Abstract

Title of Dissertation: RELATIONS AMONG TOPIC KNOWLEDGE, INDIVIDUAL INTEREST, AND RELATIONAL REASONING, AND CRITICAL THINKING IN MATERNITY NURSING

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Critical thinking in learners is a goal of educators and professional organizations in nursing as well as other professions. However, few studies in nursing have examined the role of the important individual difference factors topic knowledge, individual interest, and general relational reasoning strategies in predicting critical thinking. In addition, most previous studies have used domain-general, standardized measures, with inconsistent results. Moreover, few studies have investigated critical thinking across multiple levels of experience. The major purpose of this study was to examine the degree to which topic knowledge, individual interest, and relational reasoning predict critical thinking in maternity nurses.

For this study, 182 maternity nurses were recruited from national nursing listservs explicitly chosen to capture multiple levels of experience from prelicensure to very experienced nurses. The three independent measures included a domain-specific Topic Knowledge Assessment (TKA), consisting of 24 short-answer questions, a Professed and Engaged Interest Measure (PEIM), with 20 questions indicating level of interest and engagement in maternity nursing topics and activities, and the Test of Relational

Reasoning (TORR), a graphical selected response measure with 32 items organized in scales corresponding to four forms of relational reasoning: analogy, anomaly, antithesis, and antinomy.

The dependent measure was the Critical Thinking Task in Maternity Nursing (CT^2MN), composed of a clinical case study providing cues with follow-up questions relating to nursing care. These questions align with the cognitive processes identified in a commonly-used definition of critical thinking in nursing. Reliable coding schemes for the measures were developed for this study.

Key findings included a significant correlation between topic knowledge and individual interest. Further, the three individual difference factors explained a significant proportion of the variance in critical thinking with a large effect size. While topic knowledge was the strongest predictor of critical thinking performance, individual interest had a moderate significant effect, and relational reasoning had a small but significant effect. The findings suggest that these individual difference factors should be included in future studies of critical thinking in nursing. Implications for nursing education, research, and practice are discussed.

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RELATIONAL REASONING, AND CRITICAL THINKING IN MATERNITY
NURSING
by

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CHAPTER 1:

INTRODUCTION

Nurse Jennifer has been a maternity nurse for 5 years and has been fascinated by maternity nursing since her basic education in nursing. Today, she stares thoughtfully at her patient Mrs. Gablonsky. Nurse Jennifer sees something surprising. Mrs. Gablonsky's condition differs in a way the nurse does not expect for a woman who birthed a baby the previous day. Nurse Jennifer wonders about what is causing Mrs. Gablonsky's state and questions the patient closely to find out if there were any symptoms that could help explain her condition. Nurse Jennifer compares Mrs. Gablonsky's condition to the other postpartum women she has treated in her career. She searches her mental database for knowledge about complications that could be consistent with the symptom that surprised her. After a few moments of thinking, Nurse Jennifer knows how to help her patient.

Critical thinking has been of central importance in education and public discourse from ancient to modern times (Alexander, 2014; Fero, Witsberger, Wesmiller, Zullo, & Hoffman, 2009; Niu, Behar-Horenstein, & Garvan, 2013), from Socrates's use of probing questions to induce critical analysis to recent calls at federal, state, and professional levels for increased levels of learners' critical thinking (Shavelson, 2010). In a higher education context, critical thinking is recognized as vital for students in all fields, including healthcare (U.S. Department of Labor, 1992; White House, 2014). Further, professional associations in both nursing and medicine have recognized critical thinking and its analog in practice, clinical reasoning, as fundamental processes for the effective practice of both nursing and medicine (American Association of Colleges of Nursing, 2008; American Nurses Association, 2010; Benner, Sutphen, Leonard, & Day, 2010; Cooke, Irby, & O'Brien, 2010; Institute of Medicine [IOM], 2010).

As the opening scenario illustrates, critical thinking is centrally involved in the quality of care maternity nurses provide to women and newborns. Critical thinking involves the cognitive processes of analyzing, applying standards, discriminating, information seeking, logical reasoning, predicting, and transforming knowledge that maternity nurses use in the care of clients (Facione, 1990; Scheffer & Rubenfeld, 2000). Further, critical thinking has been theoretically and empirically linked with individuals' topic knowledge, individual interest and relational reasoning strategies (Alexander & Judy, 1988; Dumas, Alexander, & Grossnickle, 2013; Renninger & Hidi, 2011; Schiefele, 2009; Schraw, 2006; Silvia, 2006). As maternity nurses care for women and newborns every day, the outcome of each nurse's critical thinking not only may impact the lifelong health of mother and child, but also affects a healthcare system struggling with issues of safety, cost, and effectiveness (Benner, Hughes, & Sutphen, 2008).

Definitions of Critical Thinking

Due to the importance of critical thinking, much research has been focused on conceptualizing it and determining the factors that contribute to it. In 1990, the American Philosophical Association (APA) Consensus Panel led by Peter Facione defined *critical thinking* as "purposeful, self-regulatory judgment, which results in interpretation, analysis, evaluation, and inference, as well as explanation of the…considerations on which that judgment is based" (p. 2). Within the literature, critical thinking has also been associated with such terms as higher-order thinking (Alexander et al., 2011; Anderson et al., 2001; Shaughnessy, 2008), decision-making (Girot, 2000; Hicks, Merritt, & Elstein, 2003), problem-solving (Chi & Glaser, 1985; Kuiper & Pesut, 2004; Mayer & Wittrock, 2006), and clinical judgment (Lasater & Nielsen, 2009).

Research has also been conducted in order to understand critical thinking in the context of nursing and to, thus, afford better conceptualization and operationalization of the term. For example, in the mid 1990's, Scheffer and Rubenfeld conducted a three-year Delphi study to gain consensus on the nursing definition of critical thinking from a diverse group of expert nurses using a process similar to the APA process. They identified seven cognitive processes implicated in critical thinking: analyzing, applying standards, discriminating, information seeking, logical reasoning, predicting, and transforming knowledge (Scheffer & Rubenfeld, 2000). Although critical thinking has often been conceptualized as a general cognitive process, the term clinical reasoning has been adopted to refer to the application of critical thinking specifically to solve problems in the provision of health care (Higgs & Jones, 2000).

From the 1980's to the present, critical thinking and clinical reasoning have been areas of intense research (Brunt, 2005a; Victor-Chmil, 2013; Fountain, 2016; Gupta & Upshur, 2012; Norman, 2005; Simpson & Courtney, 2002; Walsh & Seldomridge, 2006a). The application of critical thinking to nursing and medical care (i.e., clinical reasoning) has been found to be associated with reduced morbidity and mortality for patients, and to increased patient satisfaction with care (IOM, 2005). Further, educating healthcare professionals to employ critical thinking may help to reduce health care costs by avoiding mistakes, unnecessary procedures, and unnecessary use of supplies (Benner et al., 2010; Kataoka-Yahiro & Saylor, 1994). Critical thinking can also improve patient outcomes by preventing rote or algorithmic thinking that could lead to inappropriate administration of medication or procedures (Fesler-Birch, 2005).

In this study, the term critical thinking will be used to represent those cognitive and analytic processes entailed in the health profession; that is in lieu of the alternative terms clinical thinking and clinical reasoning. Specifically, critical thinking in this study is defined as the cognitive processes of analyzing, applying standards, discriminating, information seeking, logical reasoning, predicting and transforming knowledge that maternity nurses use in the care of clients (Higgs & Jones, 2000; Scheffer & Rubenfeld, 2000). A critical thinking task that mirrors case-based problems common in the prelicensure and continuing education of nurses and that is reputed to require such cognitive processes will be used in this investigation. Further, it is hypothesized that individuals' knowledge, interest and strategic abilities play a significant role in their ability to engage effectively in critical thinking and to perform well on such case-based problems (e.g., Dumas et al., 2013; Facione, 1990; Renninger & Hidi, 2011). Therefore, measures of knowledge, interest, and strategic processing will also be administered and analyzed in relation to critical thinking performance.

Significance of Critical Thinking in Nursing Care

There are several reasons why critical thinking processes are vital in nursing. First, critical thinking helps prevent nurses from making errors (Rogal & Young, 2008; Worrell & Profetto-McGrath, 2007). Although originally nurses provided only supportive care and were required to follow physician orders, the profession has evolved to include a high level of autonomy in determining nursing care, with complicated medication regimens, as well as multiple protocols and standards to be met (Benner, 1982; Eisenhauer, Hurley, & Dolan, 2007). Nurses are no longer technicians following a checklist, but independently licensed professionals using higher-order thinking to solve

complex problems (Rubenfeld & Scheffer, 2014). The increasing autonomy of the nursing profession has made critical thinking skills crucial to making correct decisions about patient care.

Another reason critical thinking is a vital process is the proliferation of new technologies and the need for *evidence-based practice* (EBP) in healthcare. The crucial process EBP is defined as the process of appraising research evidence and deciding how to use it in practice (Melnyk & Fineout-Overholt, 2011), and requires nurses to evaluate care on an ongoing basis (Institute of Medicine, 2005). Nurses are often required to employ new technologies in patient care (Heller, Oros, & Durney-Crowley, 2000). Using relatively recent technology, such as increasingly complex monitors, diagnostic medical devices, and electronic medical records, requires nurses to repeatedly triage activities in the provision of individualized care (Brunt, 2005a). This type of evaluation that is needed in the use of technology and EBP is a key component of critical thinking.

Finally, critical thinking is necessary to incorporate the patient perspective in clinical decision-making. The Institute of Medicine (2001) identified patient-centered care as an aim for the healthcare system, and increasing emphasis on incorporating the patient perspective into clinical decisions has also been a nursing goal (Fero et al., 2009). Nurse educators have responded to this need by increasing the emphasis on critical thinking in teaching strategies and nursing curricula for both prelicensure (Tanner, 2011) and practicing nurses (Fero et al., 2009).

Gaps in the Literature

Two major gaps in the literature pertaining to critical thinking in nursing have been identified. First, there is the lack of research on the contributions of certain

individual difference factors to critical thinking in nursing—factors that have been found to be of importance in critical thinking generally. Second, critical thinking has been examined in specific cohorts (e.g., nurses in training or new graduates or practicing nurses), but few studies have examined critical thinking across multiple populations within nursing.

Individual Differences

Based on the extant literature pertaining to critical thinking generally and in the health professions, it is argued that the possible contributions of individual factors have not been adequately capitalized upon in nursing research in critical thinking (Benner et al., 2008; Tanner, 2006). This study will focus on three such factors: individual interest, topic knowledge, and relational reasoning.

