousi & Wenger, 2011).

Theoretical Application to Nursing Simulation

CLT has great application to nursing simulation design and efficacy, as there are many aspects of simulation that add to extraneous, intrinsic, germane, and mental cognitive load. Most often simulation design is based upon multiple elements of input that require integration where the learners must form or select an appropriate schema to guide problem solving and task completion. A simulation experience generally includes several items that require the learner’s attention and ability to discern element relevance for the situation. Furthermore, simulation is fraught with mental load issues based on the emotional aspect of many simulations and the occasional high stakes outcomes of successfully or unsuccessfully managing the simulation environment. Since simulation inherently contributes to cognitive overload it is imperative that simulation educators examine their educational practices and simulation design for efficacy. CLT offers the simulation educator viable instructional strategies that can reduce cognitive load such as scaffolding, worked-out examples, self-explanation, and use of collective memory (Sando, 2013).

Scaffolding

Scaffolding supports the learner through a simple-to-complex breakdown of a multifaceted task and decreases intrinsic load. Eventually the support diminishes until it is no longer needed. In this model the learner moves from practicing the most simple but genuine case one might encounter in the real world and progresses to the more complex version of the task (van Merrienboer et al., 2003). The use of scaffolding decreases the learner's time spent on extraneous load and reduces overall cognitive load (Stull & Mayer, 2007).

An example simulation experience with scaffolding embedded might be for the learner to begin in a skills course simulation inserting a catheter into a static manikin using appropriate sterile technique. Then in the health assessment course the learner participates in performing a bladder scan and foley evaluation as part of a simulated patient assessment. This might progress to a simulation in their medical surgical course where the learner must assess a patient, determine they have a distended bladder, check orders to ascertain that there is an as needed order for catheter insertion, and then place the catheter with appropriate sterile technique, chart output, and notify the health care provider.

One caution when using scaffolding is the recommendation that in a multifaceted task it is best to not divide the various tasks into separate instructional strategies with separate task objectives. This inhibits the integration of skills and knowledge needed to address the problem situation. The learner may experience heavy extraneous cognitive load, have difficulty transferring the differing objectives to alternate settings, integrating parts of the task, and lack development of an cohesive schema that will embed in their long term memory concerning the situation (Bennell et al., 2007; Cook, 2006; Van Merrienboer et al., 2003). Additionally, when the elements are interactive and cannot be processed in isolation without diminishing the cohesive understanding of the subject a higher intrinsic load is created.

Worked-Out Example

The worked out example is another instructional design strategy that could be used in simulation. The learner is given the goal and an example of the solution to the problem situation. In this setting, extraneous load is decreased and the learner can then focus on the problem and steps to the solution. This enables the learner to create a schema related to the problem situation (Bennell et al., 2007; van Merrienboer et al., 2003). This method has been shown to be effective with novice learners (Ayres & Paas, 2012).

A few researchers have looked at types of worked out modeling and its effect on learning in simulation. It appears that when shown a role-modeled example of expected behaviors in a particular simulation, learners will perform better on posttests and demonstrate more confidence in their abilities. Unfortunately, this has been identified as being a short-lived phenomenon, lasting approximately four weeks (Aronson, Glynn, & Squires, 2013; Lasater et al., 2104). This lack of long-term integration may be indicative that use of the worked out model needs to be paired with schema development activities, such as verbal explanation of rationale, to be most effective.

The concept of embodied cognition supports the use of worked out modeling in developing schema. Embodied cognition assumes that cognition is grounded in perception and action (Paas & Sweller, 2012). The use of worked out modeling may guide learner attention to essential aspects of the simulation and assist in the allocation of working memory resources to learning and schema development (Koning, Tabbers, Rikers, & Paas, 2007). In the case of worked out modeling the learner ideally will create higher-level schemas if the instructor provides verbal explanation paired with gestures or actions. In this sense, worked out modeling is not just observing the action but observing the action with a corresponding verbal explanation so that features that cannot be identified directly are verbally identified by the experienced nurse (Cook, 2006).

It appears to be helpful when the worked-out example also includes cases with different external features but similar concepts, as this can improve transferability of knowledge and schema development (Kalyuga, 2011). This is called the variability effect and requires the educator to assist the learner in developing flexible schemas that create a repertoire of generalizable and transferrable skills, which is important in the discipline of nursing (Bennell et al., 2007). An example of this in simulation might be two patients presenting with a myocardial infarction but with differing symptoms, one a common set of symptoms and the other atypical symptoms.

Self-Explanation Effect

An instructional strategy recommended to augment the worked-out example is the self-explanation effect. This effect engages the learner in talking out loud during a problem-solving situation in order to identify underlying principles and goals of the task. Self-explanation also can assist in the connection between the problem and schema development, as the process encourages metacognitive activity and greater processing of the material being addressed. This strategy has been found to work best when paired with learner training on self-explanation techniques and is best used with novice learners

(Bennell et al., 2007). Self-explanation training can include prompts for the student to elaborate upon or predict an outcome, make inferences, or paraphrase a concept. It has been argued that the process of self-explanation itself initiates knowledge transfer and schema development and that the accuracy of the self-explanation does not affect the efficacy of this intervention in the learning process (Chi & Van Lehn, 1991).

Collective Working Memory

Simulation is often implemented in a small group format and, as such, encourages the use of collective working memory. In some ways this can positively affect the limitations of individual working memory, as when learners collaborate they can gain working memory from the group collective memory. During collaboration with multiple people playing various roles in a scenario the learners borrow information from each other's long term memory and then are able to organize this information from their personal working memory into their individual long-term memory. One area of caution when utilizing collective working memory is the amount of cognitive effort that individuals have to exert to communicate and problem solve with each other can use up working memory capacity. It is suggested that when working with task specific coordination such as in a code team, the impact on individual working memory can be decreased with training in the use of a structured communication processes (Paas & Sweller, 2012). Therefore, ideally if relying on or encouraging collective working memory uses in simulation the learner must first be oriented to appropriate group process communication techniques. See Figure 2.1.

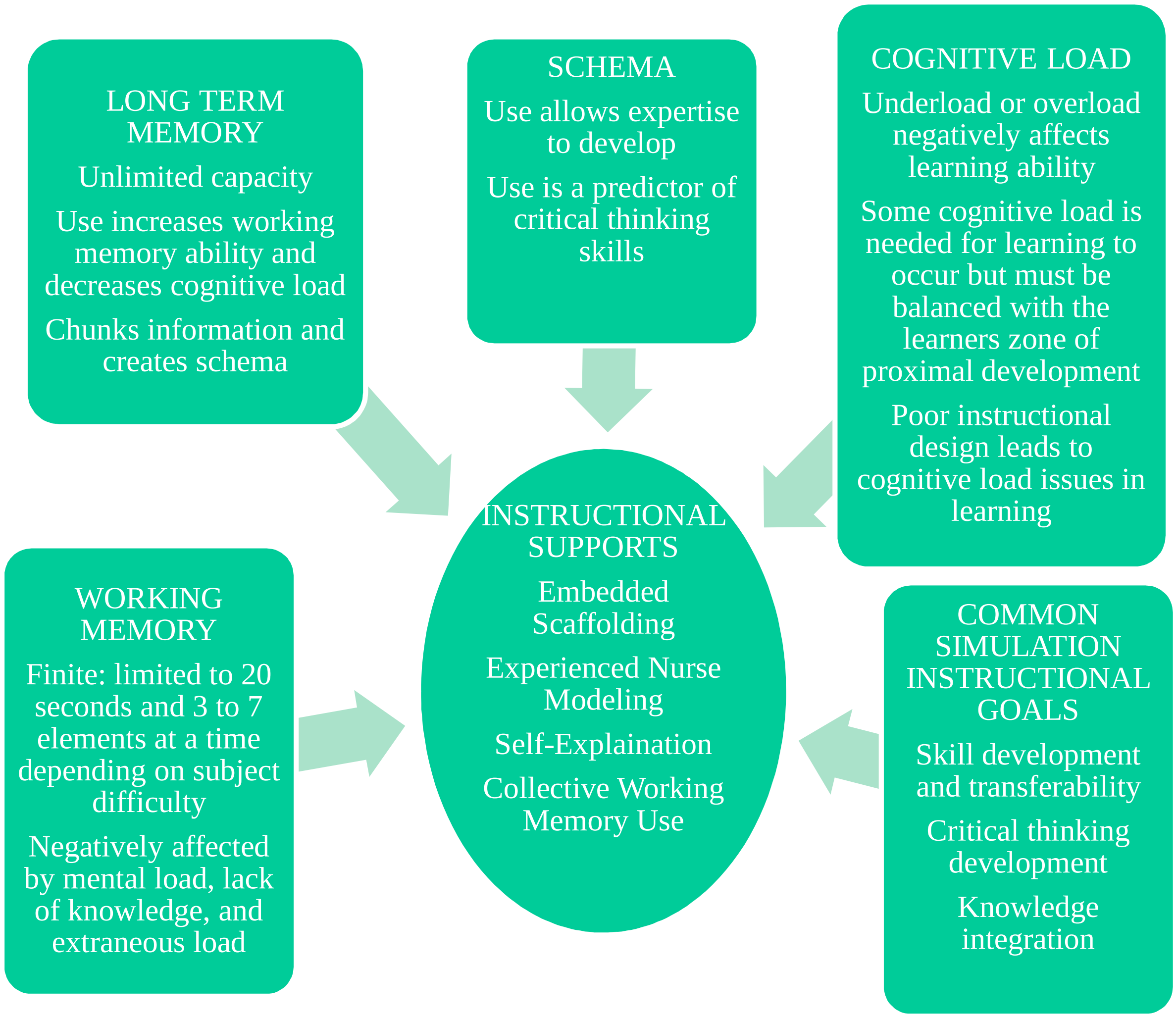

Figure 2.1. Cognitive Architecture Instructional Support Model for Simulation - Instructional Supports Applied to Cognitive Architecture in Nursing Simulation Design

<u>Worked Out Modeling</u>

With the increasing use of simulation, specifically high fidelity simulation in nursing curriculum, it is assumed that student participation will result in increased competence that can be translated to the clinical environment (Franklin et al., 2014). Yet it is difficult to ascertain whether this assumption is accurate as the student must also be able to translate the simulation experience into varying representations of the problem in the clinical setting (Chi & Bassok, 1988). Several researchers have examined the use of the worked out solution or modeling and have found that students and faculty often prefer this form of instructional tool. It has also been shown that novice nurses often rely on these examples or models in the beginning stages of learning (Benner, 1994; Chi & Bassok, 1988). Novice simulation learners may tend to grasp onto these "commonsense" explanations (Petersson, 2005, p. 282). This then produces a novice nurse who follows the formula or checklist of a task but does not consider the clinical aspects of the task implementation on patient outcomes.

When the student only learns the procedure rather than the rationale and application, then that knowledge has little transferability to other situations or settings and may cause inaccurate schema development (Chi & Bassok, 1988). This may contribute to clinical problem solving difficulties as the learner is relying on incomplete or irrelevant schema to direct actions (Yan & Lavigne, 2014). In the absence of a worked out model the student most likely will gain skills through trial and error, while potentially negatively affecting patient outcomes. The student may also gain ineffective strategies that will interfere with later learning and schema development (Pedersen & Liu, 2002; Reimann & Neubert, 2000). Therefore, experience nurse involvement is essential in the use and development of simulation as part of nursing curriculum to facilitate accurate schema development (Alison et al., 2013; Johnson et al., 2012). The use of worked out modeling has been found to be effective in new skill acquisition as well as modification of prior knowledge, especially when paired with student self-explanation techniques (Franklin et al., 2014; Renkle, 2002).

When considering the use of worked out modeling as defined by this investigator, as the modeling of a skill or procedure by an experienced nurse paired with verbal and gestural description of critical thinking processes and pathophysiological connections to the content, it is imperative to recognize that nursing students participating in simulation are novice nurses. This being the case, the student should not be expected to be able to comprehend, interpret, and problem solve nursing dilemmas in an experienced fashion. In fact, they may have had little to no experience with the clinical judgment or reasoning required for the simulation being presented. Experienced nurses have the knowledge and schemata that assists them in seeing larger patterns, predicting outcomes, and recognizing clinical solutions (Ward & Sweller, 1990). If a student is given the opportunity to study and analyze a nurse's decision-making and thinking processes then that knowledge is brought to the forefront of schema development. Additionally, there may be benefit in viewing problem solving difficulties during worked out modeling. This may encourage the learner to consider additional areas in the clinical decision-making process that can assist them in realizing that experienced nurses may struggle as well as students with decisions and thus increase confidence in the students own abilities (Nirula & Peskin, 2008).

Worked out modeling also provides a bridge from theory to practice, because the modeling is not based in one aspect of nursing theory but in the synthesis of various theoretical applications to the clinical situation. Thus, the experienced nurse can draw from a broad base of theory, pathophysiology, and patient situations to solve an everyday clinical nursing problem (Klenk & Forbus, 2009). Moreover, experienced nurses have a sense of automaticity in application of technique such as a sterile field. They have had the time and practice needed to integrate the technique of sterile field into an almost automatic procedure. The novice nurse does not possess this automaticity or the schema to transfer theory to practice, thus participation in simulation most likely carries a high cognitive load, which may interfere with learning. The use of worked out modeling paired with verbal explanations can correctly direct the student's attention and decrease cognitive load, thus increasing the learning opportunity (Renkle, 2002; Ward & Sweller, 1990).

Nursing Simulation Considerations

There are a variety of forces promoting the use of simulation in nursing education, whether it be the focus on reduction of hands-on clinical hours, organizational restrictions, or a commitment to patient safety (Bradley, 2006). Even with these issues in mind it can be difficult for a school of nursing to validate the cost of simulation in equipment, faculty training, and faculty time. If nursing education is to continue to embrace the use of simulation there must be continuing research to validate that its use has achieved educational outcomes and gained student belief that the simulation experience will be usable in their future nursing practice (Bradley, 2006; Zigmont, Kappus, & Sudikoff, 2011). Some institutions of higher education are integrating up to 25% of clinical time to be met in the simulation laboratory. With the political and organizational influences and the reduction in clinical placement availability, simulation could ultimately be used for the majority of a nursing student's clinical education experience (Jeffries, 2009). It is essential that nursing educators examine the simulation framework in place currently and provide evaluation of learning effectiveness, cognitive load being one such issue. If educational outcomes are not achieved because of cognitive overload, inappropriate schema development, or lack of application to the "real-world" setting, then learning will be diminished as well as transferability of knowledge gained to the student's future nursing practice.

Learning in simulation is purported to be based upon the individual, the experience, and the environment (Zigmont et al., 2011). The individual component assumes an androgogical position, with the belief that the student has previous knowledge and experience that they can retrieve and apply to the problem at hand. Although it is true adult learners do have a varied and rich depth of knowledge and experience, it is concerning that this would be the basis of schema development related to clinical nursing practice in simulation. Many students do not have exposure to the clinical setting, and if they do it is not in the role of a nurse. To assume that a novice student will extrapolate the correct clinical judgment for a simulation from their life experience and didactic content only is naïve. Furthermore, if the schema already in place is rigid, incorrect, or based in assumptions, this can lead to continuing use and support of a flawed schema in nursing practice. Therefore, there is support for the use of the worked out modeling to provide rationale for schema development and an appropriate experiential component that the student can retrieve when needed.