Individual interest. Individual interest has been defined as a relatively stable orientation toward a subject that is composed of the feelings and positive and negative beliefs toward the subject (Renninger & Hidi, 2011; Schiefele, 2009; Sylvia, 2006). Although much of research on critical thinking in maternity nursing has focused on cognitive aspects, there is reason to suggest that interest may likewise play an important role. First, to the extent that critical thinking has been found to be cognitively effortful, interest serves a motivational purpose in promoting critical thinking (Artino, La Rochelle, & Durning, 2010; Schiefele, 1991). Further, a lack of interest has been introduced as a possible explanation for the limited use of clinical reasoning strategies (Pintrich, 2003; van Gessel, Nendaz, Vermeulen, Junod, & Vu, 2003).

Interest is a particularly salient construct for decisions to pursue maternity nursing (Carolan & Kruger, 2011; Ulrich, 2009). Interest in maternity nursing develops either

prior to nursing school, sometimes referred to as being "called" to maternity nursing or midwifery, or during nursing school upon exposure to maternity nursing during clinical rotations and classroom experiences, and continues to be a motivating factor in practice (Ulrich, 2009). This is in line with predictions from Social Cognitive Career Theory, which has found that interest, as well as other variables, stimulates career relevant choices (Lent & Brown, 1996). So although interest has been documented as an important factor in academic performance and is included as the related construct disposition in conceptions of critical thinking (Cruz, Pimenta, & Lunney, 2009; Scheffer & Rubenfeld, 2000), no research was located that investigates the relation between individual interest and critical thinking in maternity nurses.

Topic knowledge. Topic knowledge is defined in this study as domain-specific declarative and conceptual knowledge relative to the profession of maternity nursing (Alexander, Schallert, & Hare, 1991; Schraw, 2006). The role of knowledge, broadly defined, has also been studied in the context of many learning outcomes in the health sciences and the role of knowledge has been discussed frequently in theoretical frameworks of clinical reasoning (Elstein, Shulman, & Sprafka, 1978; Higgs & Jones, 2000; Norman, 2005; Tanner, 2006). However, the role of topic knowledge in critical thinking in the context of nursing has not been adequately explored (Bråten, Ferguson, Anmarkrud, & Strømsø, 2013; Liaw, Scherpbier, Rethans, & Klainin-Yobas, 2012).

In the professional domain of nursing, domain-specific knowledge is vital to the understanding of a problem situation (Chi & Glaser, 1985; Lawless & Kulikowich, 2006). However, much of the research pertaining to critical thinking in nursing has used domain-general standardized instruments, such as the California Critical Thinking Skills

Test (Facione & Facione, 1994), that do not account for topic knowledge or individual interest. An unexpected finding in the nursing critical thinking literature is the lack of increase in critical thinking during nursing education programs or with teaching strategies designed to improve critical thinking (Beckie, Lowry, & Barnett 2001; Carter, Creedy, & Sidebotham, 2015; Walsh &Seldomridge, 2006a). Although domain-general critical thinking assessments are widely used, limited work has examined the impact of domain-specific knowledge to domain-specific critical thinking performance. Thus, instruments that examine the contribution of domain-specific knowledge and individual interest to critical thinking have not been used.

 Relational reasoning. The third individual difference in this study, relational reasoning, has been defined as "the process of discerning meaningful patterns within any informational stream" (Alexander and the Disciplined Reading and Learning Research Laboratory [DRLRL], 2012). Researchers have examined an array of processing or reasoning strategies in association with reasoning and problem solving (Gick & Holyoak, 1980; Halpern, 1998; Murphy, 2004), but relational reasoning represents a particular form of strategic processing that may be particularly relevant to critical thinking in maternity nursing. Specifically, relational reasoning is hypothesized to be an important construct for nurses who must synthesize a great deal of incoming data from multiple sources to care for patients (Offredy & Meerabeau, 2005). In maternity nursing, where the vast majority of the patient population is healthy, knowledge of common patient presentations is an important foundation for clinical practice (Lowdermilk, Perry, Cashion, & Alden, 2012).

Further, one of the key roles of nurses in caring for patients is to identify

abnormal or anomalous findings (American Nurses Association, 2010). In particular,

these two relational reasoning processes, analogy (i.e., identification of commonalities)

and anomaly (i.e., identification of discrepancies) are considered to theoretically underlie

much of clinical nursing. Although one qualitative study discussed analogical reasoning

in an example of clinical reasoning strategies (Murphy, 2004), almost no empirical

studies have investigated the role of relational reasoning in critical thinking in a clinical

context. A recent article by Dumas, Alexander, Baker, Jablansky, and Dunbar (2014) is a

notable exception. Although some studies have looked at the role of analogy in the

choice of nursing diagnoses for patients (Lunney, 2009), examinations of other forms of

relational reasoning that may be pertinent in case-based analysis were not found. For

example, differential diagnosis, which is involved in deciding applicable nursing

diagnoses, requires the elimination of certain diagnoses as untenable (antinomy).

Laboratory findings may be the opposite of what is expected in deciding if a patient is

experiencing an abnormal condition (antithesis). No studies addressing the use of these

types of relational reasoning strategies in critical thinking in nursing were found.

Theoretical framework. These three individual difference constructs of

knowledge, interest, and strategic processes have been united as theoretical framework in

Alexander's multidimensional Model of Domain Learning (MDL; 1997, 2003a). The

MDL explains the changing relations among the cognitive, motivational, and strategic

constructs throughout the learning trajectory of an individual across the professional

lifespan (see Figure 1). This model has been previously investigated in multiple diverse

domains, including reading (Alexander & Fox, 2011), physics and biology (Alexander,

Jetton, & Kulikowich, 1995), music (Langan & Athenasou, 2004) special education (Alexander, Sperl, Buehl, Fives, & Chiu, 2004), and physical education (Shen & Chen, 2006).

There are two forms of each of the constructs in the MDL. Knowledge includes two forms of subject-specific knowledge, topic and domain knowledge. Domain knowledge represents individuals' breadth of knowledge within a field of study, such as maternity nursing, whereas topic knowledge indicates individuals' depth of knowledge about topics central to that domain (e.g., involution and postpartum support system). There are also two forms of individual interest. Both fleeting situational interest, such as that engendered by an exciting speaker, as well as enduring individual interest, demonstrated by most nurses as they specialize in an area of patient care, are characterized. In the current study, the construct of relational reasoning represents a general form of the strategic processing considered within the MDL framework. Strategic processing in the MDL presents as either deep or surface processing. Surface processing is used to aid the formation of a rudimentary understanding of the learner's profession, encompassing superficial learning strategies such as rereading nursing textbooks or memorizing nursing care for a particular illness, whereas deep processing comprises more complex strategies such as interpreting and anticipating patient outcomes based on data.

MODEL OF DOMAIN LEARNING
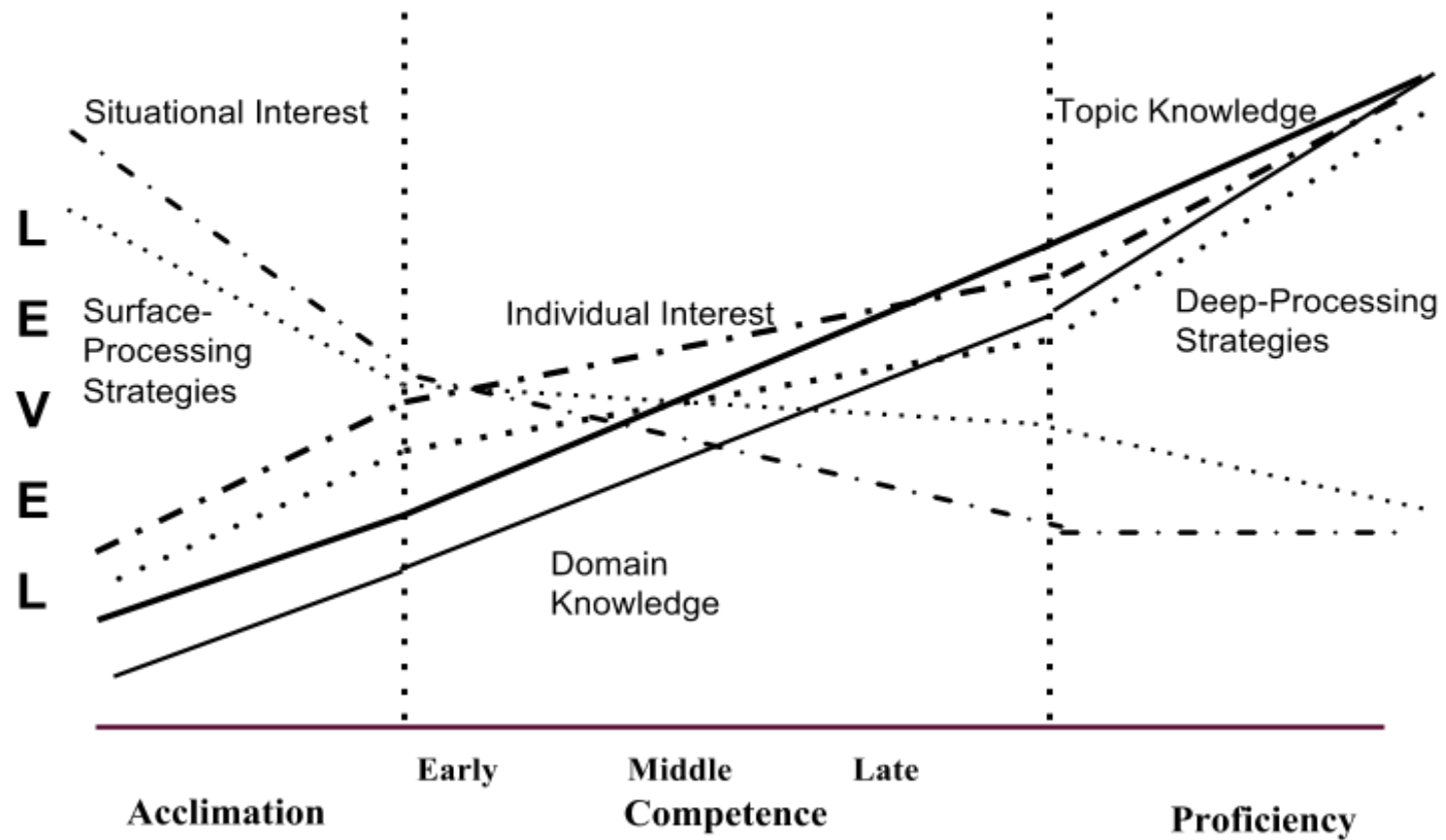
Figure 1. Model of Domain Learning stages.