Learning in simulation is often seen to take place in the debriefing experience post simulation. Debriefing is the activity that "follows and simulation experience and is led by a facilitator. Participants reflective thinking is encouraged and feedback is provided regarding the participants performance…the purpose of the debriefing it to move toward assimilation and accommodation to transfer learning to future situations (Meakim et al., 2013, S5)." This is the ideal and often may not be met (Waznonis, 2014). Debriefing varies by facilitator and institution as well as the events of the simulation. The focus solely on debriefing as the learning venue for simulation assumes the student actively reflects and critiques their performance as well as identifies gaps in their knowledge or skills. Again this places the responsibility for accurate rationale concerning clinical decision making almost solely in the student, who is a novice nurse at best. The faculty facilitator may provide information that focuses on “analogical reasoning” (Zigmont et al., 2011, p. 50), which focuses on an outcome analysis and may not support the development of schemata that is transferable to a variety of clinical and patient situations. This provides a support for the use of worked out modeling as well, since as the student views the modeling and listens to the rationale for the clinical judgment the student is able to create an appropriate schema that ideally is transferrable.

Furthermore, simulation is saddled with mental load issues. Any nursing educator that uses simulation will be able to share some experience in which a student fled the simulation crying, or became “frozen”, etc. There are many reasons why this may occur such as the anxiety of being videotaped, the concern for confidentiality about performance, and being observed by peers. In addition, some students have fears concerning manikins, or the simulation itself brings up a traumatic event such as the death of an infant. Whatever the reason, simulation participation contributes to increased anxiety in nursing students (Willhaus, Averette, Gates, Jackson, & Windnagel, 2014). The use of worked out modeling ideally can decrease mental load through exposure to the clinical situation prior to the simulation, modeling of appropriate behaviors and skills, and addressing rationale for interventions so the student may possess more confidence in their abilities.

Chapter Summary

Research suggests that critical thinking skills and knowledge gained plays a role in nursing performance and relates to positive patient outcomes (Hauber, Cormier, & Whyte, 2010). Therefore, it is essential that simulation educators have an understanding of cognitive architecture and how the simulation experience may create cognitive load. If learners are participating in simulation that has high cognitive load and overwhelms their working memory then critical thinking and learning is inhibited. Even as educators are working diligently to create reflective debriefings and collaborative practice skills, these too will not be effective if the areas of collective working memory, redundancy, spilt attention and cognitive architecture are not addressed (Chandler & Sweller, 1991). Furthermore, educators are obliged to look past a “one size fits all” simulation template and assess their learners for prior knowledge and potential achievement so that the learner’s zone of proximal development is addressed.

Educators can utilize numerous aspects of CLT to improve simulation practice such as scaffolding, worked-out examples, and self-explanation technique. Many educators may be using these practices currently, but perhaps ineffectively because the practices have not been grounded in CLT principles. Ultimately, as simulation designers and educators we must be cognizant of the limitations of working memory and cognitive load if we desire learners to create knowledge and schemas and enhance critical thinking skills through the simulation experience. We must also provide our learners simulations that represent real life experiences with varied examples of nursing practice schemas in order to enhance transferability of skills and knowledge to various nursing situations.

This research provides a framework for further research in nursing simulation related to CLT and the application to simulation. In addition, this research provides a model of viewing cognitive architecture and how this might affect the learning experience in simulation. Nursing educators can use this model when designing and implementing future simulations. The next chapter will review methods of this research and discuss implications for future research in nursing education.

CHAPTER THREE: RESEARCH DESIGN AND METHODS

Purpose of Study

The purpose of this study is to ascertain whether the use of worked out modeling affects student knowledge acquisition and self-reported cognitive load in a nursing simulation. The worked out modeling construction is based upon the cognitive load theory (CLT) instructional intervention of the worked out example. Due to the technical and complex decision making aspects of nursing simulation, this instructional technique inherently carries a high cognitive load. It is surmised by this investigator that the high cognitive load experienced in the simulation setting can affect learning negatively through overload of the working memory. This study will examine whether students offered worked out modeling paired with a verbal description of the nurses clinical judgment processes pre-simulation, experience decreased extraneous cognitive load, increased germane load, and increased learning in nursing simulation.

The use of simulation in nursing curriculum has grown exponentially, with some states allowing up to 25% of clinical hours to be conducted in the simulation setting (Jeffries, 2009). Therefore, it is important to understand the student learning process in simulation. Specifically, what may hinder learning and what interventions may assist the student in development of schemas related to clinical issues that can be translated into their future nursing practice. There has been little research conducted specific to worked out modeling and simulation, and what has been conducted has not been based in CLT.

This study will add to the discipline of simulation education in nursing and may provide a framework for future research in examining the role of cognitive load and/or worked out modeling in simulation learning and design.

Research Questions

- Is knowledge acquisition affected by worked out modeling?
- Is self-reported cognitive load affected by worked out modeling?

A quantitative quasi-experimental approach was used for this study (Creswell, 2008). A convenience sample of senior level nursing students who had previous experience with simulation was studied. These students self selected time slots per the eight groups of simulation times offered over the course of two days. Each group had eight slots each for a total of 64 time slots. Students selected their simulation times via the Signup Genius© application. With this application the available simulation times were entered and each student chose a time that worked with their individual schedules. Adjustments were not made to the student self selected time slots, as there are several issues to be taken into account when modifying groups, such as the simulation centers schedule and the students class and clinical schedules. The first four simulation groups were used as the control group and the last four were the treatment group, so there was no ability for the students to talk amongst themselves concerning the worked out modeling presented to the treatment group. Baseline knowledge data was collected concerning the simulation objectives via survey prior to the simulation experience, and then again post simulation/intervention to determine if the worked out modeling intervention had any effect on post simulation knowledge attainment. See Figure 3.1 for design diagram.

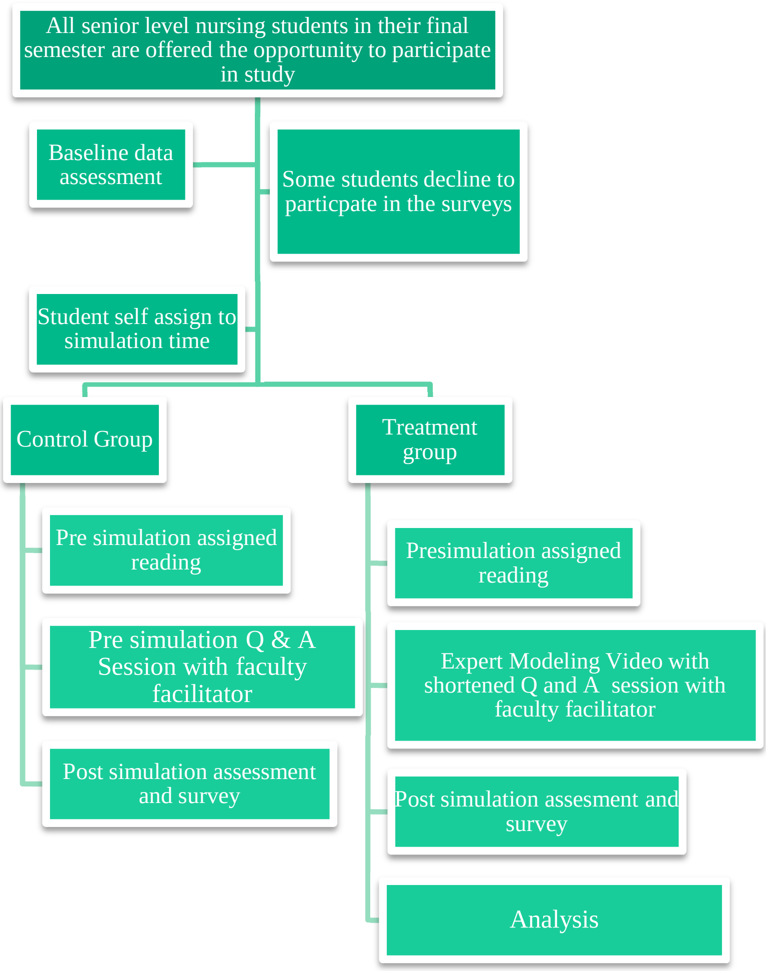

Figure 3.1. Research Design Diagram and Flowchart

Validity

Considering the limited availability of research concerning the application of CLT to nursing simulation the theory of action model centered in construct validity is being utilized. This type of model is often appropriate when there is not a conclusive criterion measure available and indirect measures are utilized to validate the theory or question being examined (Shepard, 1993). In this validity model, the constructs to be measured must be connected to the other theoretical constructs affecting the study. A construct in this case is "a network of associations or propositions in which it occurs…construct validation is possible only when some of the statements in the network lead to predicted relations among observables… (Shepard, 1993, p.416).” The internal model of this study’s construct validity is available in Figure 3.2.

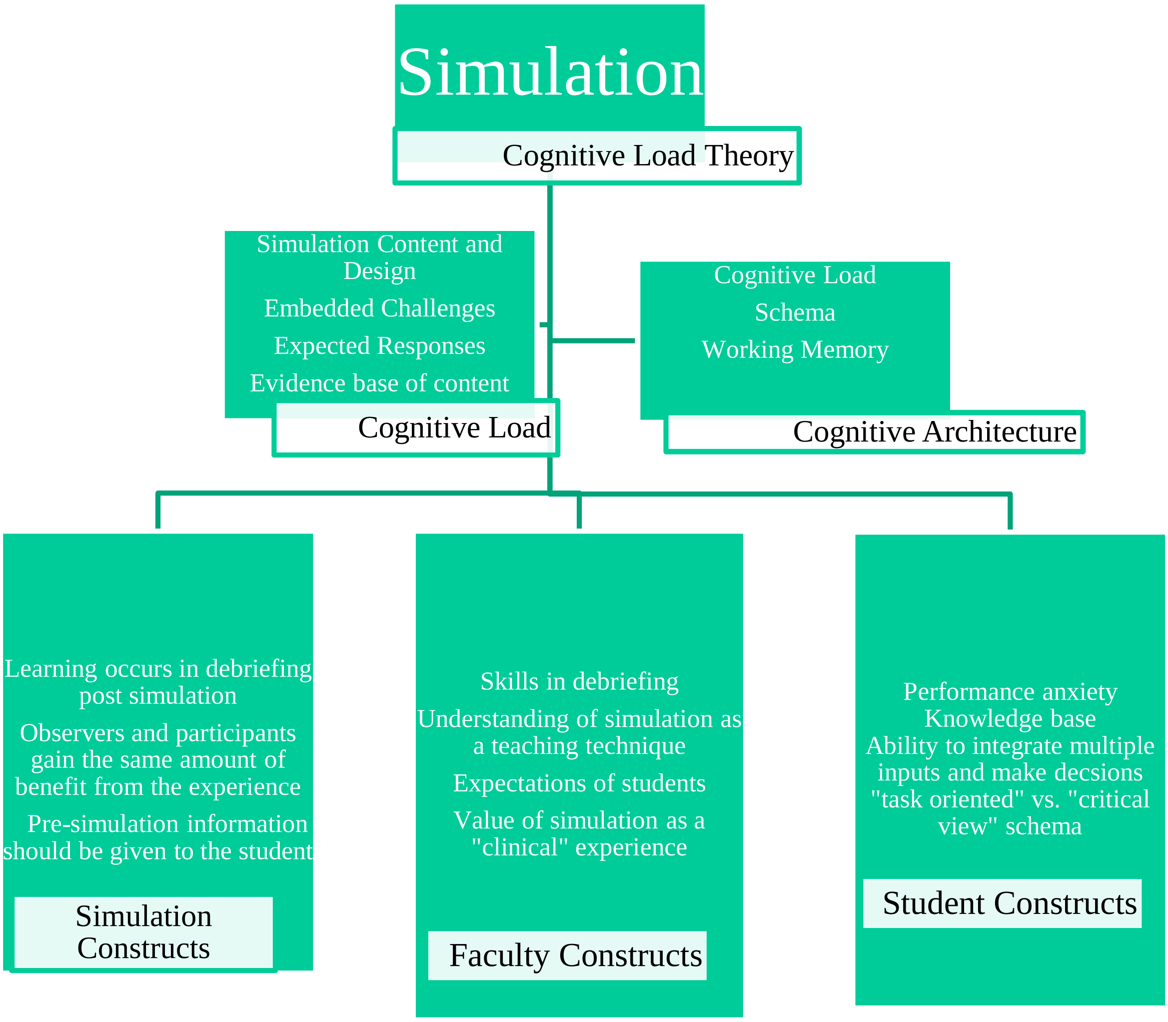

Figure 3.2. Research Design Construct Validity Model - This Internal Model Identifies The Theoretical Interrelationships Between The Various Constructs Concerning CLT And Nursing Simulation. (Adapted from Bell et al., 2012, p. 64).

In addition to a framework of construct validity that directs concept application, the theory of action model of validity is used. In this framework, examination of the proposed measurement interpretations, consistent measurement procedures related to the proposed use, and providing evidence to support assumptions is required (Kane, 1992). Use of the theory of action framework can delineate the interpretive argument and assist in visualization of the validity model. The interpretive argument in theory of action "focuses on the use of assessments to enhance individual…or institutional…performance (Bennett, Kane, & Bridgeman, 2011, p. 3)." Since the goal of this study is to ascertain whether the use of worked out modeling improves knowledge attainment and positively affects cognitive load, this study is focused on assessment to enhance the performance of the individual and the use of simulation in the nursing discipline. See Figure 3.3.

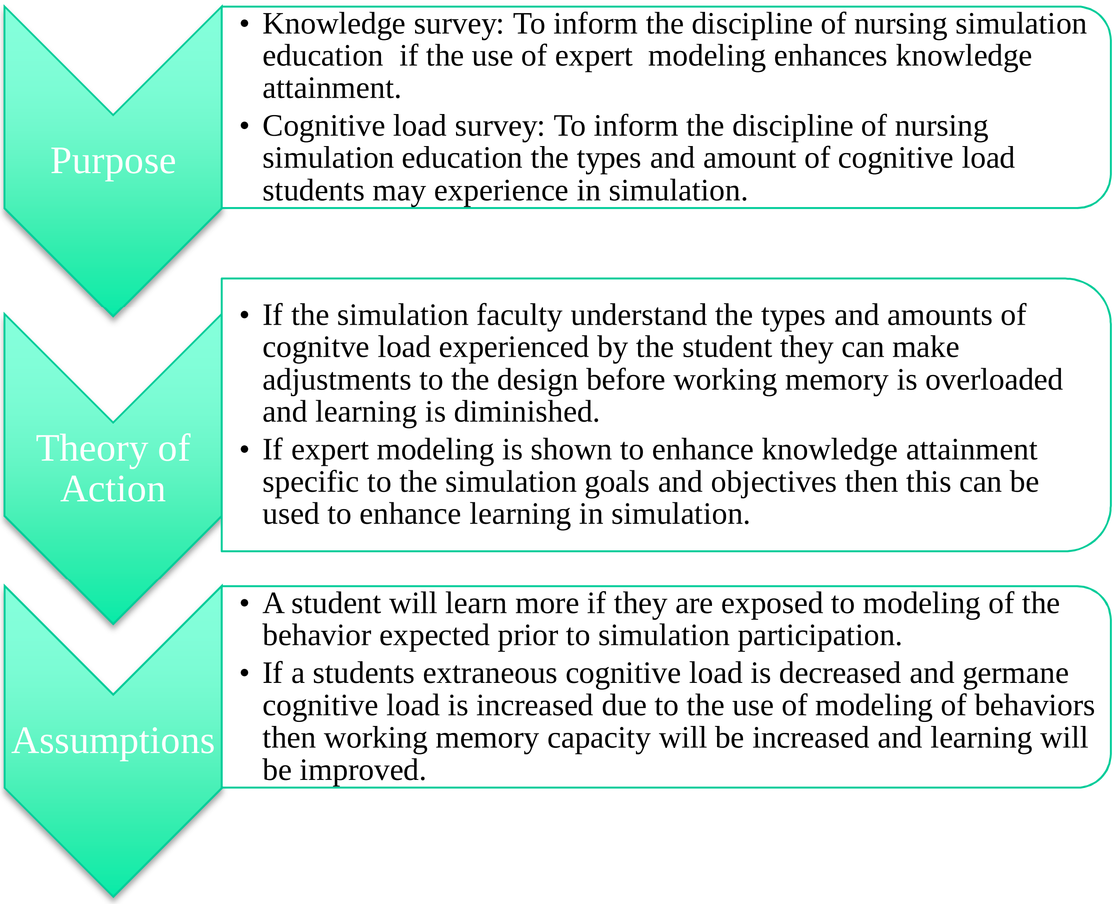

Figure 3.3. Theory of Action Framework Applied to Project

Use of the theory of action approach ideally enhances the ability to improve test design and to guide further research endeavors (Bennett et al., 2011). This approach brings ethical issues in interpretation of the data to the forefront, such as researcher bias and/or assumptions, and allows for a more transparent and evidence based approach to research. Many decisions concerning educational techniques and interventions are based upon research and the originating foundation of conclusions made. The need for an evidence-based argument on interpretation of data is fundamental to simulation research as much of the research is observation based. Thus, for the purpose of this study, the expected student behaviors and responses have to be predefined and connected theoretically and logically to the concept being evaluated.

Use of a cognitive load measurement tool that addresses the differentiation of various types of cognitive load is also important. This is of particular significance when examining simulation experiences and the behaviors students' exhibit during participation in simulation. It may appear obvious that the student is experiencing cognitive overload in simulation, but there may be many factors affecting cognitive load, such as the student's experience with simulation or maturity level. Therefore, the types and amount of cognitive load must be defined prior to measurement and connection to learning and acquisition of knowledge is required to be examined as well.

Scrutiny of internal validity limitations is also necessary, as this type of validity addresses how confidently the differences between the treatment and control group can be attributed to the intervention being studied. In this research project the threats to internal validity may be survey administration and instrumentation. To address these issues another faculty collected the surveys pre and post simulation with strict guidance as to what information could be given to students. To address the instrumentation issue, a pilot of the surveys was given to some students and faculty in an effort to gain feedback on the question constructs, length of time needed to complete the test, and value of questions from the student and faculty perspective. Several faculty reviewed the survey; two of the faculty experts certified in nursing simulation education. Changes to the initial survey were made based upon the faculty and expert feedback.

Methods

This study is a comparison of two differing simulation preparation instructional activities. The control group received the usual assignment of pre reading and a fifteen-minute question and answer session. The experimental group received the pre reading assignment with the addition of a ten-minute worked out modeling video and a shortened question and answer session. The pre reading assignment was posted two weeks prior to the simulation on the Blackboard™ course site. Currently there is no requirement to turn in an assignment or proof of completing the reading prior to simulation participation. Students were asked to self-report whether they completed the pre reading activity in the post simulation survey.

Choice of Simulation

Upon review of the available simulations and faculty who could assist with simulation facilitation and debriefing, as well as time constraints related to when the simulations are scheduled to be offered during the semester, the two patient simulation concerning delegation and decision making at the senior level was chosen to design the worked out modeling video around and to collect data for this study. These students had experience in simulation throughout their nursing education and were due to graduate upon completion of the final semester in which this simulation was offered. This simulation had several components related to cognitive load, such as multiple patients, delegation, and acute incidents. In addition, the simulation is placed in the final semester before graduation. This was ideal, as performance could be measured concerning key nursing skills needed upon graduation, giving insight to student preparedness for graduate practice. See Appendix A for the simulation description.

Standard practice for vetting a simulation at this university was to have the simulation constructed using the National League of Nursing simulation template and then reviewed by a content expert. Then the simulation is piloted with a group of faculty and student volunteers. After the pilot run changes to the simulation are made as needed.

This particular simulation had already been reviewed by an expert in the field, piloted, and been offered over the course of several semesters.

Schedule of Simulation

The simulations are set to run in two-hour blocks. Table 3.1 provides the timeline that was followed to ensure both treatment and control groups had the same amount of time for their specific teaching intervention.

Table 3.1
Sample Simulation Timeline

Control Group	**Treatment Group**
1000-1010 students arrive are oriented to the simulation center.	1000-1010: students arrive and are oriented to simulation center.
1010-1025: students review readings as a group, and question and answer session.	1010-1025: worked out modeling video and question and answer session.
1030-1035: Simulation Review: Roles and objectives	1030-1035: Simulation review: Roles and objectives
1035-1040: Student Planning	1035-1040: Student Planning
1040-1115: Simulation	1040-1115: Simulation
1115-1145: Debriefing	1115-1145: Debriefing
1145-1200: Surveys	1145-1200: Surveys

Prebriefing/Debriefing

To address reliability between the treatment and control group, both faculty involved in the simulations followed the same prebriefing and debriefing framework. For debriefing the model utilized focused on noticing, interpreting, responding, and reflection (Tanner, 2006). Post simulation the students were led through this format of debriefing in an effort to enhance learning from the simulation experience. As for the pre simulation briefing the control group reviewed pre readings as a group, reviewed roles of the simulation and had a question answer session. The treatment group was shown the worked out modeling video, reviewed roles of the simulation, and then had a question and answer session. See Figure 3.4.

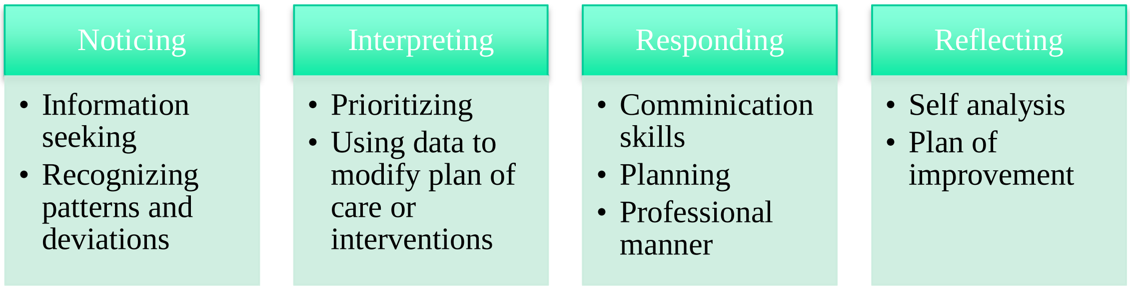

Figure 3.4. Debriefing Model used for Project (Adapted from Cato et al., 2009, p. 107)

Learner Preparation

Both treatment and control group had the opportunity to participate in pre-simulation preparation. See Appendix B for assigned learner preparation.

Treatment versus Control Intervention

The control group received the learner preparation assignment and then engaged in the standard simulation pre briefing practice of orientation to the simulation center, review of simulation roles and objectives and an approximately 15 minutes discussion concerning the materials assigned and any questions or concerns the students may have prior to the simulation with the faculty facilitator.

The treatment group received the learner preparation assignment and was offered the standard simulation pre briefing practice of orientation to the simulation center, review of simulation roles and objectives, and an approximate 10 minute worked out modeling video related to the simulation content followed by an approximate 5 minute question and answer session with a faculty facilitator prior to the simulation.

Data Collection

Institutional review board approval was granted for this study. See Appendix C for IRB approval letter. Baseline data was collected in person during a student class on January 30, 2015. The faculty running this course gave permission for this data collection during class time. Since not all students had computers available during this time to complete the survey the first survey was given in paper/pencil multiple choice format and these data were entered into SPSS manually. Data from the post simulation/intervention surveys were also collected via paper/pencil and the data manually entered into SPSS for statistical analysis.

The simulations were run over the course of two days. There were eight groups of seven to eight students. The students self selected the day and time they attended the simulation. Three groups ran day one and five groups ran the next day. The worked out modeling video was not placed on Blackboard™ for students to view, but rather offered during the simulation pre briefing time. This addressed concerns that students might share the video or its contents with other students not in the treatment group. To deal with the issue of the treatment group getting more time for pre simulation activities prior to the simulation running, the worked out modeling video was offered and then students were provided a shorter five minute timeframe for questions and answers. Furthermore, to decrease the likelihood that some student groups would share that information with the other groups, thus affecting the validity of the data collected, the first four groups were designated the control group and receive the usual pre-simulation intervention and question and answer session and the last four groups were the treatment group and received the worked out modeling video with a five minute question and answer session.

Since faculty often have differing ways of addressing the question and answer session, simulation, and debriefing only one faculty facilitated the treatment group and one faculty facilitated the control group, both following the same pre orientation and debriefing format. Surveys concerning cognitive load and post knowledge were given post simulation.

Worked Out Modeling Video

The independent variable of this research project was the use of worked out modeling as a pre activity to the simulation experience. Currently, prior to simulation students are given some pre work such as readings or questions to answer, but the current pre work does not include any modeling of the behavior or skills expected in the simulation experience. Worked out modeling in this case is based upon the CLT worked out example instructional strategy, specifically using the concept applied to an ill structured learning domain. It may be argued that nursing is a well-structured domain, as often there are healthcare algorithms or clearly defined problems, but nursing interventions are dependent upon the patient condition, which is often ill defined and variable. Whatever the problem situation, the nursing student must be able to develop a schema based on the knowledge related to the patient condition that will allow the student to recognize and plan for potential problems of care (Sweller, Ayres, Kayluga, 2011).

The value of worked out modeling is that the experienced nurse may choose solutions, thinking processes, or steps that may not be obvious in the well defined checklist approach to a nursing skill.

Typically, Benner's novice to expert model, in which many of the definitions for the expert nurse is based, is viewed from the perspective of the graduate nurse, newly out of school, to the twenty-year veteran nurse. Indeed, Benner has identified that it takes five or more years for the novice nurse to reach expert ability and that some will never reach expert status (Carlson, Crawford, & Contrades, 1989). If in the simulation experience we are relying on students to "guide" each other through the pre-simulation assignment and then through the simulation themselves, they are not being afforded the advantage of the experienced nurse, their knowledge, and interpretation of appropriate clinical judgment.

In reference to this specific simulation the focus of the worked out modeling video was on the use of SBAR (situation, background, assessment, and recommendation) for report and communicating with other professions. Additionally, the use of initial assessment, problem solving, and delegating appropriately were central themes. Lastly, the use of critical thinking skills in report, patient care and assessment, and interaction with professional staff and patients were modeled.

A medical surgical nurse with seven years of floor experience as well as charge nurse experience provided the modeling of competent nursing in the worked out modeling video. In addition, an aide with over ten years of experience performed the modeling of accepting delegation from the nurse as well as other aide appropriate activities. Each aspect of the simulation was modeled by the nurse, aide, or both the nurse and aide as appropriate in order to model for the learner a schema that could be utilized to address the problem events in the simulation. Each scene of the simulation was shot using the cameras and audio available in the simulation center with the assistance of a simulation technician. The video clips were combined via I Movie® to create a 10 minute video that modeled each event of the simulation and how a competent nurse would address the issue. In addition, the nurse went over problem solving tactics and how decisions were made verbally either while addressing the issue or afterwards in an interview session. A faculty member certified in simulation education and familiar with the simulation objectives reviewed the video for content and appropriateness prior to the video being shown to the participating students. See Appendix D for the worked out modeling video outline, scenes, and sample clip link.

Instruments

Cognitive Load Measurement.

The cognitive load measurement tool utilized was adapted from the Leppink, Paas, Van der Vlueten, Van Gog, and Van Merrienboer (2013) measure. The tool was validated utilizing complex knowledge disciplines such as statistics, which requires understanding of the interrelation of statistical concepts as well as conceptual relationships. Leppink, et al. indicated that with minor modifications the items on the measurement tool could be used in research in other complex knowledge disciplines. Reported R^2 and Cronbach's Alpha showed high reliability for the three-factor survey model, which addresses intrinsic, extraneous, and germane cognitive load (Leppink et al., 2013).

Initially, the adapted instrument calls for the student to self-report demographic information, such as gender, age, second-degree status, and role in the simulation. The survey then offered various questions concerning intrinsic, extraneous, and germane load rated on a scale of 0 to 10 (with 0 meaning not at all the case and 10 meaning completely the case). Questions 1, 2, and 3 addressed the issue of intrinsic load and perceived complexity of the simulation, the concepts, and pathophysiology covered in the simulation experience. Questions 4, 5, and 6 addressed extraneous load, asking the student about clarity of instructions, explanations and language, as well as perceived effectiveness of the learning experience. Questions 7, 8, and 9 addressed the area of germane load, asking student perceptions concerning whether the simulation experience enhanced their knowledge and understanding of the concepts covered. Lastly, general questions were asked concerning overall cognitive load perceived on a scale of 1 (very, very, little) to 9 (very, very much), identified by the amount of mental effort, difficulty of the simulation, ease of learning, and level of concentration the student self-reported. See Appendix E for full survey utilized.

Pre Knowledge/Performance Measure.

As there were not any measurement tools validated for reliability specific to nursing simulation and cognitive load theory found, other disciplines and tools were evaluated for application to measurement design in this study. When constructing the pre knowledge baseline data survey and the post simulation knowledge acquisition measure the Leppink et al. (2013) tool was examined for application. Part of this tool does address pre and post knowledge measurement, evaluated via a case study and/or word problem type questions. Additionally, the concept of knowledge transfer levels based on worked solutions and modeling assumptions was examined and integrated into the pre and post knowledge measure questions (Klenk & Forbus, 2007).

Specific to the field of healthcare the Fletcher et al. (2004) rating scale on non-technical skills system for anesthesiologists was examined and applied to the pre and post knowledge survey development. While this rating system is based in industrial psychology it does have application to behavioral indicators desired in this particular simulation, as many aspects of skills desired are non-task oriented, but rather leadership and collaborative practice focused. The Fletcher et al. (2004) rating system provided insight into these types of professional practice issues that could be evaluated such as, managing resources, situational awareness, prioritizing, case collaboration and working with others to achieve goal. See Table 3.2.