Populations Studied in Critical Thinking Research

A second evident gap in the literature on critical thinking in nursing is the lack of investigation across multiple levels of experience. Specifically, a systematic review of 43 empirical studies in nursing and medicine about critical thinking and clinical reasoning (Fountain, 2016) found that only 9% of studies (2/23) included multiple levels of participants (e.g., student, new graduate, or practicing provider). Yet, it has been shown that differences in critical thinking exist between professionals at different levels of experience (Chi & Glaser, 1985; Forneris & Peden-McAlpine, 2006; Norman, 2005). Therefore, in order to have an accurate assessment of the role of individual difference contributors to critical thinking, it is important to include multiple levels of practitioners, as the process could be different for different levels of experience.

One study that did analyze data collected about nurses and nursing students at different levels of expertise was Benner's (1982) phenomenological study describing the thinking of nurses in five stages of development from novice to expert, based on the Dreyfus and Dreyfus (1980) model of skill acquisition. In the Dreyfus and Dreyfus model, the development of skill acquisition was divided into the categories novice, with no experience, competent, with some experience, proficient, when the situation is assessed in a holistic manner, and expert, where the skill is performed with integration. Benner (1982, 1984) used this model to describe the skills demonstrated by nurses at each level of expertise. Her model emphasized experience as the primary engine of professional development. More recent studies of critical thinking have also identified professional experience as a contributor to critical thinking (Drennan, 2009; Martin,

2002). To address this theoretical notion, years of experience was included in this study as a variable when examining the regression model.

Overall, the Model of Domain Learning provides a promising framework for analyzing individual differences in cognitive, affective, and strategic processing, as well as providing justification for including nurses at education at different stages of academic and professional development in the study of critical thinking

Statement of the Problem

Critical thinking is a vital skill for modern nurses (American Association of Colleges of Nursing, 2008; American Nurses Association, 2010; Benner et al., 2010). Yet, very little research exists on the role of individual difference factors in critical thinking in maternity nursing per se, and most studies have focused on only one population (Drennan, 2009; Hunter, Pitt, Croce, & Roche, 2014; Theisen & Sandau, 2013). Further, what research does exist on critical thinking in nursing has not yielded an adequate understanding of the contributors to critical thinking (Brunt, 2005b; Simpson & Courtney, 2008; Victor-Chmil, 2013). This investigation considers topic knowledge, individual interest, and relational reasoning as important potential contributors to critical thinking in maternity nursing.

Purpose of the Study

This study examined the relations among topic knowledge, individual interest, and relational reasoning, and critical thinking. The interrelations of topic knowledge and individual interest, as well as the associated contribution of knowledge, individual interest, and relational reasoning to critical thinking, were investigated.

Research Questions and Conceptual Model

In order to address the gap in knowledge about the role of individual difference factors in critical thinking, as well as the limited populations examined in empirical studies, the current study addressed three primary questions:

1. What is the relation between domain-specific topic knowledge and individual interest in nurses?

Given the extant literature (Alexander et al., 2004; Schiefele, 2009), it is expected that topic knowledge and individual interest would be significantly related. Specifically, previous research has demonstrated that knowledge is necessary for gains in interest (Renninger, 2000), and researchers have suggested that knowledge might influence motivation (Alexander et al., 1995; Pintrich, 2003). The theoretical framework for this study, the MDL, predicts a positive correlation between topic knowledge and individual interest (Alexander, 2003b). This relation is represented in Figure 2 by a dashed double arrow labeled Q1 between topic knowledge and individual interest. To analyze this relation, a Pearson's correlation analysis was used.

2. To what extent do topic knowledge and individual interest predict critical thinking in nurses?

Previous education research has demonstrated that knowledge and interest can predict learning (Alexander et al., 2004; Taboada, Tonks, Wigfield, & Guthrie, 2009). In the health professions, interest has been shown to be associated with improved cognitive performance (Artino et al., 2010). In this study, topic knowledge and individual interest were expected to explain some of the variation in critical thinking. To test this, linear

regression analysis was used with the expected outcomes of significant paths (Figure 2, Q 2) from individual interest and topic knowledge to critical thinking.

    3.   To what extent does relational reasoning predict critical thinking in nurses above and beyond topic knowledge and individual interest?

Relational reasoning has been demonstrated in medical education research with physicians (Dumas et al., 2014; Pena & deSouza Andrade-Filho, 2010). However, it is a virtually untested variable in nursing (Lunney, 2009). For that reason, this study examined the relation between relational reasoning and critical thinking in maternity nursing, a specialty in nursing. Given the domain-general nature of the test of relational reasoning employed in this investigation (Dumas et al., 2013), no direct associations with either topic knowledge or individual interest—domain-specific constructs—are anticipated. This relation is represented in Figure 2 by the arrow from relational reasoning to critical thinking (Q 3). To test this relation, hierarchical regression will be used. First, topic knowledge and individual interest variables will be entered into the model. Second, the critical thinking variable will be entered and tested for statistical significance. Relational reasoning is expected to explain a significant proportion of critical thinking above and beyond topic knowledge and individual thinking.
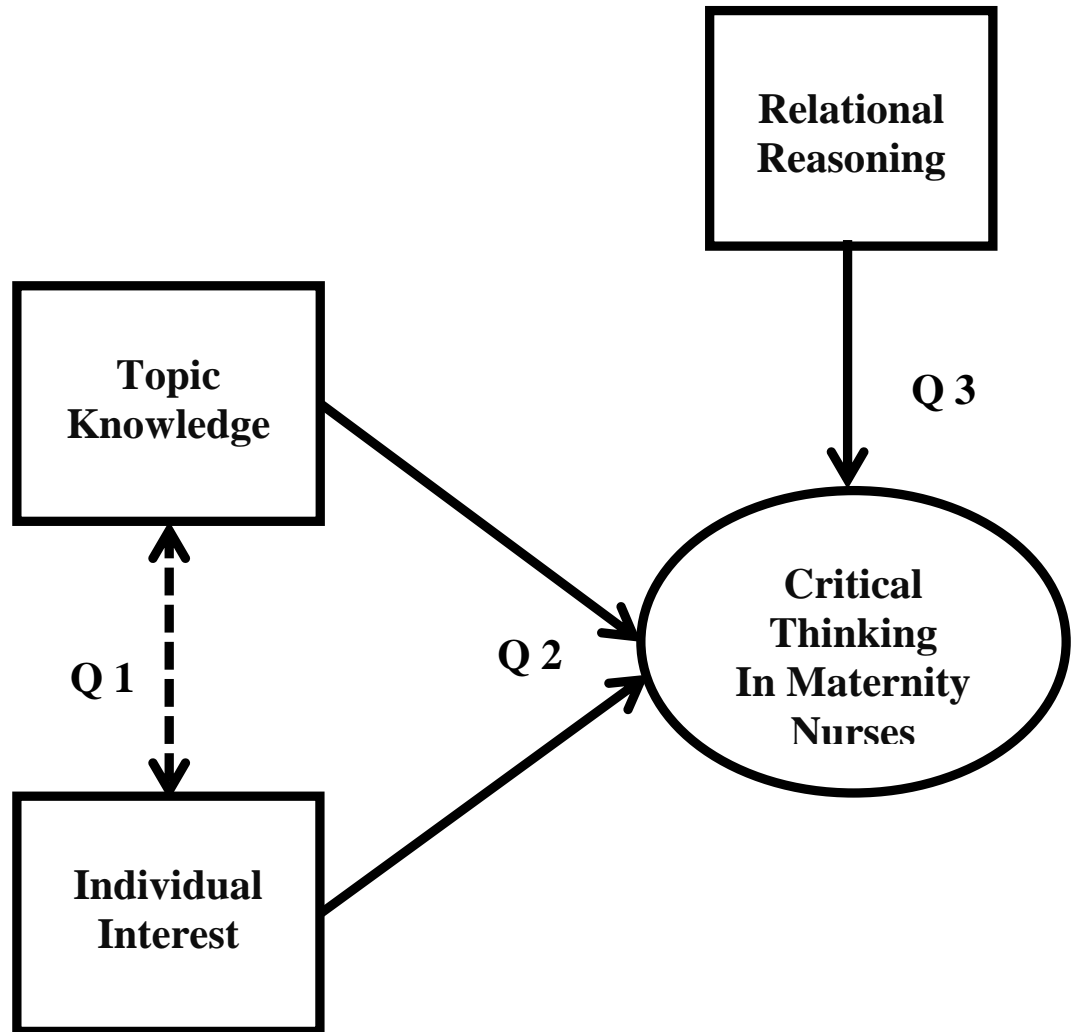
*Figure 2.*Conceptual model of individual differences and critical thinking.
Boxes represent independent variables and the ellipse represents the dependent variable.
The solid arrows indicate a causal relation, and the dashed double line indicates a
correlational relation.

Definitions of Key Terminology

The following terms were central to the conduct of this study:

Client is the person the nurse is caring for; when ill, the term *patient* is used. In maternity care, many clients do not experience any health deviations (Curtin, 1979).

Critical thinking is the cognitive processes of analyzing, applying standards, discriminating, information seeking, logical reasoning, predicting and transforming knowledge that maternity nurses use in the care of clients (Higgs & Jones, 2000; Scheffer & Rubenfeld, 2000).

Individual interest is defined as a relatively stable orientation toward a subject that is composed of the feelings and value-related beliefs towards the subject (Renninger & Hidi, 2011; Schiefele, 2009; Silvia, 2006).

Nursing is "the protection, promotion, and optimization of health and abilities, prevention of illness and injury, alleviation of suffering through the diagnosis and treatment of human response, and advocacy in the care of individuals, families, communities, and populations" (American Nurses Association, 2010, p. 9). In this study, only practicing or prelicensure registered nurses (RNs) were studied. An RN is a nurse who has graduated from an accredited school of nursing leading to eligibility for RN licensure by a state authority (Merriam-Webster, 2011); an RN has more training and broader experience than a licensed practical nurse.

Medicine is the applied science or practice of the diagnosis, treatment, and prevention of disease (Oxford English Dictionary, 2013).

Relational reasoning is defined as "the ability to recognize or derive meaningful relations between and among pieces of information that would otherwise appear unrelated" (Alexander and the DRLRL, 2012).

Topic knowledge is domain-specific declarative and conceptual knowledge relative to the profession of maternity nursing (Alexander et al., 1991; Schraw, 2006).

CHAPTER 2:

REVIEW OF THE LITERATURE

In this review of the literature, the individual difference factors in critical thinking introduced in the conceptual model of this study in Chapter 1 are examined (see Figure 2). First, topic knowledge will be discussed, followed by individual interest, relational reasoning, and finally, critical thinking. For each factor, the conceptualization will be discussed. Next, the types of assessment used to measure that individual difference factor will be described. Finally, the empirical findings related to that factor will be analyzed.

Topic Knowledge

The influence of knowledge on learning and performance seems obvious. Decades of study of the role of topic knowledge have addressed multiple models of types and qualities of knowledge, and multiple ways of measuring knowledge. The association between knowledge and human learning and performance has been repeatedly demonstrated (Anmarkrud & Bråten, 2009; Adams, Simmons, Willis, & Pawling, 2010; Alexander et al., 1995; Dinsmore, Alexander, & Loughlin, 2008a). In order to address the research question about the contribution of the specific construct *topic knowledge* to predicting critical thinking in maternity nurses, a review of the conceptualization, measurement, and empirical findings of this form of knowledge is warranted. Specifically, findings regarding the role of topic knowledge in health sciences education research that evaluate learning outcomes and critical thinking will be described, with reference to general education literature as necessary.

Conceptualization of Topic Knowledge

This study defined *topic knowledge* as individuals' declarative knowledge specifically related to the nursing care of women and newborns during the maternity cycle (Alexander & Judy, 1988; Lowdermilk et al., 2012). Topic knowledge has evolved from the source construct *knowledge*, defined as "the recall of specifics and universals, methods and processes, or…a pattern, structure, or setting" (Bloom, 1956, p. 201). Since ancient times, philosophers and researchers have divided knowledge into different categories in order to analyze its use. Aristotle divided knowledge into several categories. *Techne* was described as the making of things or outcomes, *episteme* as scientific knowing, and *phronesis* as practical ethical knowing (*Nicomachean Ethics* 1139b18-1140b12). These categories continue to shape educational goals and research. Vestiges of this classification are discernible in Benjamin Bloom's (1956) early modern classification system. Although Bloom's Taxonomy of Educational Objectives was designed for aligning curricular components, it has been extended to categorizing the types of knowledge and levels of cognitive processes (Krathwohl, 2002). In order to create this taxonomy, Bloom and a national panel of education experts across many disciplines and universities divided educational objectives used in many educational settings into three domains: cognitive, affective, and psychomotor.

The cognitive domain included "knowledge and the development of intellectual abilities and skills" (Bloom, 1956, p. 7); Bloom acknowledged that some would call this category "critical thinking" (p. 38). In the cognitive domain, the original taxonomy identified six classes: Knowledge, comprehension, application, analysis, synthesis, and evaluation. The classes are arranged in order of increasing complexity, with the

assumption that each level was cumulatively contained within the next (Bloom, 1956).

For example, in order for the learner to demonstrate comprehension, the learner must be

able to demonstrate knowledge. So, when this taxonomy is applied to classifying test

items, any test items about comprehension also test the lower level class knowledge, and

so forth for each level.

More recently, the understanding of topic knowledge has evolved beyond

Bloom's conceptualization of knowledge (Bereiter & Scardamalia, 1998). In addition to

types of knowledge, qualities of knowledge has also appeared in multiple frameworks.

The model of knowledge proposed by de Jong & Ferguson-Hessler (1996) classified

seven qualities of knowledge in a multi-factorial model. A key quality of knowledge

described by de Jong & Ferguson-Hessler is whether or not knowledge is specific to a

particular domain of study, such as middle-school science or nursing. The quality of

being domain-specific is also reflected in other classifications such as Schraw's (2006)

framework of knowledge structure and processes.

However, there are many conflicting aspects in the conceptualization of topic

knowledge. Along with de Jong & Ferguson-Hessler (1996) and Schraw (2006), the

"conceptual swamp" that has arisen in the literature pertaining to the forms and types of

knowledge (Haladyna & Rodriguez, 2013, p. 34) was addressed by Alexander et al.

(1991). In a systematic review of the literature, these researchers identified 27 terms

related to the construct of knowledge. That article specifically addressed the important

but problematic term *topic knowledge*, pertinent to the current investigation. These

researchers defined topic knowledge as a form of subject-specific, conceptual knowledge

that individuals have about a particular idea, event, or concept addressed within a given text or task (e.g., topics relevant to maternity nursing).

In nursing, conceptualization of knowledge stemmed from the philosophical orientation of researchers. Four major philosophical theorists, Sister Callista Roy, Dorthea Orem, Betty Neuman, and Martha Rogers have provided most of the frameworks for approaching the conceptualization of knowledge (Alligood, 2013). As knowledge began to be defined in relation to critical thinking, conceptual knowledge became more clearly associated with the measurement of topic knowledge. An example of a study that examined knowledge in conjunction with critical thinking in nursing was Angel, Duffy, and Belyea's study of undergraduate student nurse outcomes in knowledge and critical thinking skills. They defined knowledge as knowledge of pathophysiology of medical conditions, relevant health assessment data, and correct prioritization of problems (2000). Conceptual knowledge increased across the semester, but there was no relation between the knowledge variable and the standardized critical thinking measure. Because these type of conceptualizations seemed very broad, other models of topic knowledge were sought.

The Model of Domain Learning (Alexander, 1997, 2003a), overviewed in Chapter 1, not only deals with the domain-specificity of knowledge considered by de Jong & Ferguson-Hessler (1996) and Schraw (2006), but also distinguishes between two types of subject-specific knowledge, topic knowledge and domain knowledge (see Figure 1). Domain knowledge has been defined as the breadth of knowledge about all aspect of a domain, whereas topic knowledge is perceived as more in-depth knowledge about domain-specific constructs. For example, early in learning about science, in the

acclimating stage, learners have little topic or domain knowledge, and less awareness of domain breadth. Both types of knowledge rapidly increase during the competence stage, and at the proficient expertise stage, domain knowledge and topic knowledge reach nearly equivalent levels. Construct validity for this model for these changes in knowledge has been documented in several domains (Alexander et al., 1995; Alexander et al., 1994a, 1994b; Dinsmore, Alexander, & Loughlin, 2008b; Alexander & Fox, 2011).

Measurement of Topic Knowledge in Learning and Performance

Researchers investigating topic knowledge have used different types of instruments, including multiple-choice tests, open-ended writing prompts, and concept maps (Alexander, Kulikowich, & Jetton, 1994). In a review of the literature on subject-matter knowledge and interest in processing texts, Alexander, Kulikowich and Jetton (1994) found that researcher-made multiple-choice tests were the most common type of instrument used for measuring topic knowledge. For example, Anmarkrud and Bråten (2009) used a 12-item multiple-choice test with Norwegian ninth grade students to measure topic knowledge and assess its relation to motivation and reading comprehension. Similarly, in a study of individual difference factors affecting writing revision outcomes, Adams et al. (2010) measured topic knowledge using a researcher-made 15-item multiple-choice test on infant development, administered to undergraduate psychology majors.

Topic knowledge has also been measured using open-ended writing prompts. For instance, Taboada et al. (2009) used an open-ended writing format to measure knowledge in the context of biology by administering researcher generated prompts to fourth-grade students studying biomes. Interrater agreement was high using a 6-level rubric to rate

student responses to the prompt. Other researchers have used a combination of instruments to measure topic knowledge. For example, Schiefele used a Kintsch text situation model (1991) to describe outcomes of comprehension: 12 open-ended questions with questions at three levels of understanding: memory of concrete details, groupings of facts, and application to new situation. In another study, Rydland, Aukrust, and Fulland (2012) used questions with open-ended prompts about the meaning of global warming concepts, which were scored using a 0-2 rubric scale, as well as a 14-item multiple-choice item.

In a study of construct validity of different types of measures of topic knowledge, Valencia, Stallman, Commeyras, Pearson, and Harman (1991) described measures of topic knowledge as varying on a continuum from recognition to recall, with multiple-choice tests falling near the end of the recognition end of the continuum, completion questions in the middle, short-answer questions toward the recall end, and with oral recall interviews providing the most information on a learner's true topic knowledge at the end of the recall end of the continuum. These researchers found that ideas that were identified in the interview or recall measure were more likely to be correctly identified on a recognition measure. In contrast, ideas from the recognition measures were less likely to be identified in the interview. The second finding was that information shared in the recognition measures was less likely to be shared in the interview. This was particularly true for the science topics compared to the general topics. The percentage of unique information students gave during the interview was higher for science topics than general topics. And finally, a case analysis indicated that the variability of the scores was much greater for the interview than the recognition measures at both grade levels.

In addition to these topic-knowledge measurement findings, studies of performance in the health sciences have noted that short-answer questions are not limited by cueing and overestimation effects as multiple-choice items are (Newble, Baxter, & Elmsie, 1979; Reinert, Berlin, Swan-Sein, Nowygrod, & Fingeret, 2013). Research on topic knowledge in the context of nursing has used teacher/researcher-made multiple-choice tests, teacher and textbook-made final exams, teacher-made term papers, as well as concept maps and short-answer questions to measure topic knowledge in prelicensure nurses (Billings & Halstead, 2012; Bråten et al., 2013; Fountain, 2016; Liaw et al., 2012; Toth & Ritchey, 1984).

Although multiple formats have been used to assess topic knowledge in nurses, these methods have considerable practical and theoretical inadequacies, including over-reliance on multiple-choice tests, and erratic adherence to reliability and validity standards for educator-made tests (Kubiszyn& Borich, 1999). In addition, differences in content between standardized tests and nursing curriculum have been a drawback in the use of standardized testing as a measure of topic knowledge in the context of nursing (Solórzano, 2008; Spurlock & Hunt, 2008).

Empirical Findings about Topic Knowledge in Learning and Performance Outcomes

Despite the aforementioned measurement issues, topic knowledge has continued to play a frequent role as a construct in learning outcomes research. Topic knowledge has been studied extensively as a predictor of reading outcomes (Anmarkrud & Bråten, 2009; Boscolo & Mason, 2003; Shapiro, 2004), search strategies (Allen, 1991; Zhang, Liu, & Cole, 2013), and test performance. In medicine and nursing, topic knowledge has

been used as a measure for the achievement of other goals such as evaluating teaching-learning strategies and programmatic changes (Fero, O'Donnell, Zullo, Dabbs, Kitutu, Samosky, & Hoffman, 2010; MacPherson & Owen, 2010).

Many studies have documented the relation between topic knowledge and learning outcomes (Alexander et al., 1994a, 1994b; Dochy, Segars, & Buehl, 1999). For example, an early review by Dochy, Segers, and Buehl (1999) on topic knowledge and learning outcomes showed that prior knowledge was correlated with better performance 91.5% of the time and in all studies using open-ended and completion questions as measurement instruments. A later study by Shapiro (2004) examined undergraduate psychology majors for the effects of topic knowledge on posttests about cognition. She found that topic knowledge was correlated with posttest scores for detailed texts. In her discussion, she reiterated the importance of including a measure of topic knowledge in studies of learning outcomes. Shapiro's findings were replicated in a recent study using regression to show the relative contribution of topic knowledge in explaining comprehension (Ozuru, Dempsey, & McNamara, 2009).