Table 3.2
Survey Design Framework Specific to Each Survey

Assessment	Content Focus	Administration	Task Types	Purpose
Cognitive Load Survey	Intrinsic, Extraneous, and Germane Load. Student perceived effort and benefit of simulation experience.	Post Simulation Paper/Pencil Items recorded in SPSS	Likert Scale	Identify level of cognitive load and types experienced
Pre/Post Knowledge Survey	Simulation objectives: Clinical Reasoning & Critical Inquiry Communication Experiential Learning Professionalism & Leadership	Pre and Post Simulation Paper/Pencil Items recorded in SPSS	Multiple Choice	Identify if there is a difference pre and post simulation related to knowledge acquisition per survey results

Pre and Post Knowledge Survey.

The pre and post knowledge survey was based upon specific objectives of the simulation. The simulation objectives centered on the school's curricular threads of clinical reasoning, communication, professionalism, and experiential learning. Specific objectives related to recognition of signs and symptoms of bowel obstruction and dehydration, use of SBAR (situation, background, assessment, and recommendation), assessment, prioritizing and planning care, and appropriate delegation. The survey began with the presentation of four different patients, two of which were the patients in the simulation. The student was then asked questions related to symptoms and interventions concerning a bowel obstruction and dehydration as well as delegation and prioritization of cares. Furthermore, questions were offered specific to SBAR, time management, and prioritization of care. The questions were offered in a NCLEX (National Council Licensure Examination) style, multiple-choice format. The knowledge survey was scored either correct or incorrect, based on the choices the student made. See Appendix F for the full survey.

Participants

This study focused on a sample of baccalaureate senior nursing students who participated in simulation as part of their nursing curriculum. The sample for the purposes of this study was a convenience sample of senior nursing students who are enrolled in the nursing 427-preceptorship course. As part of this course the students are required to participate in several simulation experiences. All students enrolled in the course were offered the opportunity to participate in the study. There were a total of 63 students in this course, and 61 students chose to participate in this research for a 97% response/participation rate.

<u>Response Rates</u>

Data was collected via a total of three surveys. The first survey was a pre knowledge test related to simulation content. The pre knowledge survey was administered during a class time when most of the students who would be participating in the simulation were in attendance. A total of 46 out of the 63 possible students participated in both the pre knowledge and post knowledge survey for a 73% response rate.

The second survey was the post knowledge survey given after students participated in the simulation. This survey was identical to the pre knowledge survey and the pre and post knowledge scores of treatment and control groups were compared to see if there were differences between groups. Again a total of 46 out of the 63 possible students participated in both the pre and the post knowledge survey. Several other students did participate in the post knowledge survey only for a total of 60 out of the possible 63 students participating in the post knowledge survey for a 95% response rate.

The last survey was given post simulation participation to a total of 61 students out of a potential 63 students for a 97% response rate. This survey gathered information specific to the amount and type of cognitive load experience by students. The cognitive load survey was adapted from the Leppink et al. (2013) cognitive load survey. The adaptations to the survey centered on matching the focus of the questions with the nursing simulation setting. In addition the students was asked to rate their level of concentration and mental effort during the simulation. Information was also gathered on student role in the simulation (participant or observer), age, gender, and second-degree status.

Baseline Data Differences

The pre knowledge survey was examined to determine if there were significant differences in pre knowledge related to the treatment and control groups. A one-way ANOVA was conducted with a .05 p value to determine if the pre knowledge differed among the treatment and control groups. A one-way ANOVA was used to do this comparison as there was only one factor used to classify the groups, treatment or control (Field, 2009). No significant differences were found between groups when running the one-way ANOVA see table 3.3. With this analysis it can then be assumed that the pre knowledge of the control and treatment groups were similar and likely did not affect the outcome of the post knowledge survey intervention.

Table 3.3
Control and Treatment Group Pre Knowledge Survey Comparisons (N=48 Treatment Group=25 Control Group=23)

Question	Mean and Standard Deviation: Treatment Group	Mean and Standard Deviation: Control Group	P value
Signs and Symptoms of Bowel Obstruction	M: .5200 SD: .5099	M: .4348 SD: .5068	.565
Appropriate Delegation	M: .3600 SD: .4899	M: .3913 SD: .4990	.827
Use of Situation, Background, Assessment, and Recommendations report tool	M: .4400 SD: .5066	M: .4348 SD: .5968	.972
Use of Medications	M: .2000 SD: .4082	M: .2609 SD: .4489	.625
Fall Interventions	M: .8400	M: .7391	.401

	SD: .3741	SD: .4489	
Delirium Interventions	M: .3200 SD: .4671	M: .2174 SD: .4217	.435
Initial Assessment	M: .3600 SD: .4899	M: .4783 SD: .5107	.417
Prioritization of Initial Cares	M: .6800 SD: .4899	M: .5217 SD: .5107	.272
Prioritization of Tasks	M: .2400 SD: .4358	M: .2609 SD: .4489	.871
Time Management of Shift	M: .3200 SD: .4761	M: .1739 SD: .3875	.252

Participant Demographics

In order to ensure that the treatment and control groups were similar in terms of demographic makeup and completion of the pre-reading a x^2 was used to determine whether there were significant differences (Field, 2009). The results identified that there was not a significant association between the treatment and control groups concerning gender, second degree status, pre-reading completion, age, and role.

Gender x^2 (1)=1.201, p .273, second-degree status x^2 (1)= 1.201, p .273, pre-reading completion x^2 (1)= 1.300, p .254, and age x^2 (4)=5.408, p .248, role x^2 (1)= .066, p .798. See Table 3.4 for overall demographic information.

Table 3.4
Participant Demographics (N=61)

	Simulation Role:	Second Degree Student:	Gender:	Completed Pre-reading:	Age Groups
Treatment Group	Observer=15 Participant=12	Yes=6 No=21	Male=6 Female=21	Yes=26 No=1	20-25= 13 26-30= 2 31-35=5 36-40=5 Over 40=2
Control Group	Observer=20 Participant=14	Yes=4 No=30	Male=4 Female=30	Yes=30 No-4	20-25= 17 26-30= 6 31-35=5 36-40=1 Over 40=4 Unidentified=1

As seen in Table 3.4, the treatment and control groups look similar and therefore post-intervention differences cannot be attributed to pre-existing differences between the control and treatment groups.

Chapter Summary

This quantitative quasi-experimental study design utilized a convenience sample of senior baccalaureate students in the school of nursing program who participate in a simulation as part of their normal coursework. Students were given a pre knowledge survey prior to completing the simulation pre activity or the simulation itself to gain baseline knowledge data. Students self selected their simulation time slot per simulation center and course guidelines. There were 8 groups of students of between 7 and 8 students. Of the 63 students in the course 61 students participated in this research project.

The first four simulation groups were in the control group and were given the usual pre simulation assignments as well as the usual pre briefing and debriefing. The last four simulation groups were the treatment group and were given the usual pre simulation assignments and the usual pre briefing and debriefing, but were also given a worked out modeling video concerning simulation content to view prior to simulation participation. All students were given a post knowledge and cognitive load survey post simulation participation. ANOVA analysis of the data was conducted via the SPSS® program.

CHAPTER FOUR: RESULTS

Overview

This study utilized a quasi-experimental design with a convenience sample of senior baccalaureate nursing students, to examine the following research questions.

Research Questions

- Is knowledge acquisition affected by worked out modeling?
- Is self-reported cognitive load affected by worked out modeling?

Preliminary Analyses

To answer the first question, a one-way analysis of covariance (ANCOVA) was conducted for each dependent variable related to cognitive load. Key outcome variables of cognitive load included intrinsic, extraneous, germane, and overall perception of cognitive load. To answer the second question, a one-way analysis of variance (ANOVA) was conducted on each dependent variable associated with performance. Key outcome variables related to performance included knowledge of signs and symptoms of a bowel obstruction and dehydration, delegation, use of SBAR, nursing interventions, assessment, and time management and prioritizing patient care.

The assumptions of the ANOVA and ANCOVA were analyzed for violations. The assumption of independence, that the observations are independent of each other within and between samples was tested. The assumption of normality, that the population followed a normal distribution was evaluated as well. Lastly, the assumption of homoscedasticity, that the population variances are equal was tested (Lomax & Hahs-Vaughn, 2012). The data did not violate any assumptions; see specific assumption analysis results below.

<u>Assumption of Independence</u>

Since this research utilized a quasi-experimental design due to student self selection of simulation times extra precautions were made to address the assumption of independence. In this case, the treatment and control groups were kept separate and unaware of the intervention so the control group could not influence the treatment group and vice versa through discussion of the intervention. Furthermore, a residual plot of both groups was run and the residuals were found to fall into a random display for each group (Lomax & Hahs-Vaughn, 2012). See Figure 4.1 for sample scatterplot.

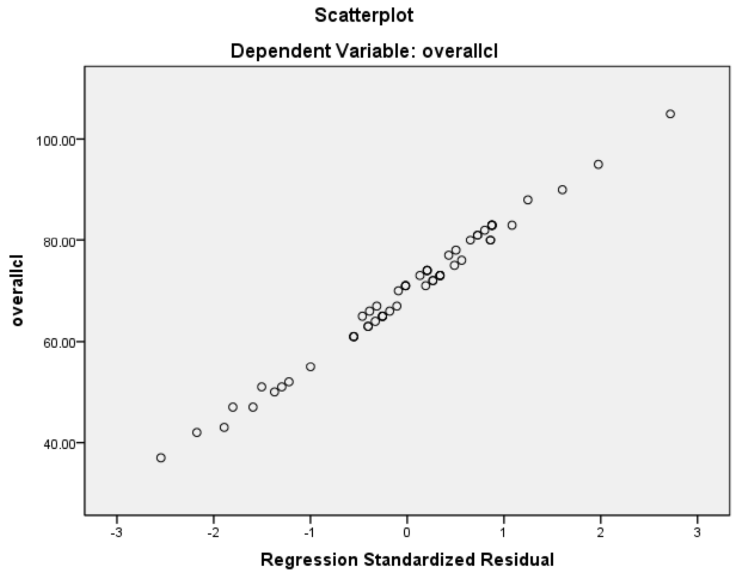

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Figure 4.1. Sample Residual Scatterplot of Overall Cognitive Load

Assumption of Normality

To address the assumption of normality, histograms were graphed to look for a normal distribution over the groups. The histograms identified a normal distribution, so the assumption of normality was met (Lomax & Hahs-Vaughn, 2012). See Figure 4.2 for sample histogram.

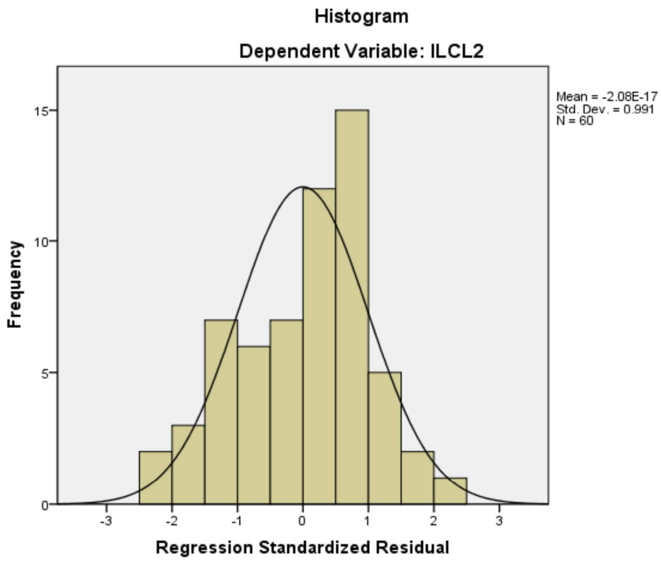

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Figure 4.2. Sample Histogram of Intrinsic Load

Assumption of Homogeneity of Variance

The homogeneity of variance assumption was addressed by the use of the Levene's test throughout the research where sample groups were fairly even with a p value of greater than .01 (Field, 2009). See Table 4.1 for statistics.

Table 4.1
Levene's Test Results Pre-Knowledge Survey and Cognitive Load Survey

Pre Knowledge Questions	Levene's test	Cognitive Load Questions	Levene's test
PreSOBSS1	F (1,46)=. 308, ns	Topic1	F (1,59)=. 100, ns
PreDelegation2	F (1,46)=. 188, ns	Patho2	F (1,59)=3.39, ns
PreSBAR3	F (1,46)=. 005, ns	Complex3	F (1,59)=2.66, ns
PreMeds4	F (1,46)=. 967, ns	Unclear4	F (1,59)=3.05, ns
PreFall5	F (1,46)=2.92,ns	Ineffective5	F (1,59)=6.00,ns
PreDelerium6	F (1,46)=2.54,ns	Language6	F (1,59)=. 012,ns
PreAssessment7	F (1,46)=1.74,ns	Understanding7	F (1,59)=. 166,ns
PrePrioritize8	F (1,46)=3.13,ns	NursingProcess8	F (1,59)=. 890,ns
PrePrioritize9	F (1,46)=. 106,ns	Disease Process9	F (1,59)=1.92,ns
PreTimeManagement10	F (1,46)=5.71, ns	Definitions10	F (1,59)=4.31, ns
		Learning11	F (1,59)=. 101,ns
		Concentrate12	F (1,59)=. 415,ns
		MentalEffort13	F (1,59)=. 523,ns
		Difficulty14	F (1,59)=2.12,ns

Data Analyses

<u>Worked Out Modeling Treatment vs. Control Groups</u>

- Is self-reported cognitive load affected by worked out modeling?

For questions 1 through 10 an aggregate mean score was calculated for each type of cognitive load. Questions 1 through 3 and 12 measured intrinsic load, 4 through 6 and

13 extraneous load, and 7 through 10 and 14 germane load. The means of the scale scores are presented in Table 4.2.

For each participant items 1 through 3 and 12 were combined to create an Intrinsic Load Scale aggregate score (which had acceptable internal consistency reliability, Cronbach's alpha = .775). This scale had a maximum score of 10 and a minimum score of 0. The mean Intrinsic Load score was computed across participants in each group, see Table 4.2.

For each participant items 4 through 6 and 13 were combined to create an Extraneous Load Scale aggregate score (which had poor internal consistency reliability of, Cronbach's alpha = .384). The questionable reliability suggests a need to interpret results of this scale with caution. This scale had a maximum score of 10 and a minimum score of 0. The mean Extraneous Load score was computed across participants in each group, see Table 4.2.

For each participant items 7 through 10 and 14 were combined to create a Germane Load Scale aggregate score (which had good internal consistency reliability, Cronbach's alpha = .841). This scale had a maximum score of 10 and a minimum score of 0. The mean Germane Load score was computed across participants in each group, see Table 4.2.

See Tables 4.2 and 4.3 below for scoring and reliability measures.