In addition to its role in learning outcomes, topic knowledge has been studied as a predictor of critical thinking. Previous research has documented a link between critical thinking and learning progression (e.g., Hammer & Green, 2011), and the relation between topic knowledge and critical thinking, as well as clinical reasoning in medical practice, has been investigated (Gijselaers & Schmidt, 1990; Reinert et al., 2013). Topic knowledge, along with other contextual variables such as clinical schedule, was used in a causal path analysis to evaluate problem-based learning, a model of medical education that focuses on integration of knowledge with problem-solving (Gijselaers & Schmidt,

1990). With medical students as participants, topic knowledge was found to explain 37.8% of the variance in achievement as measured by a 200-item true/false test. It was also found to have a .49 correlation with interest.

In one methodological study, the short-answer format was used to measure topic knowledge for the purpose of evaluating the reliability and validity of the data from a clinical surgical exam (Reinart et al., 2013). After reading one of five scenarios, participants answered short-answer questions on surgical knowledge, x-ray interpretation, and management of complications. These authors concluded that 21st century medical education needs to go beyond recall knowledge as tested in multiple-choice tests, and move toward short-answer tests that more accurately demonstrate competence regarding knowledge needed for critical thinking in clinical cases.

In the context of nursing, the relation between topic knowledge and educational outcomes has been primarily studied qualitatively (Paans, Sermeus, Niewer, & Van Der Schans, 2010; Palese, Saiani, Brugnolli, & Regattin, 2008). In qualitative studies of critical thinking using a think-aloud method, where participants verbalized their thoughts as they analyze a case, knowledge was noted as one of the emergent themes. Similarly, Funkesson, Anbäckena & Ek (2007) identified recalling objective information about health status as one of the themes in a qualitative analysis of nurses' think-alouds. In certain nursing studies, knowledge was credited as a factor in clinical thinking, although this assumption was not clearly tested (Göransson, Ehnfors, Fonteyn, & Ehrenberg, 2007; Johansson, Pilhammar, & Willman, 2009). For example, McAllister Billett, Moyle, & Zimmer-Gembeck (2009) stated that changes in knowledge was one of their outcomes. In this study, knowledge was embedded in the therapeutic mental health nursing

strategies that their think-aloud study analyzed. Johansson et al. (2009) also included

prior knowledge as one of the underlying themes. In Sorensen and Yankech's (2008)

mixed methods study of nursing preceptors, using the California Critical Thinking Skills

Test for the quantitative arm and focus groups for the qualitative arm, preceptors

described helping students connect prior knowledge to practice knowledge. But direct

measures of knowledge were not included.

In spite of a great deal of research from learning outcomes in education that

document the importance of measuring topic knowledge, and in spite of statements that

topic knowledge is important in nursing (e.g., Petty, 2011), most nursing studies do not

include a measure of knowledge, nor assess the potential interaction of topic knowledge

with other individual differences. The vast majority of quantitative studies use domain-

general measures of knowledge, and have had mixed results regarding clinical thinking

outcomes (Drennan, 2009; Herbig, Büssing, & Ewert, 2001; Zygmont & Schaefer, 2006).

Although topic knowledge as measured through short-answer tests has been

frequently used in education literature on learning outcomes, the role of topic knowledge

in critical thinking in nursing has not been well-articulated or empirically documented.

The widespread use of domain-general standardized tests in the domain of nursing has

also limited the amount of empirical evidence about the role of knowledge in clinical

thinking that is available. Based on these findings, topic knowledge will be retained as

an individual difference factor that may predict critical thinking in the current study, and

will be measured using a short-answer format with domain-specific content.

Individual Interest

The motivational construct *individual interest* has been studied extensively. This section will describe the conceptualization of interest in previous literature and justify the definition used for individual interest in this study. Then the measurement in related literature, vis-à-vis the proposed study, will be described. Empirical findings about individual interest from previous research in education in general and nursing in particular will be analyzed in the context of the conceptual model for this study. The nexus of individual interest and topic knowledge will be discussed.

Conceptualization of Individual Interest in Learning and Performance

The role of interest and the development of interest in learning has been well investigated in education research (Alexander & Murphy, 1998; Hidi & Renninger, 2006; Renninger, Ewen, & Lasher, 2002; Schiefele, 1999). Two types of interest have been identified in models of interest: situational interest and individual interest. Situational interest is a temporary psychological state of effortless increased attention, affective involvement, and externally-engendered curiosity (Schiefele, 2009). The context of the learning, such as active learning techniques, as well as other external factors and prior knowledge can stimulate situational interest (Hidi & Renninger, 2006; Trocky, Fountain, & Chen, 2015). It has been distinguished from the more enduring, less context-triggered individual interest, which develops later (Hidi & Renninger, 2006). It is the more enduring form of interest that will be investigated in the current study.

Individual interest is defined as a relatively stable orientation toward a subject that is composed of the feelings-related and value-related beliefs toward the subject (Renninger & Hidi, 2011; Schiefele, 1999, 2009; Sylvia, 2006). Individual interest is

sustained through ongoing interaction, and has both cognitive and affective components (Renninger & Hidi, 2002, 2011; Hidi & Renninger, 2006; Schiefele, 2009). The cognitive component is the engagement and attention that are present during interaction between the person exhibiting the individual interest and the object of interest (Renninger & Hidi, 2011). Individual interest refers to a relation between a particular person and particular topics, not to a more general motivational orientation (Hidi & Renninger, 2006).

Because the nature of interest seems to change over the course of learning, models that examine the stages or phases of interest have been constructed. Both the Model of Domain Learning (MDL; Alexander, 1997, 2004) and the Four-Phase Model of Interest Development (Hidi & Renninger, 2006) describe learners at different phases of expertise development. The MDL conceptualizes the changes in individual interest over a professional lifespan. In the MDL, beginners in a domain demonstrate low levels of individual interest in a domain. In conjunction with changes in knowledge and strategies, intermediate learners in a domain show decreased levels of situational interest but increased levels of individual interest. As learners become proficient in a domain, individual interest sharply increases and situational interest plateaus at a low level (Alexander, 1997, 2004).

Hypothesized changes in individual interest relatively to situational interest have also been depicted in Hidi and Renninger's Four-Phase Model of Interest Development (2006). They posit a model that places levels of interest on a developmental continuum. Each phase varies in the levels of affect or liking of the topic of interest, the amount of knowledge the learner has about the topic, and the amount of value of the topic to the

learner. Educational intervention needs vary at each phase, but are especially important

prior to the development of well-developed individual interest. The earliest type of

interest identified by this model is *triggered situational interest*. In this phase, the learner

begins to form connections to the content. For a brief period of time, the learner has

positive feelings of liking towards the topic, and is cognitively engaged in thinking about

it. Educational conditions have been found to trigger situational interest (Linnenbrink-

Garcia, Durik, Conley, Barron, Tauer, Karabenick, & Harackiewicz, 2010). Triggered

situational interest may serve as a precursor to *maintained situational interest*, which is

characterized by the persistence of attention over a longer period of time. Meaningful

tasks such as project-based learning can contribute to maintained situational interest,

which may or may not serve as a precursor to *beginning individual interest* (Hidi &

Renninger, 2006).

In beginning individual interest, a large knowledge base does not exist yet for the

area of interest, but value of the topic is increasing and positive feelings continue to

increase. Learners begin to demonstrate individual resourcefulness in answering

questions that arise about the topic. External support is vital at this stage, or interest

could regress to earlier stages. The final stage of *well-developed individual interest*

(Senko, Durik, & Harackiewicz, 2008; Hidi & Renninger, 2006) is characterized by an

enduring disposition to engage with the topic. The pursuit of knowledge feels effortless,

and high levels of knowledge and value and liking are maintained. Learners in this stage

are very independent and persevere in their search for answers to questions (Hidi &

Renninger, 2006). The participants in this study fell into the early to well-developed

stages of individual interest.

In addition to changes in situational and individual interest across the professional lifespan, researchers have also examined the cognitive and affective aspects of interest. Along with cognitive variables, such as engagement and persistence (Ainley, Hidi, & Berndorff, 2002; Schraw, Flowerday, & Reisetter, 1998), researchers found that feelings play an important role in defining interest (Ainley, Corrigan, & Richardson, 2005; Schiefele, 1999; Wigfield & Cambria, 2010). Values or personal significance of a topic have also been found to have a role in individual interest (Schiefele, 1999, 2009; Wigfield & Cambria, 2010). Vocational interest has also been noted as a factor in individual interest (Renninger & Hidi, 2011).

Individual interest specifically in maternity nursing students has been investigated (Carolan & Kruger, 2011; Ulrich, 2009; Wilkes, Corwin, & Johnson, 2014). The onset of individual interest during nursing school usually occurs after students are exposed to their first maternity nursing class (Ulrich, 2009). It has been suggested that exposure to knowledge as well as first clinical experience impacts values and feelings during initial exposure during nursing school (Ulrich, 2009). During the final semester of prelicensure education, nurses must choose an area of specialization, possibly for post-graduation job search. Not only do nursing students at this stage of their education frequently verbalize affective reasons such as love (Wilkes et al., 2014) or specific interest ("I have known since I was 17 years old that my work in the world is to be a midwife"; Ulrich, 2009, p. 129) for choosing their specialty, but also cite values such as the importance of maternity nursing to their professional identity, how working in the specialty makes them feel whole, and similar reasons (Ulrich, 2009). Experienced nurses and nurse-midwives often also verbalize affective reasons for their commitment to their profession (e.g., stating "I

love helping women find their inner strength"; Ulrich, 2009, p. 129). In an analysis of midwifery graduate school applications, 43% identified this as the reason for wanting to enter the profession, (Ulrich, 2009). Interest in midwifery and maternity as domains also has shown cognitive aspects (e.g., "I am always watching maternity shows to increase my knowledge, even before I started the course;" Carolan & Kruger, 2011, p. 644).

Measurement of Individual Interest in Learning and Performance

To assess the effects of individual interest on learning, a variety of measures have been developed (Alexander et al., 1994; Schiefele, 2009). Commonly, instruments used to measure interest are multidimensional. For example, Schiefele created an instrument that measured both emotions and values. The instrument consisted of a series of written questions to which the participant had to respond. One of the questions emotions subsection was "While reading text I feel bored/ stimulated/ interested/ indifferent/ involved/ engaged" (Schiefele, 2009, p. 205). A question from the value subsection was: "Describe text topic value to you personally: meaningful/ unimportant/ useful/ worthless" (Schiefele, 2009, p. 205). These two dimensions of individual interest were averaged for the individual interest scale (Schiefele, 1991).

Another study where a multidimensional measure of interest was used was the Haeussler and Hoffman (2000) instrument, designed to measure interest in physics. This study examined a large sample of adolescent German science students. The researchers measured interest in topics, contexts, and activities in physics. The topics included a systematic list of areas of physics such as electricity, astronomy, and quantum mechanics. They also measured interest in five different contexts for physics: practical aspects like safety, intellectual aspects like mental stimulation or use of mathematics, work-related

aspects like jobs in physics, emotional aspects like physics as a leisure activity, and societal aspects of physics like contributions to innovation. The third part of the measure queried the students regarding their interest in physics activities such as reading, building things, inventing, or discussing physics with others (Haeussler & Hoffman, 2000).

There also exists a variety of instruments that measure self-reported individual interest. The number of questions and the nature of the questions vary widely. The number of questions has ranged from one to 26 (Ainley & Patrick, 2006; Alexander & Murphy, 1998; Dinsmore et al., 2008b; Siegel, Rubenstein, Pollard, & Ramey, 2010). Alexander et al. (1995) asked college students to report their interest in immunology and biology by indicating *low interest* to *high interest*. Self-reported interest was found to correlate with recall of the passage information. Some studies also include a measure of domain engagement by asking about the frequency of activities relating to the domain topics, such as extra reading or specific activities in relation to the domain (Dinsmore et al., 2008b; Murphy & Alexander, 2002). This has been done to cross-check self-reported interest, and because they demonstrate investment in the domain (Alexander & Murphy, 1998; Schiefele & Csikszentmihalyi, 1995).

Empirical Findings about Individual Interest in Learning and Performance

Individual interest has been studied for its effect on learning outcomes. Many of the studies on interest have examined individual interest in the context of a text reading task; text comprehension served as a proxy for learning in these studies. For example, Schiefele (1991) examined the effect of interest on comprehension. He measured the feelings, interest, and value university students placed on different topics with questions such as, "While reading the text on ___ I expect to feel ____" (p. 305), and found that

high interest was associated with higher levels of text comprehension as measured by the number of recalled propositions and main ideas.

Changes in individual interest over time have also been studied. Alexander et al. (2004) examined the contribution of interest and other individual difference factors to special education learners at the undergraduate, graduate and faculty levels. The measures included a multiple-choice domain knowledge measure about special education facts, policies, and procedures, and a second knowledge measure with domain-specific case scenarios followed by multiple-choice questions. Interest was measured by indicating their level of involvement in professional activities such as reading special education articles by marking an X on a continuum from *very rarely* to *very frequently*. Levels of interest as measured by self-reported interest in topics related to educational psychology statistically significantly increased over the course of a semester.

In addition to these knowledge and interest measures, strategy use was measured by a task requiring reading and recalling an article about special education. A short-answer test about the article the participants read served as the recall task. Cluster analysis was used to group the participants on variables, and an analogical reasoning task about terms in special education was used as the needed criterion measure (e.g., one limb: monoplegia::side of body: ___? (hemiplegia). Four clusters aligning with the levels of expertise in the Model of Domain Learning emerged: acclimation, early competence, mid competence, and proficiency. Using the individual difference variables, the authors were able to predict correct cluster membership for 96% of the cases. In addition, the clusters were statistically significantly different from each other at the four levels, and increasing in the expected direction for individual interest. Other studies have shown these changes

in interest over the course of the professional lifespan (Langan & Athenasou, 2004; Shen & Chen, 2006).

Empirical studies of interest and performance in nursing and medicine are rare. There has been a great deal of use of instruments that measure general dispositions toward all domains, not domain-specific individual interest. Most research on dispositions in nurses has focused on measuring general critical thinking dispositions through the California Critical Thinking Skills Dispositions Inventory (Wangensteen, Johansson, Björkström& Nordström, 2011; Wood & Toronto, 2012; Zori, Kohn, Gallo, & Friedman, 2013). This instrument has an *inquisitiveness* subscale with domain-general Likert questions, such as "Rate your agreement with the following: Learn everything you can, you never know when it could be handy."

However, there are a few studies that have investigated interest in the nursing context. Instruments that have been used include the Motivated Strategies for Learning Questionnaire (MSLQ) and the Study Interest Questionnaire (SIQ). The MSLQ is a motivation measure that includes two broad sections of motivation and learning strategies (Pintrich & DeGroot, 1990). The six motivation subscales are intrinsic goal orientation, extrinsic goal orientation, control of learning beliefs, self-efficacy for learning and performance, test anxiety, and task value, with 31 questions. Task value has been described as being similar to individual interest (Schiefele, 2009). It has been used to measure course-specific interest in nursing (Salamonson, Everett, Koch, Wilson, & Davidson, 2009).

The Study Interest Questionnaire (SIQ), designed for assessment of interest in a university subject and containing feeling, value, and intrinsic value valence questions

(Schiefele, Krapp, Wild, & Winteler, 1993) has also been used to examine individual interest in nursing (Bråten & Olauffssen, 2007). In a study of Norwegian nursing students at three different levels, Bråten and Olauffssen used the Norwegian SIQ to study changes in motivational development during nursing school. Interest scores decreased during the second year as students adjusted to the differences in professional education (Bråten & Olauffssen, 2007). However, these studies involved the measurement of general interest *applied to* nursing, rather than the specific assessment of individual interest *in* nursing.

The Nexus of Individual Interest and Topic Knowledge

Many of the studies in the two previous sections on topic knowledge and individual interest also examined the relation between these two constructs. The mechanism of action for the effects of interest on more complex forms of learning have been hypothesized to be due to its effect on attention, such that learners' attentional processes are stimulated by interest (Artino, Holmboe, & Durning, 2012; Renninger & Hidi, 2011). Boscolo and Mason (2003) felt that when the inferential processes are activated by interest, topic knowledge fills in any missing information to increase learning even more.

Schiefele (1999) reported that although certain studies did not find a relation between interest and knowledge, it might have been due to a limited range of expertise in these investigations. Schraw and Lehman (2001) also stated that some of these contradictory studies may have been due to the level of information in the text. Specifically, according to Schraw and Lehman, if no there was no need to infer, then topic knowledge would not be required. Tobias (1994) likewise criticized studies

exploring the intersection of topic knowledge and individual interest on methodological grounds. He criticized the use of non-continuous variables, the invention of new measures instead of adapting ones already in use, and not using the same topic for both the knowledge and interest measure.

Later studies did find a relation between knowledge and interest (Lawless & Kulikowich, 2006; Schiefele, 2012). For example, the effect of topic knowledge on interest and the learning outcome recall of text were studied by Alexander et al. (1994a). Using a short-answer topic knowledge instrument and an interest rating of passage topics to measure topic interest with college students in psychology and education, they found that topic knowledge predicted individual interest in a regression analysis (Alexander et al., 1994a).

The nature of the structure of a domain may also influence the relations between interest and knowledge. An ill-structured domain requires the integration of multiple concepts and schemas, and cross-case irregularity is present. For instance, Lawless and Kulikowich studied the interaction of interest and knowledge in the ill-structured domain of psychology and the highly-structured domain of statistics. The correlation between interest and knowledge was much higher in statistics (Lawless & Kulikowich, 2006). The nature of the relations between the two constructs has been debated, with some finding a curvilinear and some finding a linear relation (Schraw & Lehman, 2001). No studies in nursing or medicine have examined the relations between topic knowledge and individual interest.

Therefore, for this study, an interest/activities inventory was adapted from Alexander and others (Dinsmore et al., 2008b; Murphy & Alexander, 2002) to the

domain of nursing in maternity care, using a visual analog scale to ensure variables are continuous, and using topics analogous categories to the knowledge measure, namely, pregnancy, childbirth, newborn, breastfeeding, postpartum, and professional issues.

Relational Reasoning

Relational reasoning, the ability to discern patterns in information across different contexts (Dumas et al., 2013; Gentner & Calhoun, 2010), has been described as "the fuel and the fire of human thinking" (Hofstadter & Sander, 2013, p. 3). This higher-order strategy impacts the ability of learners to process large amounts of incoming information (Dumas et al., 2013), contributes to the structure of the learner's knowledge base (Holyoak, 2012), and is essential for the development of expertise (Patel, Arocha, & Zhang, 2012; Sternberg, 1977). In order to answer the question of the contribution of relational reasoning to critical thinking, this section will describe the conceptualization of, measurement of, and empirical findings regarding relational reasoning in previous literature.

Conceptualization of Relational Reasoning

Although the use of similarities and dissimilarities in logical reasoning dates to ancient Greek philosophers (Lloyd, 1966), they have been studied as an educational construct since early in the 20th century (Morgan & Carrington, 1944). Following the recent theoretical and empirical work of Alexander and others (Alexander and the DRLRL, 2012; Dumas et al., 2013; Dumas et al., 2014), the current investigation explored the predictive role relational reasoning, in the four forms analogy, anomaly, antithesis, and antinomy, on nurses' critical thinking performance.

Analogies involve the recognition of relational similarity between two seemingly different ideas, objects, or events (Alexander & the DRLRL, 2012). Using analogical inference, where the source idea generates a new conjecture about the target idea, is a major part of scientific (Dunbar & Klar, 2012) and medical reasoning (Patel et al., 2012). One of the first methods of measuring analogy, first described by Aristotle (Aristotle, *Metaphysics),* was the four part analogy in the A:B::C:D format comparing the relation between two terms A and B to the relation between C and D (e.g., kitten: cat:: puppy: dog). Relational reasoning has been measured by these four-part proportional analogies (Wendelken, Nakhabenko, Donohue, Carter, & Bunge, 2008), word problems (Novick & Holyoak, 1991), scene analogy problems (Richland, Morrison, & Holyoak, 2006), and neuroimaging studies of activity in the brain during relational reasoning (Krawczyk, 2012; Wright, Matlen, Baym, Ferrer, & Bunge, 2007).

Opposites are another commonly understood form of relational reasoning. *Antithesis* is the placement of two propositions, principles, or explanations in direct contrast or direct opposition to each other (e.g., dead/alive, or dirty/clean). Previous research on antithesis has mainly focused on refutational text and counterarguments and their positive impact on conceptual change (Broughton, Sinatra, & Reynolds, 2010; Buehl, Alexander, Murphy, & Sperl; 2001; Kreezer & Dallenbach, 1929; Sinatra & Broughton, 2011), and how students resolve discrepancies (Alexander & the DRLRL, 2012). Linguistic opposites have been used in cognitive tasks (Baker, Friedman, & Leslie, 2010; Dymond, Roche, Forsyth, Whelan, & Rhoden 2008; Kjeldergaard & Higa, 1962), in discussing contrasts, such as feeling young in an old body (Fischer, Norberg, & Lundman, 2008), and in studying political categorization (Heit & Nicholson, 2010). Two

types of opposites have been identified: gradable opposites, where intermediate adjectives like "warm" can be designated between the poles of "hot" and "cold," and complementary opposites, where there is no middle ground in meaning, such as "inside" and "outside" (Bianchi, Savardi, & Kubovy, 2011). This distinction is important for testing different kinds of opposites and understanding their use in practice.