Table 4.2
Cognitive Load Self Ratings Reliability Across Participants in Each Group

Load Type	Treatment Group Mean	Control Group Mean	Chronbach's Alpha	Confidence Interval 95%
Intrinsic Load (Questions 1-3 and 12)	M= 19.70 SD=6.12	M=18.66 SD= 6.53	.775	[17.49, 20.76]
Extraneous (Questions 4-6 and 13)	M= 7.69 SD= 5.93	M= 8.12 SD= 5.73	.384	[6.42,9.43]
Germane (Questions 7-10 and 14)	M= 37.15 SD= 9.29	M=35.61 SD= 7.61	.841	[34.12, 38.43]
Overall Cognitive Load (All Questions)	M= 71.23 SD= 13.31	M= 68.43 SD= 13.55	.736	[66.16, 73.21]

Table 4.3
ANOVA Cognitive Load Survey Analysis (N = 61 Treatment =27 Control= 34)

Load Type	F	Df	P value	Partial Eta Squared	MSe
Intrinsic Load (Questions 1-3 and 12)	.395	1, 59	.532	.007	1.64
Extraneous (Questions 4-6 and 13)	.079	1, 59	.780	.001	1.52
Germane (Questions 7-10 and 14)	.495	1, 59	.484	.008	2.18
Overall Cognitive Load (All questions)	.619	1, 58	.435	.011	3.55

<u>Post Knowledge Analysis Treatment vs. Control Groups</u>

- Is knowledge acquisition affected by worked out modeling?

There were ten measures of knowledge assessed in this study: signs and symptoms of bowel obstruction, delegation, use of SBAR, use of medications, fall interventions, delirium interventions, assessment, prioritization of cares and tasks, and time management. For each measure mean performance was computed across participants in the treatment and control groups (see Table 4.4). The group means were compared using an ANCOVA, with pre test knowledge entered as a covariate, in order to control for potential differences in prior knowledge between groups.

Table 4.4
Comparison of Post Knowledge Means Treatment vs. Control Groups (N=46 Treatment Group=25 Control Group=21)

Question	Mean and Standard Deviation: Treatment Group	Mean and Standard Deviation: Control Group
1. Signs and Symptoms of Bowel Obstruction	M: .840 SD: .374	M: .666 SD: .483
2. Appropriate Delegation	M: .600 SD: .500	M: .523 SD: .511
3. Use of Situation, Background, Assessment, and Recommendations report tool	M: .640 SD: .489	M:. 571 SD: .507
4. Use of Medications	M: .080 SD: .276	M: .190 SD: .402
5. Fall Interventions	M: .1.0 SD: .000	M: .761 SD: .436
6. Delirium Interventions	M: .160 SD: .374	M: .190 SD: .402
7. Initial Assessment	M: .600	M: .619

	SD: .500	SD: .497
8. Prioritization of Initial Cares	M: .720 SD: .458	M: .809 SD: .402
9. Prioritization of Tasks	M: .360 SD: .489	M: .333 SD: .483
10. Time Management of Shift	M: .400 SD: .500	M: .333 SD: .483

The results of the ANCOVA are presented in Table 4.5.

Table 4.5
ANCOVA Comparison of Treatment vs. Control Group controlling for Pre-Knowledge (N=46 Treatment Group=25 Control Group=21)

Question	F	Df	P value	Partial Eta squared	MSe
1. Signs and Symptoms of Bowel Obstruction	1.79	1,43	.187	.040	.060
2. Appropriate Delegation	.347	1, 43	.559	.008	.075
3. Use of Situation, Background, Assessment, and Recommendations report tool	.244	1, 43	.624	.006	.063
4. Use of Medications	.746	1, 43	.393	.017	.043
5. Fall Interventions	6.91	1, 43	.012	.139	.041
6. Delirium Interventions	.165	1, 43	.686	.004	.056
7. Initial Assessment	.273	1, 43	.604	.006	.063
8. Prioritization of Initial Cares	1.23	1, 43	.272	.028	.059
9. Prioritization of Tasks	.044	1, 43	.835	.001	.061
10. Time Management of Shift	0	1, 43	1	0	.065

As seen in Table 4.5, the groups differed on post simulation knowledge on only one variable. There was a significant effect of the worked out modeling on post simulation knowledge acquisition concerning falls after controlling for the effect of pre knowledge scores. $F(1,43) = 6.91$, $MSe = .041$, $p = .012$, partial eta squared= .139. That is, knowledge of fall interventions was greater for the treatment group than for the control group.

Chapter Summary

This study utilized a quasi-experimental design with a convenience sample of senior baccalaureate nursing students, to examine the following research questions: is self-reported cognitive load affected by worked out modeling and is knowledge acquisition affected by worked out modeling. No assumptions were found to be violated concerning the ANOVA and ANCOVA data analysis. No significant differences were found between the treatment and control groups concerning cognitive load. The area of knowledge attainment related to fall management was found to be significant with the treatment group scoring correctly more often than the control group.

CHAPTER FIVE: CONCLUSION

Introduction

The purpose of this study was to discover whether the use of worked out modeling affects student knowledge acquisition and self-reported cognitive load in a nursing simulation. This study examined whether students offered a worked out modeling video of simulation content pre-simulation, experience decreased extraneous cognitive load, increased intrinsic and germane load, and increased learning in nursing simulation.

CLT has not been applied to nursing simulation extensively. This study's intent was to answer the research questions concerning knowledge acquisition/performance and cognitive load, but also to trial a cognitive load survey tool that had been adapted to meet the discipline of nursing simulation. Furthermore, several demographic features were collected and analyzed in an effort to examine nursing simulation practice in the context of CLT and direct further research related to CLT in this area of nursing education. The ultimate purpose of this study was to add to the discipline of simulation education in nursing and provide a framework for future research in examining the role of cognitive load and/or worked out modeling in simulation learning and design.

Research Questions

- Is knowledge acquisition affected by worked out modeling?
- Is self-reported cognitive load affected by worked out modeling?

Knowledge Acquisition Findings and Interpretations

Post Knowledge Analysis

A focus of this research was to examine if the use of the worked out modeling video prior to simulation participation enhanced knowledge related to the simulation content. One knowledge/performance area had a significant p value as well as a large effect size. This content was that related to addressing a patient fall, $F(1,43) = 6.91$, $MSe = .041$, $p = .012$, partial eta squared= .139. In the simulation, one of the patients had mild dementia with delirium and is on a bed alarm. In the worked out modeling video this scene provided a model of the Registered Nurse responding to the fall as well as a post fall debriefing with the unlicensed assistive personnel. The results suggest that this particular component of the worked out modeling video was effective in enhancing student learning and knowledge development related to patient falls compared to the control group.

This supports what is known about worked out examples concerning schema development based upon problem situations. The use of worked out examples to enhance problem schema development ideally shows the learner explicitly what information or events the learner should focus upon in the situation. Research has shown that schema focused worked out examples enhance students ability to categorize problems and identify appropriate schema (Yan & Lavigne, 2014). Since this particular vignette was solely focused on post fall assessment and interventions, a schema related to this issue was easily identified and evidenced by post knowledge test performance.

Pre and Post Knowledge Overall Comparisons

A paired-samples t-test was conducted to compare pre and post knowledge scores. When examining pre and post knowledge scores in the overall student group there were several areas of significance found. There was a significant difference in the scores for symptoms of a small bowel obstruction $t\ (45)=3.31$, $p=.002$. The use of SBAR (situation, background, assessment, and recommendations) $t\ (45)= 2.43$, $p= .019$, and assessment $t\ (45)= 2.43$, $p= .019$. This is useful data when attempting to identify whether the use of simulation does indeed increase performance and knowledge in important clinical skills and supports simulation research (Alinier, Hunt, Gordon, & Harwood, 2006).

Furthermore, this data quantitatively supports the use of simulation as a learning technology in nursing. The pre and post knowledge survey design such as used in this study can be replicated by faculty in other nursing programs to investigate whether their specific simulation design is indeed meeting student learning needs and evidence based teaching practices in nursing education, as well as identifying areas of improvement (Josephsen, 2013).

In this simulation, we can see that it is effective in several of its objectives but likely could use revision concerning content related to medication use, delegation, prioritization, time management, and care of the patient with delirium. It is also interesting to note that both the treatment and control groups had a lower group mean score concerning the areas of medication use and delirium post simulation. There may be several reasons for this finding. This particular simulation is of a multi-patient simulation with six distinct objectives, two of which have two or more sub-objectives. Not only is this a large amount of knowledge and skills the student is to attain and perform in one simulation, these discrete behavioral objectives do not do justice to the disciplinary knowledge desired. When considering the discipline of nursing it is difficult to express overall judgment, decision-making, and professional leadership skills desired in an objective as they represent a “body of knowledge with its own logical structure and form…” (Scott, 2008, p.33).

Although it is proposed that this type of disciplinary knowledge is gained best in an active learning environment such as simulation the difficulty is that the learner may gain a misguided or inaccurate view of the learning desired in such an environment (Scott, 2008). This may occur because of poor instructional design or because the student somehow is overwhelmed or does not pay attention to the learning opportunity. When applying CLT to these results is would appear that the simulation participants may have been overwhelmed with cognitive load due to the instructional design of the simulation or the content somehow being lost through excessive extraneous load.

When considering the application of the worked out modeling intervention it is clear that these higher order objectives were not obviously interpreted by the learner via the video shown. This does support what is known about the worked out example in CLT. The worked out example works best with novice learners in the initial stages of knowledge and skill attainment concerning a concept. The novice learner in this case would be focused on specific problem solving interventions or techniques for a specific situation rather than focusing on content areas rather than focusing on abstract disciplinary principles such as clinical judgment (Plass et al., 2010).

Post Knowledge Hypothesis

The ANCOVA is statistically significant concerning the concepts and skills surrounding a patient fall $F (1,43) = 6.91$, $MSe = .041$, $p = .012$, partial eta squared= .139, the effect size is large, suggesting that the treatment accounts for almost 14% of the variance in post knowledge scores related to fall content. The means and standard deviations of the rating of the fall post knowledge content were as follows for the treatment and control group respectively M=. 76 SD .44, M=1 SD=0. These results suggest that the worked out modeling video did have a positive effect on post knowledge attained concerning patient falls. Since there was only one knowledge area found to be significant the results should be interpreted with caution. Therefore the null hypothesis is rejected and the alternative hypothesis is accepted only for the content area concerning the use of the worked out modeling and post knowledge performance indicators related to patient falls.

Limitations of Post Knowledge Analysis

The largest limitation of the post knowledge analysis interpretations is the lack of scalable measures. Due to time constraints, only ten questions were used on the pre and post knowledge survey. These questions specifically addressed objectives of the simulation and had one question per knowledge/content area. Because of the higher order thinking required for each question, due to the objectives of the simulation, 1 minute was allowed for each multiple choice question (Billings & Halstead, 2005). Therefore, the post knowledge survey was limited to 10 questions to be completed post simulation in the time frame allowed. Additionally, since the knowledge survey was specific to this simulation it cannot be generalized to other simulations, although the survey design and implementation format can be used as a framework for other nursing simulation researchers to examine learning efficacy of individual simulations. Lastly, although every effort was made for each faculty facilitator to follow the same process and debriefing style, individual facilitator differences could have affected the knowledge survey results.

Application and Recommendations of Pre and Post Knowledge Analysis

Pre and post knowledge analysis concerning simulation content is a valuable exercise, and one that ideally should be integrated into simulation construction and implementation best practices. Nursing simulation use will likely increase and grow to encompass many other aspects of the nursing students clinical experience. This being the case, it is imperative that simulation educators use evidence based practice in the methodology of simulation, but also in the evaluation of the simulation intervention meeting the designated learning objectives (Chinn & Kramer, 2004).

Therefore, this investigator recommends that a version of a pre and post knowledge survey related to simulation content and learning objectives be administered and evaluated for all simulations being utilized by a school of nursing. Only with quantitative support for the efficacy of the simulation being used can the tenants of evidence-based practice be followed and the rigors of nursing simulation increase. In turn, quantitative support for the use of simulation in nursing education can promote the use of resources for further development of the simulation agenda as well as faculty development and addressing the theory practice gap often found in nursing education (Melnyk & Fineout-Overholt, 2005).

Lastly, a significant effect was found in the area of fall interventions related to the treatment intervention. Although this was the only significant effect found related to knowledge attainment, it does point to the need for further research concerning the use of worked out modeling; especially for very focused nursing interventions such as fall assessment and the professional nurse's role. Much of the worked out modeling video used for this study had higher order interventions such as prioritization and symptom management, which rely on advanced schemas for accurate implementation. It is likely that the knowledge domains in which a significant effect was not found contained an overwhelming amount of information, or novel information to the student, so that the worked out modeling video shown one time was not enough of an intervention to facilitate long term schema development.

This outcome is supported by research that has identified that video role modeling studies that have had positive outcomes related to behavioral objectives such as prioritization have provided a video with at least 24 minutes of length, the ability for the study participants to view the video repeatedly and in their own time, and the video being paired with distinct instruction (Anderson, LeFlore, & Anderson, 2013, p. e345). This particular worked out modeling video was limited to 10 minutes in length to cover a multitude of objectives, the students were only shown the video one time in a group setting, and the instructions for outcomes in the simulation were limited to describing the objectives of the simulation.

In addition, this is the first multi-patient simulation that the students were exposed to, so this may have affected the amount of cognitive load experienced. Yet, the fall response vignette was very specific in protocol and intervention related to fall management so that the student left with a schema that can be applied to his/her nursing practice. This does support what is known about the CLT worked out example intervention in which explicit instructional guidance provides a substitute schema in the initial stages of learning (Plass et al., 2010). Even with the positive result related to fall management these results require further research to ascertain whether knowledge is retained long term and applied to the nursing practice setting.

Cognitive Load Findings and Interpretations

Cognitive Load Analysis

No significant differences were found between the treatment and control groups concerning cognitive load. Although, when looking at means between the groups there is the suggestion that the treatment group experienced more intrinsic and germane load than the control group, and the control group appears to have experienced slightly more extraneous load. Please refer to Table 4.2 for specific means, standard deviations, and confidence intervals. The simulation educator does want to increase intrinsic and germane load and decrease extraneous load. These results suggest that further research is warranted concerning the use of worked out modeling and its effect on cognitive load.

Cognitive Load Hypothesis

From Table 4.2 and 4.3 we see that there is no statistical significance concerning intrinsic, extraneous, or germane load. Therefore the null hypothesis is accepted and the alternative hypothesis is rejected concerning the use of the worked out modeling and cognitive load.

Additional Cognitive Load Analysis

Since limited research is available concerning cognitive load and nursing simulation other factors were examined for interest concerning current simulation best practices and directions for future research.

Cognitive Load and Pre Reading.

Other factors of interest related to cognitive load and simulation included the pre reading assignment. The use of a preparatory activity prior to simulation is recommended for simulation best practices and students often request such an activity so they can prepare for the simulation (Ganley & Linnard-Palmer, 2012). Use of a preparatory activity is standard practice at the institution in which this research was conducted. Therefore students were asked if they completed the pre-reading assignment prior to the simulation. The results show that students who self-reported positively that they did complete the pre-reading activity experienced greater germane load, which is desired for schema development. $F(1, 59) = 5.97$, $p = .018$, partial eta squared= .095, MSe= 1.07. See Table 5.1.

Table 5.1

Comparison of Pre Reading and Non Pre Reading Groups (N = 55 Pre Reading N=5 Non Pre Reading)

Load Type	F	Df	P value	Partial Eta Squared	MSe
Intrinsic Load (Questions 1-3 and 12)	.388	1, 59	.538	.007	.816
Extraneous (Questions 4-6 and 13)	1.667	1, 58	.202	.202	.752
Germane (Questions 7-10 and 14)	5.967	1, 59	.018	.095	1.07

These results indicate that the completion of the pre reading assignment does enhance the student's learning potential concerning germane load and schema construction and processing. When considering that the goal of simulation in nursing is the ability for the student to transfer learning to other patient care situations germane load is a necessary component of the instructional design (Plass et al., 2010). The analysis of these data indicate that use of a pre reading or a preparatory activity prior to simulation participation increases germane load which contributes to schema construction and knowledge transferability.

Simulation Role and Cognitive Load.

Another area of interest in nursing simulation is the discussion concerning whether a student that actively participates in the simulation has a better learning experience than the student who is in the observer role. This has been an ongoing debate in nursing simulation, as it is difficult to have all students participate in the simulation in the active participant role due to the number of students and resources available. In this particular situation out of the seven to eight students in each simulation group four participated, and the remaining three or four observed the simulation. The results indicate that there is not a significant difference between students who are active participants and students who are observers of the simulation in cognitive load experienced. Overall, these results do support research in nursing simulation indicating that there is not a significant difference in learning related to the observer or participant roles (Hober & Bonnel, 2014; Jeffries & Rizzolo, 2006). See Table 5.2 below.

Table 5.2
Comparison of Observer vs. Participant on Cognitive Load (N = 35 Observer N=25 Participant)

Load Type	F	Df	P value	Partial Eta Squared	MSe
Intrinsic Load (Questions 1-3 and 12)	.217	1, 59	.643	.004	.816
Extraneous (Questions 4-6 and 13)	.058	1, 59	.811	.001	.752
Germane (Questions 7-10 and 14)	.025	1, 59	.875	.000	1.07

Limitations of Cognitive Load Analysis

The amount of cognitive load students experience in nursing simulation has not been adequately researched. Therefore, the purpose of this study was to ascertain whether the use of worked out modeling significantly affected the amount and types of cognitive load that nursing students experience. Moreover, this study was a pilot of the cognitive load measurement tool adapted from Leppink et al. (2013). When reviewing the reliability scores concerning the cognitive load measurement tool it did have adequate reliability in the areas of intrinsic and germane load, as well as overall cognitive load (Chronbach's Alpha .775, .841, and .736 respectively). The area that did not fall into adequate to strong reliability was that of extraneous load. This suggests that the cognitive load measurement tool could be revised in order to accurately measure extraneous load.

This result may be due to a variety of factors but most likely due to question wording related to extraneous load (Leppink et al., 2013). The specific questions addressing extraneous load were focused on the concept of learning and instructions and/or explanations. In simulation the instructions and explanations are limited to pre briefing and debriefing, it may have been more appropriate to use more specific simulation descriptors such as the pre briefing and debriefing or simulation set up. The lack of specificity may have led students on a different path in interpretation of ease or difficulty of learning in the simulation setting. This is a limitation on the interpretation and analysis of the cognitive load measures, as extraneous load scores provided may not be an accurate reflection of this type of cognitive load due to the inadequate reliability (LoBiondo-Wood & Haber, 2006).

An additional limitation of the analysis concerns the pre simulation activity. The number of students who self-reported they did not complete the pre reading compared to the number of students who self-reported they did complete the pre reading was quite different (N=5, N=55 respectively). This warrants further research utilizing a treatment and control group and the use of a pre simulation assignment as the intervention related to cognitive load experienced.

Summary and Conclusions

This quasi-experimental quantitative exploratory study investigated the amount and types of cognitive load and knowledge acquisition senior level nursing students experience in a single nursing simulation. The theoretical framework utilized to design the study and the survey tools was that of CLT. This theory proposes that knowledge/learning is linked to the amount and type of cognitive load a student experiences. Cognitive load is believed to be managed by appropriate instructional design that promotes germane and intrinsic load and decreases extraneous cognitive load. The literature reviewed identified a gap in knowledge related to cognitive load and nursing simulation.

According to the data analysis there was suggestive evidence that the worked out modeling intervention did affect knowledge acquisition concerning patient fall management. The data analysis was less clear as to whether there was a difference in cognitive load in the treatment versus the control group. Therefore, the alternative hypothesis was accepted concerning knowledge attainment and the null hypothesis was accepted concerning the interventions affect on cognitive load.

Additional analysis of common nursing simulation practices of prereading and participant versus observer role supported current simulation best practices in the context of CLT. Data analysis indicated that the use of a pre reading or preparatory activity prior to simulation participation increases germane load, which contributes to schema construction and knowledge transferability. Data analysis also supported current research in nursing simulation indicating there is not a significant difference in learning related to observer or participant status.

This is a single study in one school of nursing utilizing pilot survey tools. The results of this study are not generalizable to the larger population of nursing students. The study does provide a framework for additional research concerning the types and amounts of cognitive load nursing students experience in simulation as well as the efficacy of the simulation learning intervention. Specifically, a cognitive load survey was adapted to meet the needs of nursing simulation and was shown to be reliable as a measurement tool.

Areas for future research are vast concerning CLT and obviously include continued research concerning the cognitive load survey tool and its reliability across a variety of nursing schools, student levels, and types of simulation. In addition, further research is warranted concerning the use of worked out modeling best practices, such as how many times is it needed to affect cognitive load and knowledge attainment, what format (video, live, etc.) has the best results, and the best way to present the worked out modeling (e.g. a single scene, multiple scenes, etc.). In this study the worked out modeling video was shown to be effective in the area of fall management, but research is needed to ascertain if the video could have been more effective in knowledge attainment if the format, length, or other factors were different, such as use in a one patient versus a multiple patient scenario.

The area of cognitive load has ample room for research in nursing simulation as well. Although the results in this study were not significant in the area of cognitive load measurement between the treatment and control groups, there is little information concerning the amount and type of cognitive load nursing students experience in simulation and this study showed that students are indeed experiencing cognitive load in simulation. This study identified that there are differences in cognitive load related to some standard simulation practices such as a pre simulation assignment. Further research is needed to ascertain how best to design and implement simulations in order to maximize germane and intrinsic load and minimize extraneous load so that the student has an effective learning experience that provides for schema development, which can ultimately be used in their future nursing practice.

Chapter five concludes this research study. The findings support continued awareness and evaluation of cognitive load and knowledge attainment in nursing simulation. Recommendations for the discipline of nursing include integration of CLT concepts into simulation design and implementation, use of pre and post knowledge tests/surveys to ascertain effectiveness of the simulation meeting identified learning objectives, continued use of a pre simulation assignment to enhance germane load, and the use of worked out modeling in some form prior to simulation with novel content. With the growth in the use of simulation as an adjunctive or replacement for student clinical experiences further research is needed concerning effective simulation design and implementation as well as the student learning experience and the effect cognitive load may have on this experience.

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APPENDIX A

Two Patient Decision Making and Delegation Simulation

Last Review Date: 9/2014

Scenario Name: **Two Patient Decision Making and Delegation**

Author: Ann Butt Content Expert Reviewer: Becky Bunderson		Concept(s): Decision making & delegation Disease(s): Bowel obstruction, dementia Course Number(s): N427
Learner Group: Nursing		
Main Focus/Desired Learner Take Aways		
1	Decision making	
2	Delegation	
3	Communication with physician and family	
4		
Scenario Synopsis		
This is a two patient scenario that involves one patient needing an NGT insertion and IV restart (existing cath got dislodged) while the other patient experiences a fall and needs assessment and assistance.		
Facilitator Information		
Objectives		
1	Clinical Reasoning & Critical Inquiry	✓ Identify/recognize the signs and symptoms of a bowel obstruction. ✓ Identify/recognize the signs and symptoms of dehydration. ✓ Form a plan based on pertinent information.
2	Communication	✓ Communicate effectively using SBAR.
3	Experiential Learning	✓ Perform appropriate assessments and initiate nursing care as needed.
4	Global Worldview	
5	Professionalism & Leadership	✓ Appropriately organize, prioritize and delegate care for two clients.
Learner Roles and Staging		
Role	Timing	

Primary Care Nurse	Receive report and proceed with care		
Charge Nurse	At the nurse's station available to help as requested.		
RN - float	At the nurse's station available to help as requested.		
Confederate Roles and Scripting			
Role	Tone	Timing	Lines/Comments
None			
Imbedded Challenges			
1	None	2	
Notes for Facilitators			
***May need to remind students how to use the phone to call family and physician as needed.			

Learner Information – Patient #1		
Patient Name: Mark Lopez Age: 35 Gender: M	Allergies: NKA Code Status: Full	Weight: 140 Height: 5’ 8” Major Support: Girlfriend
Diagnosis: Nausea/vomiting		
History of Present Illness: Abdominal bloating, distention, diffuse abdominal pain with diarrhea off and on		
Past Medical History/Surgical History: Current childhood immunizations, No surgeries		
Current Medications: None		
Significant Lab Values/Diagnostics: CBC, Chem Screen, Flat plate of abdomen		
Social History: 1-2 beers 3 times a week, Non-smoker		
Learner Information – Patient #2		
Patient Name: Pat Gibson Age: 75	Allergies: NKA Code Status: DNR	Weight: 160 Height: 5’ 7” Major Support: Son
Diagnosis: Dehydration/confusion		
History of Present Illness: Increasing dehydration over past two weeks, decreased urine output. Alzheimer’s Disease diagnosed approximately two years ago.		
Past Medical History/Surgical History: Heart arrhythmia x 3 years, Chickenpox 1939, Mumps 1942		
Current Medications: Lanoxin .25mg po daily Tylenol 650mg po q4 hours prn pain or temperature greater than 38.5 C		
Significant Lab Values/Diagnostics: CBC, UA, Chem Screen, EKG		
Social History: Drinks an occasional glass of wine. Quit smoking 20 years ago. Widowed		

Facilitator Report to Primary Learner(s) to Start Scenario	
Mark Lopez is a 35-year-old patient of Dr. Martin that was just transferred to the floor from the ED at change of shift—I have not yet had a chance to review his orders. He was admitted for nausea and vomiting along with mild belly pain. He is a full code with no known drug allergies. Pt is alert and oriented, seems to be fairly healthy otherwise. Apparently, the last formed BM the patient can recall was around 5 or 6 days ago though he reports some mild diarrhea. He has had no appetite for the last couple of days and finally came to the ED to get it checked out after vomiting several times. He has D5LR running at 125ml/hour and has been admitted for a rule-out bowel obstruction. VS are stable on room air. Pat Gibson is an elderly patient of Dr. Martin's with mild dementia, admitted a couple days ago for dehydration and acute confusion. Pt is a DNR and has no known drug allergies. Pt is alert and oriented to person but inconsistently oriented to place and time, has been pleasant and cooperative but is a high fall risk and needs to have the bed alarm on at all times. Pt has D5 NS with 20 meq KCL running at 75 ml/hr, site looks good. Lungs are clear, heart rate and rhythm are regular and skin turgor has improved. Pt is continent of bowel and bladder, needs standby assist to get to bathroom and is on strict I & O; regular diet but needs some encouragement to eat and drink. Patient slept ok last night but when awake, rings the call bell and needs frequent reminders not to try to get out of bed. VS have been stable on room air.	
Pre Simulation Learner Prep	
Learning Outcomes/Objectives	1. Identify/recognize the signs and symptoms of a bowel obstruction. 2. Identify/recognize the signs and symptoms of dehydration. 3. Appropriately organize, prioritize and delegate care for two clients. 4. Communicate effectively using SBAR. 5. Perform appropriate assessments and initiate nursing care as needed.
Readings	(Hendrich, A. (2007). When a fall occurs. *AJN 107*(11), see nursing center website below) Review med-surg textbook regarding dehydration
Websites	http://www.drugs.com/health-guide/bowel-obstruction.html http://www.nursingcenter.com/lnc/pdfjournal?AID=751198&an=00000446-200711000-00030&Journal_ID=&Issue_ID=

<table>
<tr><th colspan="3">Sim Tech Staging Information – Patient #1, Mark Lopez</th></tr>
<tr><td colspan="3">Manikin/Standardized Patient</td></tr>
<tr><td>Manikin/Standardized Patient Type: manikin</td><td>Gender: Male</td><td>Clothing: Hospital gown</td></tr>
<tr><td>Position:
In bed</td><td colspan="2">Moulage: Make IV look as though pulled out and now not infusing into vein.</td></tr>
<tr><td colspan="3"></td></tr>
</table>

	Setup	**Ready for Learner Use**
Environment	Hospital bed	
Safety	ID band	
Hospital Equipment	VS monitor (off until taken by nurse)	BP cuff, pulse ox, thermometer, stethoscope, pen light, nurse server supplies On CS cart for NG insertion: NG insertion caddy (NG tube, 60cc cath tip syringe, Tape) Wall suction with Intermittent regulator
IV	D5LR on pump/pole w/drain bag at 125 cc/hr but saline lock has been pulled out so IV is no good and needs to be restarted.	On CS cart for IV start: 1000cc D5 LR @ 125 cc/hr Primary IV set IV start caddy

	Fluid can be pumping out onto manikin arm and bed. (blue pad under sheets to catch fluid)	Drain connected to IV arm
Medications	None	None
Labs/Xray		
Chart Records	MD orders	Nursing flow sheet on chart
Other		CS cart stocked Glass w/straw for NGT insertion Phone to call family and physician – may need to remind students how to use.

Sim Tech Staging Information – Patient #2, Pat Gibson		
Manikin/Standardized Patient		
Manikin/Standardized Patient Type: SP	Gender: Gender of the SP	Clothing: Hospital gown
Position: In bed, side rails down on one side	Moulage: depending on age of SP, may need glasses/wig	

	Setup	**Ready for Learner Use**
Environment	Hospital bed No Monitor Bed alarm for fall	Bed alarm will need to sound when SP gets out of bed.
Safety	ID band DNR on chart	
Hospital Equipment	Temp index card - 98.6	BP cuff, pulse ox (*Working)* , thermometer, stethoscope, pen light, nurse server supplies
IV	D5 NS with 20 meq KCL at 75 ml/hr on pump with drain bag	
Medications	None	None

Labs/Xray		
Chart Records	MD orders MAR – meds charted as given	Nursing flow sheet on chart Phone to call family and physician – may need to remind students how to use.
Other	Depending on age of SP, may need glasses/wig Mic & speaker to prompt SP	CS cart stocked Sample incident report for use in debriefing

Physician Orders

PATIENT'S NAME: Mark Lopez

ALLERGIES: NKDA

Date	Time	Order	Signature
Today's Date		Admitting Diagnosis: Nausea/vomiting, rule out bowel obstruction	
		Vital Signs: Q 4 hours	
		Diet: NPO	
		Activity: Up as tolerated	
		Diagnostic Tests: Flat plate of the abdomen CBC, Chem Screen, UA	
		Medications: None	

		IV Therapy: D5 LR @ 125 cc/hr	
		Treatments: NG tube to low intermittent suction as soon as possible once admitted to the floor.	
			Dr. Martin MD

Physician Orders

PATIENT'S NAME: Pat Gibson

ALLERGIES: NKDA

Date	Time	Order	Signature
Today's Date		Admitting Diagnosis: Dehydration, Alzheimer's Disease	
		Vital Signs: Q 4 hours	
		Diet: Regular	
		Activity: Up with assistance	
		Diagnostic Tests: CBC, Chem Screen, UA	
		Medications: Lanoxin .25mg po daily Tylenol 650 mg q4 hours po prn pain or temp greater than 38.5 C	

		IV Therapy: D5 NS with 20 meq KCL at 75 ml/hr	
		Treatments:	
			Dr. Martin MD

Sim Tech Scenario Progression Information – Patients #1 & #2			
Manikin Actions		**Desired Learner Actions**	**Prompts**
0-5 Minutes		Patient #1: Assessing patient. Gathering supplies for NGT insertion	
HR: 90	R: 16		
BP: 120/80	Temp: 37.1C		
SPO2: 98			
Auscultation Sounds			
Lungs: Normal			
Heart: Normal			
Bowel: Absent			
Manikin Vocals			
Mental Status: Normal			
Vocal Examples: Patient #1 – "I don't feel good, my stomach hurts, I have been vomiting. Something is wrong with my IV. What are you putting in my nose?"			
Other: Patient #2 (SP) – fidgeting in bed, playing with call button			
5-10 Minutes		Patient #1: Properly inserting NG tube	
HR:	R:		
BP:	Temp:		
SPO2:			
Auscultation Sounds			
Lungs:			

<table>
<tr><td colspan="2">Heart:</td><td rowspan="6"></td><td rowspan="6">Patient #2
Bed alarms sounds as SP falls to floor</td></tr>
<tr><td colspan="2">Bowel:</td></tr>
<tr><td colspan="2">Manikin Vocals</td></tr>
<tr><td colspan="2">Mental Status:</td></tr>
<tr><td colspan="2">Vocal Examples: Patient #1 – “I don’t like this tube, it hurts?”</td></tr>
<tr><td colspan="2">Other: Patient #2 – Begins to crawl out of bed, falls to floor, mumbling/moaning</td></tr>
<tr><td colspan="2">10-15 Minutes</td><td rowspan="12">Patient #1:
Gets assistance from another nurse to continue care with patient #1. Turns on call light or calls charge nurse.