An *anomaly* is a discrepancy or deviation from an established pattern, rule, or trend (Chinn & Brewer, 1993). The education literature has focused on the use of teaching techniques based on learners identifying anomalous data (Chinn & Brewer, 1993). Learners demonstrate strong, sometimes unexpected reactions to anomalous data such as (a) ignoring it; (b) rejecting it by attributing it to error, random variation or fraud; (c) excluding it, d) reinterpreting the anomalous data to fit previous knowledge, e) holding the anomalous data in abeyance for later consideration, f) reinterpretation of anomalous data to fit the previous situation, and g) accepting the anomaly as accurate (Chinn & Brewer, 1993).

In contrast, *antinomy* is a paradoxical, mutual incompatibility of two laws, rules, or principles (Alexander & the DRLRL, 2012; Gardner, 1995; Sorensen and Yankech, 2008). An antinomous example of conflicting paradigms in psychology would be a comparison of the theories of Piaget and Vygotsky (Cole & Wertsch, 1996). Although antinomy is the least studied of the four forms of relational reasoning, it is a very important strategy in the health sciences.

For many years, analogy and antithesis were the predominant types of relational reasoning studied. Hoffman and Eskridge (2009) attempted to broaden the scope of forms of analogies by discussion of forms such as disanalogy, or mutually exclusive

conclusions. Alexander and others (e.g., Alexander & the DRLRL, 2012; Dumas et al, 2013) brought together disparate lines of research for different cognitive strategies by describing these four forms of relational reasoning under one umbrella, which they referred to by the general label *relational reasoning*.

Relational reasoning in the medical professions. Turning to the use of relational reasoning in the medical field, in a study of Nobel prize-winning medical and other scientists, Rothenberg (1996) studied the use of the *janusian process* or "actively conceiving multiple opposites or antitheses simultaneously" (p. 207). For example, abnormal tumor cells were contrasted with normal antibody cells by Kohler in the discovery of monoclonal antibodies, artificially created sticky proteins that attack specific foreign substances. Rothenberg found that the medical scientists used this process during scientific discovery, either with polarities such as "liberty/slavery" or "least/most," or dichotomies such as "man/woman, left side/right side" (p. 222). This antinomous type of relational reasoning led to many great medical discoveries.

In studies of reasoning in medical students, relational reasoning has been considered one of several effective strategies for learners (Heemskerk, Norman, Chou, Mintz, Mandin, & McLaughlin, 2008). It is also easy to see how antinomous contrasting could also be used in ruling out certain medical or nursing diagnoses in clinical evaluation of patients. This is also known as differential diagnosis, a critical early step in clinical reasoning (Eva, 2005).

Using antithetical reasoning is also used as a structural check on conclusions in nursing. For example, the nurse might think, "this mother shows good signs of bonding with her baby. Can I think of any symptoms that would demonstrate that she is *not*

bonding well with the baby?" Or, "To diagnose labor, there must be cervical change. This mother's cervix is not changing, so she is not in labor" (Lowdermilk et al., 2012). Relational reasoning strategies appear to play an important role in the evaluation phase of critical thinking (Pena & de Souza Andrade-Filho, 2010).

Some examples of analogous reasoning in nursing include comparing the current client to one cared for previously (Hayes, 2000), generalizing a nursing action from one type of patient situation to another (analogy). The next form of relational reasoning, anomaly, is demonstrated in nursing by noting an anomalous finding in a physical examination (Lowdermilk et al., 2012). Anomaly describes quite a bit of the analysis of patient assessment nurses must usually perform in patient care. Ensuring that patients are within the expected symptom range is an important part of the monitoring function of nursing, and anomalies are red flags. An example of an anomalous assessment finding would be an unexpected rash on newborn skin (Lowdermilk et al., 2012).

An example of antithetical reasoning in maternity nursing would be the following situation: A nurse needs to decide whether to immunize a mother against Rh Disease after birth. In general, nurses need to do this if a mother's blood has Rh antibodies that would negatively impact the next pregnancy. The nurse might think, "This is an Rh-negative mother with an Rh-positive baby." So when the lab test for the baby's blood comes back, her nursing action is based on whether the test was positive or negative (Thureen, Deacon, Hernandez, & Hall, 2005). The example, "Her head is cool, not warm," is an example of a gradable opposite, and "The lab test was negative for hepatitis, so this can't be a hepatitis symptom" is an example of a complementary opposite. These examples suggest that acclimating, competent, proficient and expert nurses demonstrate

relational reasoning in its various forms across the professional lifespan, but it has not been measured.

Another aspect of the conceptualization of relational reasoning, which is relevant to its use in the health sciences, is how learner goals affect the process. Depending on whether the learner is remembering, learning, reasoning, debating or making new discoveries, the forms of relational reasoning may vary (Pena & de Souza Andrade-Filho, 2010). In the health sciences, analogical reasoning has been used for structuring and learning new material, as well as reasoning with new cases (Pena & de Souza Andrade-Filho, 2010). The effect of function on relational reasoning can be seen in how the purpose of the analogy can affect the kind of analogy generated (Holyoak & Thagard, 1997; Goswami and Mead, 1992), and the analogy generated can contain a normative or argumentative purpose. For example, Hofmann, Solbakk, and Holm (2006) suggest that comparing umbilical cord banking, the storage of umbilical cord blood from birth for future therapeutic use, to a waste product versus a natural resource brings different connotations that impact decision-making differently. Or, labor and birth could be described as "like running a marathon" or "lots of hormonal changes similar to those seen during making love" versus "the most dangerous time in one's life" or "an accident waiting to happen"; all of these are analogies that impart normative messages about the safety or normalcy of birth.

Developmental aspects of relational reasoning. By young adulthood, the ability to engage in relational reasoning has fully developed (Richland, Zur, & Holyoak, 2007). There are also changes in relational reasoning across the professional lifespan (Chinn & Brewer, 1993). Although analogy research has shown that novices tend to map onto

superficial structures such as semantic similarity more than experts who rely more on similarity in structure (Holyoak, 2005), anomaly research has found that both acclimating and proficient expert learners downplay anomalies in the same fashion (Chinn & Brewer, 1993).

Problems with the use of analogies. Although analogies have been touted as a core feature of human cognition (Hofstadter, 2001), they also present possible weaknesses and challenges. Analogies are a form of inference and hence uncertainty is inherent in their use. Research using analogies has found positive benefits in nursing and medicine (Hayes, 2000; Rees, 2011). Although educators in the professions often teach analogical reasoning, one identified drawback can be a sort of groupthink (Rees, 2011), when a small community determines which cases are used in educating professionals, such as the community-determined interpretation of forensic medical cases (Rees, 2011). In addition, when clinicians use the similarity of current patient data with schemata from previous experience, instead of mapping specific data from the target to specific data from the source, errors can occur (Patel et al., 2012). Sometimes in the health sciences, the use of analogy can lead to incorrect conclusions (Gentner & Markman, 1997). Improper use of analogy can also lead to the large problem of medical errors, such as when look-alike drugs cause medication errors (Kohn, Corrigan, & Donaldson, 1999).

Another possible problem with analogies is that they may also have embedded cultural assumptions (Pena & de Souza Andrade-Filho, 2010). For example, historical analogies such as nurses as doctors' handmaidens may belie the profession's current scope of practice and be detrimental to public understanding of the profession (Hayes, 2000).

On a daily basis, nurses receive data regarding patients, some of which are anomalous to expected findings. How the anomalous data are handled is vital for care outcomes, as nurses may reject or ignore the data to the peril of patient well-being (Chinn & Brewer, 1993). In another example of how inappropriate handling of anomalous data can be negative to health outcomes, in considering safety of birth settings, some physicians exclude the large number of normal births that occur at home because it does not fit their expected pattern of childbirth as a high-risk experience (ACOG, 2011).

Measurement of Relational Reasoning

The benefits and risks of relational reasoning demonstrate the need for careful consideration of its measurement. Many studies describe relational reasoning but do not evaluate its relative role in thinking (Bianchi et al., 2011; Gordon & Moser, 2007). In a review of 109 studies about relational reasoning, few studies examined domain-specific relational reasoning (Dumas et al., 2013). A measure of fluid intelligence often employed in studies of relational reasoning is the Raven's Progressive Matrices (RPM; Raven, 1938; Wiley, Jarosz, Cushen, & Colflesh, 2011). This well-known instrument solely measures analogical relations. Recently Alexander and the DRLRL (2012) developed a graphical Test of Relational Reasoning that captures multiple forms of relational reasoning. The measure has 32 items, with 8 items each for analogy, anomaly, antinomy, and antithesis, and was targeted to measure forms of relational reasoning in adults.

Empirical Findings about Relational Reasoning in Education and Health Sciences

Empirically, relational reasoning has been shown to positively impact learning outcomes. For example, in the domain of undergraduate science, prior knowledge of the

analogy was found to be related to better performance on learning outcomes, decreased misconceptions in learners' conceptual models, and demonstrated that prior knowledge of an analogically related domain positively impacts target domain learning (Braasch & Goldman, 2010).

In the health sciences, some researchers have argued that analogical reasoning is built into the decision-making processes, because practitioners are comparing the patient to animal models and previous patients with the problem (Dumas et al., 2013; Patel et al., 2005). In nursing, the benefits of analogy in teaching have been postulated (Hayes, 2000). A small number of empirical nursing studies have looked at the role of analogical reasoning in nursing care. A quasi-experimental non-equivalent group posttest nursing study (Edelman, 2009) found that a teaching intervention did promote improved clinical decision-making. The intervention promoted analogical reasoning through instructor questioning using case comparisons with students while on clinical units and in self-report of analogical reasoning in journals.

Analogy has been found to be most useful early in the understanding of a phenomenon, because the limitations in the mapping become more apparent as one understands a phenomenon better. The use of multiple analogies helps ensure that more aspects of the phenomenon under study can be understood more clearly and accurately (Hofmannet al., 2006). Analogy has also been studied in nursing in the context of standardizing nursing diagnosis in electronic medical systems (Falan, 2007; Lunney, 2003).

A nursing diagnosis is a structured three part statement focusing on an aspect of a patient/client's response to health or disease. It is different from a medical diagnosis: the

identification of a disease from its signs and symptoms (Herdman, 2011). A standardized

list of nursing diagnoses and standardized possible interventions and options was

generated by NANDA, an international nursing organization. Because previous research

had shown that nurses' diagnoses for the same situation overlapped by only about 40%,

Falan (2007) studied the patterns in analogy use of different levels of experience and

education in medical surgical nurses. Falan's study enumerated four kinds of similarity

of increasing complexity: surface, literal, thematic, and analogy. She found the level of

the participant's level of experience and education did influence the use of similarity.