Patient #2:
Assess the client condition including VS, gets the patient back into bed with assistance from other nurses. Calls the doctor.</td><td rowspan="12"></td></tr>
<tr><td>HR:</td><td>R:</td></tr>
<tr><td>BP:</td><td>Temp:</td></tr>
<tr><td colspan="2">SPO2:</td></tr>
<tr><td colspan="2">Auscultation Sounds</td></tr>
<tr><td colspan="2">Lungs:</td></tr>
<tr><td colspan="2">Heart:</td></tr>
<tr><td colspan="2">Bowel:</td></tr>
<tr><td colspan="2">Manikin Vocals</td></tr>
<tr><td colspan="2">Vocal Examples: Patient #1 – “I’m concerned about the noise next door. What is happening?”</td></tr>
<tr><td colspan="2">Other: Patient #2 – Moaning on floor, gets back in bed with assistance.</td></tr>
<tr><td colspan="2"></td></tr>
</table>

Guided Reflection Debriefing Guide		
	Outcomes/Performance Measures/Objectives	**Debriefing Prompt**
Opening	Initial group discussion/facilitation	✓ How do you think things went? ✓ Can someone give me a quick summary of the scenario? ✓ What did you see? ✓ How was that?
Clinical Reasoning & Critical Inquiry	✓ Identify/recognize the signs and symptoms of a bowel obstruction. ✓ Identify/recognize the signs and symptoms of dehydration. ✓ Appropriately organize, prioritize and delegate care for two clients.	✓ Tell me about the priorities of your patient care? ✓ What are the signs and symptoms of a bowel obstruction? ✓ What are the signs and symptoms of dehydration?
Communication	✓ Communicate effectively using SBAR.	✓ How do you communicate effectively using SBAR? ✓ How do you communicate effectively with team members? ✓ How do you provide therapeutic communication with clients and family members?
Experiential Learning	✓ Perform appropriate assessments and initiate nursing care as needed.	✓ What is the correct technique for the insertion of a NG tube? ✓ How do you obtain an assessment of client after a fall?
Global Worldview		

Professionalism & Leadership		
Closing	Wrap up group discussion	✓ What would you do differently next time? ✓ What are some things from this experience that will stick with you? ✓ Any additional questions?

Role Cards

Role	**Cues**
Primary Nurse	✓ Receive report and begin patient care

Role	**Cues**
Charge Nurse	✓ Sit at the nurse's station until needed by primary nurse.

Role	**Cues**
RN – Float	✓ Sit at the nurse's station until needed by primary nurse.

MEDICATION ADMINISTRATION RECORD

Patient's Name: Mark Lopez

Date: Today's Date

SCHEDULED MEDICATIONS				
MEDICATION	**2400-0559**	**0600-1159**	**1200-1759**	**1800-2359**
NON-SCHEDULED MEDICATIONS				
MEDICATION	**2400-0559**	**0600-1159**	**1200-1759**	**1800-2359**
SIGNATURE			**INITIALS**	

MEDICATION ADMINISTRATION RECORD

Patient's Name: Pat Gibson

Date: Today's Date

SCHEDULED MEDICATIONS				
MEDICATION	**2400-0559**	**0600-1159**	**1200-1759**	**1800-2359**
Lanoxin .25mg po daily		**0800 BKB**		
NON-SCHEDULED MEDICATIONS				
MEDICATION	**2400-0559**	**0600-1159**	**1200-1759**	**1800-2359**
Tylenol 650 mg q4 hours po prn pain or temp greater than 38.5 C				
SIGNATURE **Becky K. Barnes**			**INITIALS** **BKB**	

Standardized Patient Role

Patient: Pat Gibson

In this simulation experience the SP will be portraying a patient that is experiencing signs of Alzheimer's (confused) and has a fall from their hospital bed. You will be provided with a script and some background information about the patient prior to the simulation. No prior rehearsal is required. You may be asked to wear a wig/glasses to appear as though you are an elderly patient. Props will be provided if needed. You will be asked to wear a hospital gown. Please wear shorts/leggings and a t-shirt to the session.

Patient #2		
Patient Name: Pat Gibson Age: 75 Gender: SP dependent	Allergies: NKDA Code Status: Full code Race: Caucasian	Weight: 160 lbs. Height: 5'7" Major Support: Son
Diagnosis: Dehydration/confusion Dehydration x 3 weeks Alzheimer's Disease diagnosed approximately two years ago.		
Past Medical History/Surgical History: Heart arrhythmia x 3 years, Chickenpox 1939, Mumps 1942		
Social History: Drinks an occasional glass of wine., Quit smoking 20 years ago., Widow/widower		
Ideas for questions/conversation with the student as appropriate: You are 75 years old and experiencing some confusion. You are in the hospital because you are dehydrated. You are in your bed fidgeting a bit, playing with the call bell, etc…..After the scenario has started and a few minutes have passed, you are going to move from the bed to floor as if you have fallen and begin moaning. When the nurses		

come to your assistance you can let them help you back into bed.

"I don't know what happened. I just fell on the floor."

"I needed to go to the bathroom."

"I am so confused."

"I don't know what to do."

You may be asked to wear a wig/glasses to appear as though you are an elderly patient. Props will be provided if needed. You will be asked to wear a hospital gown. Please wear shorts/leggings and a t-shirt to the session.

Nursing Flow Sheet

Patient's Name: Lopez, Mark

Date: Today's Date

VITAL SIGNS	**TIME**				
	BLOOD PRESSURE				
	PULSE				
	RESP RATE				
	TEMP				
PAIN	**SCORE**				
	LOCATION				
	CHARACTER				
RESP	**OXYGEN**				
	OXIMETER				
N UTR	**DIET / % EATEN**				
	SUPP FEEDING				
INTAKE	**PO**				
	IV				
OUTPUT	**URINE**				
	DRAINS				
PROBLEM / EVENT DOCUMENTATION					

DATE / TIME	
SIGNATURE	

Nursing Flow Sheet

Patient's Name: Gibson, Pat

Date: Today's Date

VITAL SIGNS	**TIME**				
	BLOOD PRESSURE				
	PULSE				
	RESP RATE				
	TEMP				
PAIN	**SCORE**				
	LOCATION				
	CHARACTER				
RESP	**OXYGEN**				
	OXIMETER				
N UTR	**DIET / % EATEN**				
	SUPP FEEDING				
INTAKE	**PO**				
	IV				
OUTPUT	**URINE**				
	DRAINS				
PROBLEM / EVENT DOCUMENTATION					

DATE / TIME	
SIGNATURE	

APPENDIX B

Learner Preparation

N427: Two Patient Decision Making and Delegation		
Learner Information – Patient #1		
Patient Name: Mark Lopez Age: 35 Gender: M	Allergies: NKA Code Status: Full	Weight: 140 Height: 5' 8" Major Support: Girlfriend
Diagnosis: Nausea/vomiting		
History of Present Illness: Abdominal bloating, distention, diffuse abdominal pain with diarrhea off and on		
Past Medical History/Surgical History: Current childhood immunizations, No surgeries		
Current Medications: None		
Significant Lab Values/Diagnostics: CBC, Chem Screen, Flat plate of abdomen		
Social History: 1-2 beers 3 times a week, Non-smoker		
Learner Information – Patient #2		
Patient Name: Pat Gibson Age: 75	Allergies: NKA Code Status: DNR	Weight: 160 Height: 5' 7" Major Support: Son
Diagnosis: Dehydration/confusion		
History of Present Illness: Increasing dehydration over past two weeks, decreased urine output. Alzheimer's Disease diagnosed approximately two years ago.		
Past Medical History/Surgical History: Heart arrhythmia x 3 years, Chickenpox 1939, Mumps 1942		
Current Medications: Lanoxin .25mg po daily Tylenol 650mg po q4 hours prn pain or temperature greater than 38.5 C		
Significant Lab Values/Diagnostics: CBC, UA, Chem Screen, EKG		
Social History: Drinks an occasional glass of wine. Quit smoking 20 years ago. Widowed		

Facilitator Report to Primary Learner(s) to Start Scenario	
Mark Lopez is a 35-year-old patient of Dr. Martin that was just transferred to the floor from the ED at change of shift—I have not yet had a chance to review his orders. He was admitted for nausea and vomiting along with mild belly pain. He is a full code with no known drug allergies. Pt is alert and oriented, seems to be fairly healthy otherwise. Apparently, the last formed BM the patient can recall was around 5 or 6 days ago though he reports some mild diarrhea. He has had no appetite for the last couple of days and finally came to the ED to get it checked out after vomiting several times. He has D5LR running at 125ml/hour and has been admitted for a rule-out bowel obstruction. VS are stable on room air. Pat Gibson is an elderly patient of Dr. Martin's with mild dementia, admitted a couple days ago for dehydration and acute confusion. Pt is a DNR and has no known drug allergies. Pt is alert and oriented to person but inconsistently oriented to place and time, has been pleasant and cooperative but is a high fall risk and needs to have the bed alarm on at all times. Pt has D5 NS with 20 meq KCL running at 75 ml/hr, site looks good. Lungs are clear, heart rate and rhythm are regular and skin turgor has improved. Pt is continent of bowel and bladder, needs standby assist to get to bathroom and is on strict I & O; regular diet but needs some encouragement to eat and drink. Patient slept ok last night but when awake, rings the call bell and needs frequent reminders not to try to get out of bed. VS have been stable on room air.	
Pre Simulation Learner Prep	
Learning Outcomes/ Objectives	6. Identify/recognize the signs and symptoms of a bowel obstruction. 7. Identify/recognize the signs and symptoms of dehydration. 8. Appropriately organize, prioritize and delegate care for two clients. 9. Communicate effectively using SBAR. 10. Perform appropriate assessments and initiate nursing care as needed.
Readings	(Hendrich, A. (2007). When a fall occurs. *AJN 107*(11), see nursing center website below) Review med-surg textbook regarding dehydration
Websites	http://www.drugs.com/health-guide/bowel-obstruction.html http://www.nursingcenter.com/lnc/pdfjournal?AID=751198&an=00000446-200711000-00030&Journal_ID=&Issue_ID=

APPENDIX C

Institutional Review Board Approval

BOISE STATE UNIVERSITY

RESEARCH AND ECONOMIC DEVELOPMENT

Date: January 27, 2015

To: Jayne Josephsen

From: Office of Research Compliance (ORC)

Subject: SB-IRB Notification of Exemption - 187-SB15-014

The Effect of Expert Modeling in Nursing Simulation on Cognitive Load

The Boise State University ORC has reviewed your protocol application and has determined that your research is exempt from further IRB review and supervision under 45 CFR 46.101(b).

Protocol Number: 187-SB15-014

Approved: 1/26/2015 Application Received: 1/19/2015

Review: Exempt

Category: 1, 2

This exemption covers any research and data collected under your protocol as of the date of approval indicated above, unless terminated in writing by you, the Principal Investigator, or the Boise State University IRB. All amendments or changes (including personnel changes) to your approved protocol must be brought to the attention of the Office of Research Compliance for review and approval before they occur, as these modifications may change your exempt status. Complete and submit a Modification Form indicating any changes to your project.

Annual renewals are not required for exempt protocols. When the research project is completed, please notify our office by submitting a Final Report. The exempt status expires when the research project is completed (closed) or when the review category changes as described above.

All forms are available on the ORC website at http://goo.gl/D2FYTV

Please direct any questions or concerns to ORC at 426-5401 or humansubjects@boisestate.edu.

Thank you and good luck with your research.

Office of Research Compliance

1910 University Drive Boise, Idaho 83725-1135
Phone (208) 426-5401 orc@boisestate.edu

This letter is an electronic communication from Boise State University

APPENDIX D

Worked Out Modeling Video Outline, Scenes, and Clip Link For Two Patient Decision Making and Delegation Simulation

Outline

Definition of worked out modeling guiding video development: The modeling of

a skill or procedure by an expert nurse paired with verbal and gestural description of critical thinking processes and pathophysiological connections to the content.

Theoretical basis of video: Cognitive load theory with the hypothesis that if offered an worked out modeling video prior to simulation participation the student will experience less cognitive load thus increasing working memory capacity which translates into increased learning, which leads to enhanced ability of the student to transfer knowledge gained into the long term memory and schema development. The use of worked out modeling will guide learner attention to essential aspects of the simulation and assist in the allocation of working memory resources to learning and schema development (Koning, Tabbers, Rikers, & Paas, 2007). In the case of worked out modeling the learner ideally will create higher-level schemas if the instructor provides verbal explanation paired with gestures or actions. In this sense worked out modeling is not just observing the action but observing the action with a corresponding verbal explanation so that features that cannot be identified directly are verbally identified by the expert (Cook, 2006).

Goals of the simulation include:

- Clinical Reasoning & Critical Inquiry
    - Recognize pathophysiological conditions presented
    - Differentiate between pertinent information and extraneous information

  - Prioritize care and develop a plan of care to implement

- Communication
  - Utilize SBAR appropriately with UAP, Dr., nurse colleagues, etc.
  - Utilize effective patient report skills
  - Utilize therapeutic and effective communication with patients and family members
- Experiential Learning
  - Assess appropriately for pathophysiological conditions present
  - Initiate appropriate nursing care for positive patient outcomes
  - Follow safety guidelines for safe patient care
- Professionalism & Leadership
  - Appropriately delegate care as needed
  - Advocate for patient care needs as needed

Roles of simulation include:

Primary Care Nurse: Receive report and proceeds with cares

UAP: Receives delegation and proceeds with cares as appropriate

Doctor: Available via phone for orders as needed

Charge Nurse: Available via phone as needed

Simulation Overview:

- RN comes on duty and receives a brief report concerning the 4 patients assigned. Two of the patients will be present for the video, the other two will be non-existent but have cares that could be delegated to the UAP as needed. The RN initiates questions as needed for an appropriate report in order to care for patients
    - A vignette will also be taken to discuss what the RN is thinking when getting report and how they go about deciding what is important to know in report when on the receiving end. This vignette will be limited to just a few sentences.
- RN comes into the patient room to assess either patient Mark Lopez or patient Pat Gibson. The RN will verbalize why they are choosing one patient over the other for first assessment. Their other two patients will be stable with no needs.
    - A vignette will also be taken to discuss how to prioritize patient assessment and what is appropriate to delegate at the beginning of the shift. The RN will make a point of checking orders carefully for priorities.
- When RN is assessing Mark Lopez it will become clear that the patient has a dislodged IV and a non-functioning NG tube. For the purposes of this video we will not have the RN actually replace these items.
    - A vignette will be taken in which the RN will discuss what is important to assess initially with a patient just coming up from the ER and other conditions presented with this patient. In addition the RN can discuss the

rationale they used to assess these items and rationale for which they would replace first, etc.

- ❖ When the RN is assessing Pat Gibson the patient will be assessed for safety issues and these will be reviewed with the patient. The RN will delegate appropriately to the UAP to increase patient safety. Post fall there will be a focus on patient assessment and communication with the Dr. or charge nurse as appropriate.
  - o A vignette will be taken to discuss what is important to consider in the cares of a patient who is a high fall risk and the rationale behind these considerations.
- ❖ Ultimately the worked out modeling video will present an example solution to the situation paired with verbal rationale from the RN and UAP. Additionally the RN will discuss any difficulties with patient care experienced and discuss how they would solve the issue.
- ❖ The time limit for the video is 10 minutes, so all vignettes will be a 15 to 30 second clip. The complete simulation will be taped but for the purposes of this video what will be presented will be focused taping paired with vignettes as needed.
- ❖ If time permits we will tape NG tube insertion technique with the RN talking describing what she is doing and rationale, as well as the IV insertion.

<u>Worked Out Modeling Video Scenes</u>

Scene One: Report

Setting: Nurses Station

Off going Nurse: (we will not tape the whole report, just the last patient)

"Mark Lopez is a 35 year old patient of Dr. Martin that was transferred to the floor from the ED at change of shift. I have not had a chance to review his orders. He was admitted for N/V and abdominal pain. He is a full code NKA. He is alert and oriented and seems healthy otherwise. He has had some diarrhea and decreased appetite for the last few days also. He has D5LR at 125ml/hr. and has been admitted to rule out a SBO. VS are stable on RA. So really I think they are all good to go. The patient in room one just needs her am BG's done, she is due to transfer to the rehab floor later today, and room two is to discharge after the Dr. rounds. I just saw him down the hall. Room three is on a bed alarm so just keep a listen. "

Expert Nurse: Ask questions concerning report, items that may not have been reviewed that you need information on (especially with Lopez and Gibson, as students need this modeled, they often don't ask enough questions)

Expert Nurse Vignette: Brief review of what is important to know in report in order to prioritize cares, organize day, and delegate appropriately.

Scene Two: Organization of Day/Prioritization of Cares

Setting: Nurses Station with UAP

Expert Nurse: Verbally describes how they are organizing their day and prioritizing cares. Checks orders for priorities of cares. Delegates cares to UAP using SBAR or other appropriate communication techniques.

UAP: Ask questions for further clarification if needed.

Vignette: Both Expert Nurse and UAP discuss what is needed when delegating cares.

Scene Three: Focused Assessment of Mark Lopez

Setting: Lopez's Room

Expert Nurse: (Talking aloud while doing assessment so student can understand rationale of focused initial assessment). When assessing Lopez it becomes clear that the patient has a dislodged IV and a non-functioning NG tube. The nurse will communicate with the Dr. or Charge Nurse as needed. The nurse will use the UAP to assist as appropriate and verbalize rationale for this.

Vignette: Nurse will discuss what is important to assess initially with a patient just coming to the floor from the ER or another floor. Also the nurse will discuss how to use resources to assist with other patient cares when confronted with a patient who will need dedicated time.

Scene Four: Focused Assessment of Pat Gibson post fall

Setting: Gibson's Room

Expert Nurse: (Talking aloud while doing assessment so student can understand rationale of focused assessment). Nurse will perform a focused assessment. Nurse will communicate with Dr. or charge nurse as appropriate using SBAR.

UAP: Will find patient down and follow protocol for a fall.

Vignette: Expert nurse will discuss what is important to consider in the cares of a patient who is a high fall risk and the rationale behind these considerations.

Scene Five: Insertion of NG tube procedure with UAP assist if appropriate

Setting: Lopez's Room

Expert Nurse: Will insert NG tube while talking aloud concerning the procedure and considerations.

UAP: Will assist as appropriate.

Scene Six: Insertion of IV procedure

Setting: Lopez's Room

Expert Nurse: Will insert IV while talking aloud concerning the procedure and considerations.

Scene Seven: Pathophysiology

Setting: Conference Room

Vignette: Expert nurse will discuss what is important to assess for in a SBO, dehydration, Alzheimer's, GLF. UAP will discuss what is important when performing cares in these patients.

Scene Eight: Assessment

Vignette: Expert nurse will discuss how to differentiate between pertinent and extraneous assessment information.

Scene Nine: Communication

Vignette: Expert nurse and UAP discuss techniques to communicate effectively with patients and in the workplace.

<u>Sample Clip Link</u>
https://drive.google.com/file/d/0B_46F7CpxwXIbFZyS0FCLUhqMGM/view?usp=sharing

APPENDIX E

Cognitive Load Measurement Tool

Hello, my name is Jayne Josephsen, MS, RN, CHPN. I am a faculty member at Boise State University. I am conducting a research study about the simulations developed and implemented in your Nursing 427 course at the beginning of Spring 2015 semester. You are being given a survey related to the content of these simulations/cognitive load. The survey should take about 10 minutes to complete. The survey is completely voluntary, anonymous, and has no impact on your grade in the 427 course. Your feedback is greatly appreciated, as it will be utilized to improve the simulations and activities for future students.

If you have questions about your rights as a research participant, you may contact the Boise State University Institutional Review Board (IRB), which is concerned with the protection of volunteers in research projects. You may reach the board office between 8:00 AM and 5:00 PM, Monday through Friday, by calling **(208) 426-5401** or by **writing:humansubjects@boisestate.edu**.

By continuing with this survey, I affirm my consent to participant and I acknowledge that I am 18 years of age or older.

Thank you for your help.

Jayne Josephsen, MS, RN, CHPN

School of Nursing

Boise State University

(208) 426-5473

Second Degree Status: yes___ no___

Gender: male ____ female _____

Age Range: 20-25___26-30___31-35____36-40_____Over 40_____

Role in Simulation: Observer ____ Nurse _____ Both______

Time of Simulation: AM____ PM_____

Please respond to each of the questions on the following scale (0 meaning *not at all the case* and 10 meaning *completely the case*).

0 1 2 3 4 5 6 7 8 9 10

9. The topic/topics covered in the simulation was/were very complex.
10. The simulation covered pathophysiology that I perceived as very complex.
11. The simulation covered concepts and definitions that I perceived as very complex.
12. The instructions and/or explanations during the simulation were very unclear.
13. The instructions and/or explanations given during the simulation were, in terms of learning, very ineffective.
14. The instructions and/or explanations given during the simulation were full of unclear language.
15. The simulation really enhanced my understanding of the topic(s) covered.
16. The simulation really enhanced my knowledge and understanding of application of the nursing process.
17. The simulation really enhanced my understanding of the disease process covered.
18. The simulation really enhanced my understanding of concepts and definitions.

Please choose the category (1, 2, 3, 4, 5, 6, 7, 8, or 9) that applies to you: Please check only one. In the simulation that just finished I invested:

_ very, very low mental effort

_ very low mental effort

_ low mental effort

_ rather low mental effort

_ neither low nor high mental effort

_ rather high mental effort

_ high mental effort/ 8. very high mental effort

_ very, very high mental effort

Please choose the category (1, 2, 3, 4, 5, 6, 7, 8, or 9) that applies to you: Please check only one. The simulation that just finished was:

_ very, very easy

_ very easy

_ easy

_ rather easy

_ neither easy nor difficult

_ rather difficult

_ difficult

_ very difficult

_ very, very difficult

Please choose the category (1, 2, 3, 4, 5, 6, 7, 8, or 9) that applies to you: Please chose only one. To learn from the simulation was

_ very, very easy

_ very easy

_ easy

_ rather easy

_ neither easy nor difficult

_ rather difficult

_ difficult

_ very difficult

_ very, very difficult

Please choose the category (1, 2, 3, 4, 5, 6, 7, 8, or 9) that applies to you: Please chose only one. How much did you concentrate during the simulation?

_ very, very little

_ very little

_ little

_ rather little

_ neither little nor much

_ rather much

_ much

_ very much

_ very, very much

(Tool adapted from: Leppink, Jimmie; Paas, Fred; Van der Vleuten, Cees P. M.; Van Gog, Tamara; Van Merriënboer, Jeroen J. G. Behavior Research Methods. Dec2013, Vol. 45 Issue 4, p1058-1072).

APPENDIX F

Pre and Post Knowledge Survey

Hello, my name is Jayne Josephsen, MS, RN, CHPN. I am a faculty member at Boise State University. I am conducting a research study about the simulations developed and implemented in your Nursing 427 course at the beginning of Spring 2015 semester. You are being given a survey related to the content of these simulations/cognitive load. The survey should take about 10 minutes to complete. The survey is completely voluntary, anonymous, and has no impact on your grade in the 427 course. Your feedback is greatly appreciated, as it will be utilized to improve the simulations and activities for future students.

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By continuing with this survey, I affirm my consent to participant and I acknowledge that I am 18 years of age or older.

Thank you for your help.

Jayne Josephsen, MS, RN, CHPN

School of Nursing

Boise State University

(208) 426-5473

You are beginning your nursing shift at 0700. You will be caring for four patients.

Patient One: A 67-year-old woman who is post left hip joint replacement. She is due to go to the rehabilitation floor today after breakfast. She receives AC and HS BG's with a sliding scale insulin correction.

Patient Two: A 54-year-old man who is post debridement for an abscess on his left foot. He is going home today with a wound vac and home health nursing. He is due to discharge as soon as the Dr. rounds and writes discharge orders.

Patient Three: A 35-year-old man who has just arrived to the floor from the emergency department. He has been admitted for nausea and vomiting and it is suspected he has a small bowel obstruction. He has an IV running with D5LR at 125/hr.

Patient Four: A 75-year-old woman who was admitted with acute dehydration and has a history of Alzheimer's dementia. She is confused and has a bed alarm placed for safety. She has an IV running with D5NS with 20meqKCL at 75/hr.

1. When considering patient three which symptoms would you not expect to see during your assessment?

☐Constipation and hemorrhoids (correct answer)

☐Cramping and bloating

☐Abdominal pain and diarrhea

☐Nausea and decreased appetite

2. When considering patient four which symptom would you not expect to see during your assessment?

☐Confusion

☐Seizure

☐Mild muscle aches (correct answer)

☐Tachycardia

3. Which cares would you delegate to the unlicensed assistive personnel? Select all that apply.

☐Patient 1 BG's and Patient 2 ensure breakfast is ordered (correct answer)

☐Patient 3 ensure breakfast is ordered and Patient 4 report any confusion

☐Patient 2 assist patient in getting dressed and Patient 4 offer patient water every two hours (correct answer)

☐Patient 1 ensure breakfast is ordered, Patient 3 keep track of output in urinal (correct answer)

4. When assessing patient four you notice her confusion has increased when comparing it to the night nurses report. You examine her morning labs and intake and output recordings and realize that she has only had 40 ml of recorded output overnight. You are considering calling the physician for further orders. Which of the following phrases would you use when communicating with the physician? Select all that apply. (All are correct)

☐I reviewed her labs and intake and output and it looks as though she only had 40 ml of output overnight.

☐Dr. Knight this is Anna the nurse caring for your patient in room 5432, Mrs. Gibson. She is 75 years old, has Alzheimer's dementia and was admitted for acute dehydration.

☐ I would like to give her a bladder scan to see if she is having any urine retention. Additionally, I would like to get a PRN order for Risperdal.

☐She has been showing signs of increasing confusion and agitation, stating that she is seeing things and is not oriented to person, place or time.

5. When assessing patient three he is complaining of intense nausea you check his orders to see if there are any medications for nausea. There are no orders at this time. You call the physician to get an order for nausea medication. Which order is the physician most likely to give?

☐Ondansetron hydrochloride (Zofran) IV 20mg/ml every 12 hours PRN.

☐Prochlorperazine maleate (Compazine) PO 10 mg every 6 hours PRN.

☐Promethazine hydrochloride (Phenergan) IM 25 mg every 4 hours PRN. (Correct answer)

☐Dronabinol (Marinol) NGT 5 mg every 4 hours PRN.

6. The unlicensed assistive personnel find patient 3 down on the floor of their room. What are your responsibilities as the Nurse? Check all that apply.

☐Assess level of consciousness, pain and range of motion (correct answer)

☐Update Plan of Care (correct answer)

☐Turn off the alarm as soon as you arrive

☐Debrief with unlicensed assistive personnel (correct answer)

7. When performing an initial patient assessment what questions should you consider? Select all that apply.

☐Is there any clinical data that indicates the situation needs immediate action? (Correct answer)

☐What are your senses telling you? (Correct answer)

☐What additional information do you need? (Correct answer)

☐Does the patient need those tubes? (Correct answer)

8. When prioritizing patient care the nurse uses which of the following information? Check all that apply.

☐Patient assessment (correct answer)

☐Resources available (correct answer)

☐Patient Acuity (correct answer)

☐Report Received (correct answer)

9. Prioritize the following tasks based on the desired outcome of providing safe and effective care for Mr. Bradley, a 68 year old man with a total hip replacement who is two days post op and stable. Use the criteria (L) life threatening, (S) safety, (E) essential to care plan, and (N) nice to do, but not a priority.

☐ Administer medications as ordered for arrhythmia (L)

☐Instruct patient regarding post discharge care (E)

☐ Monitor vital signs every four hours (E)

☐ Order meal for patient's family member (N)

☐ Assist patient with ambulation after discussion with physical therapy (S)

☐Place side rails up when patient has been medicated for pain (S)

10. When managing their time the nurse will do which of the following:

- Gather all supplies needed before beginning an activity and respond to things as they happen.
- Document as soon as possible and respond as soon as possible to patients that are most vocal to create a restful atmosphere
- Delegate appropriately and do the simplest tasks first
- Schedule difficult tasks when the nurse is most productive and rank patient needs in terms of urgency (correct answer)