Also, she suggested that patterns of thinking strategies might vary by nursing specialty.

This study used both general and nursing-specific drawings of clinical situations, and the

author recommended that future research utilize more clinically realistic methods of

judging similarity use (Falan, 2007).

Relational reasoning has demonstrated strong potential as a predictor of critical

thinking. To measure the role of relational reasoning in this study, a measure that

captures all the forms of relational reasoning used in nursing is needed. Given the lack of

domain-specific measures, the Test of Relational Reasoning (Alexander & the DRLRL,

2012) was used as a preliminary measure of the strength of this construct's contribution

to critical thinking.

Critical Thinking

In order to understand the relations among the individual difference factors topic

knowledge, individual interest, and relational reasoning and their influence on critical

thinking, this section will describe the history of the conceptualization of critical thinking

in education, the conceptualization in nursing, the ways it has been assessed in nursing, and empirical findings in nursing to date.

Conceptualization of Critical Thinking

Critical thinking (CT) is a deliberate, metacognitive process which results in interpretation, analysis, evaluation, and inference, and includes evidential, conceptual, methodological, criteriological, or contextual considerations (Byrnes & Dunbar, 2014; Facione, 1990). Critical thinking has been studied since antiquity. What is now characterized as critical thinking was initially promoted by epistemological thinkers such as Socrates in ancient times (*Phaedo*, *360 B.C.E./1909*), Thomas Aquinas (*Summa Theologica, 1274*) in the Middle Ages, and Francis Bacon (*The Advancement of Learning, 1605)* and Descartes *(Rules For the Direction of the Mind, 1628)* during the Renaissance. Writers during the French Enlightenment such as Montesquieu, Voltaire, and Diderot emphasized the importance of disciplined reasoning, and during the 17th and 18th centuries critical thought was celebrated in documents such as the Declaration of Independence (Paul, Elder, & Bartell, 1997).

More recently, John Dewey (1910), considered the founder of the critical thinking research, in his treatise *How We Think*, foreshadowed the elements currently ascribed to critical thinking, such as interpretation, analysis, evaluation, inference, explanation and self-regulation (Facione, 1990; Sternberg, 1986). During the 20th century, education researchers continued to study critical thinking (Ennis, 1962; Facione, 1990; Paul & Binker, 1990).

Conceptualization in educational psychology. Much professional discourse has been expended on defining critical thinking. The following themes about the

conceptualization of critical thinking emerge from the literature: (a) critical thinking is an affective as well as cognitive process; (b) critical thinking is domain-specific; (c) critical thinking is an evaluative process; and (d) there are relations among individual difference factors and critical thinking.

Early research was focused on studying critical thinking as a cognitive process. Although Benjamin Bloom posited both cognitive and affective domains in learning, most studies after the 1950's initially focused on the cognitive processes of analysis, evaluation, and synthesis (Bloom, 1956; Anderson et al., 2001). By the 1970's, research on motivation and critical thinking was increasing (Wigfield & Eccles, 2002). In 1980, Watson and Glaser defined critical thinking in general as a composite of knowledge, attitudes, skills, and reflective thinking (Watson & Glaser, 1980). Further, the APA definition of CT published in 1990 also articulated critical thinking in terms of cognitive skills and affective dispositions. In addition to using the cognitive skills of interpretation, analysis, evaluation, and inference, "the ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit" (Facione, 1990, p. 3).

Researchers have attempted to understand whether critical thinking is domain-specific. In other words, is critical thinking a skill that applies to all areas of learning, and are the processes of critical thinking the same in all domains (Alexander & Judy,

1988; Sternberg, 1986)? While some researchers have proposed that critical thinking is domain-specific, others have posited that critical thinking is domain-general or a combination of domain-specific and domain-general (Ennis, 1989; Glaser, 1984). Robert Ennis defined critical thinking as "reasonable reflective thinking focused on deciding what to believe and do" (1985, p. 46), but McPeck (1990) argued that there are no general skills since critical thinking must be connected to an object of thought. Sternberg (1986) identified cognitive skills that were common to many instruments, as well as acknowledging domain-specific aspects of critical thinking, merging these two approaches. The authors of a recent metasynthesis suggested that although domain-specificity is important to measuring critical thinking, particularly in nursing, only 6 of 88 studies used domain-specific measures (Huber & Kuncel, 2015).

The role of evaluative processes in critical thinking has also been studied. (Byrnes & Dunbar, 2014). Pintrich and DeGroot (1990), along with Pintrich, Smith, Garcia, and McKeachie (1991), defined evaluation as applying previous knowledge to new situations to solve problems or make critical evaluations. The issues of critical evaluation and cognitive processes are brought together by the definition by Scriven and Paul (1987): critical thinking is "the intellectually disciplined process of actively and skillfully conceptualizing applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by observation, experience, reflection, reasoning or communication as a guide to belief and action" (p. 766). They propose that values such as accuracy, relevance, reliability, and use of sound evidence may be the aspects of critical thinking that are universal (Scriven & Paul, 1987).

The relations between critical thinking and individual differences such as topic knowledge, individual interest, and relational reasoning have also been studied (Alexander et al., 1994a; Richland et al., 2007; Schiefele, 2009). Many studies of critical thinking have included knowledge as a predictor of critical thinking. Glaser (1942) found that there was a relation between critical thinking and topic knowledge, and that critical thinking was limited by insufficiency of topic knowledge. Higher levels of individual interest have been shown to predict greater reading comprehension and better learning outcomes (Schiefele, 1991). Although relational reasoning is related to learning outcomes (Richland et al., 2007), the precise relation between relational reasoning and critical thinking has not been thoroughly investigated for nursing.

Critical thinking in the health professions. In addition to the interest in educational psychology, a focus on critical thinking is a special concern in the education of health care providers (Institute of Medicine, 2010). Similar themes of: a) the need for domain-specific conceptualization and measurement, b) the importance of evaluation as part of the conceptualization, and c) the role of individual difference factors such as topic knowledge, individual interest, and relational reasoning strategies also emerged in a systematic review of the literature conducted prior to the proposed study (Fountain, 2016).

In order to examine the conceptualization of critical thinking in the health sciences, this review used the search terms critical thinking and clinical reasoning with the terms nurs* and doctor or physician and the PsycInfo database (Fountain, 2016). Two hundred twenty-four abstracts were produced by the search terms; after title, abstract, and full article review, 43 articles met the criteria for inclusion in the review.

This review used an explicit coding scheme based on prior research (Alexander & Murphy, 2000; Dinsmore et al., 2008b), and the recommendations of the Best Evidence Medical Education (BEME) collaboration (Harden, Grant, Buckley, & Hart, 2000) were used for the review procedures, except for external panel review. Each study in the review was categorized by conceptualization variables and measurement variables.

For the conceptualization variables in the studies, 42% of the studies did not use explicit definitions, 76% of the nursing studies used a domain-general definition, while 86% of studies of doctors used domain-specific definitions, and 62% of the studies used more than one term as analogs to critical thinking. A content analysis of the themes in the definitions revealed 22 themes, of which 16 were variations on the components of critical thinking used in the study definition, such as analysis, evaluation, and prediction. Three related to patient-specific situation variables or metacognition that are relevant to this study, and two related to knowledge, which is a construct elsewhere in the model. The other findings are relevant to the measurement of critical thinking which is discussed in the next section.

The problems with conflation of terms was recognized in nursing. In the mid 1990's, Scheffer and Rubenfeld conducted a three year Delphi study to gain consensus from a diverse group of expert nurses using a process similar to the APA process. They identified seven cognitive strategies and ten dispositions or habits of mind that have been used by many nursing researchers: the skills of analyzing, applying standards, discriminating, information seeking, logical reasoning, predicting, and transforming knowledge, as well as the dispositions or "habits of mind" of confidence, contextual perspective, creativity, flexibility, inquisitiveness, intellectual integrity, intuition, open-

mindedness, perseverance, and reflection (Scheffer & Rubenfeld, 2000, p. 353). There were a great number of similarities in the characteristics identified by the nursing consensus definition and the APA definition. Of note, in the dispositions, creativity, intuition, and transforming knowledge were not identified by the APA group (Facione, Sanchez, Facione, & Gainen, 1995; Scheffer & Rubenfeld, 2000, p. 353).

However, in spite of a definition obtained by a consensus process in a scientific manner, problems have continued to be identified with the definition of critical thinking in nursing education research (Brunt, 2005a; Victor-Chmil, 2013; Fountain, 2016; Simpson & Courtney, 2002; Walsh & Seldomridge, 2006a). Traditional methods of nursing education have downplayed the evaluative aspect of learning, and emphasized rote memorization. In fact, studies using domain-general measures have demonstrated a decrease in evaluative thinking proficiency in nurses over the course of their educational trajectory. It has been hypothesized that this emphasis on rote memorization of procedures, medications and nursing intervention checklists actually makes nurses less effective medical practitioners (Bråten& Olaussen, 2007).

These findings have caused a recent increase in interest in critical thinking research in the context of nursing. Specifically, from the 1980's to the present, critical thinking and clinical reasoning have been areas of intense research, as documented by several recent reviews of the literature (Brunt, 2005b; Fountain, 2016; Norman, 2005; Victor-Chmil, 2013; Simpson & Courtney, 2002; Walsh & Seldomridge, 2006a). Development of critical thinking in nurses across the professional lifespan has been examined by two studies (Benner, 1982; Papp et al., 2014). In addition to Benner's 1982 *From Novice to Expert* study discussed in Chapter 1, Papp et al. (2014) identified stages

of critical thinking across the professional lifespan in nursing and medicine by examining meta-cognition, attitudes, and skills. Nurses or doctors were identified by one of five stages ranging from an unreflective thinker, a practitioner who is unable to examine his or her own actions, is inflexible in thinking, and is dependent on rote memorization, to accomplished critical thinkers. Although this study mentions some strategies that resemble relational reasoning, it deliberately excludes knowledge as a factor, and includes only domain-general dispositions, not individual interest, as contributors to critical thinking.

Measurement of Critical Thinking

Critical thinking has been studied in nursing through standardized measures and teacher/researcher created measures (Brunt, 2005a; Victor-Chmil, 2013). Fountain's systematic review addressed several measurement issues (2016). In these critical thinking studies, over half the studies (51%) examined participants at the student level; 35% studied participants at the provider level of experience; 12% examined residents or new graduates; and only 2% studied participants at more than one level of experience. Only 16% of the studies were experimental. For the critical thinking studies, standardized measures were used nearly half the time (48%), and researcher-made tests were used for the remaining studies.

Standardized Measures. For ease of measurement and due to their established reliability and validity, standardized tests have been used as the instruments in much of the nursing critical thinking research (Brunt, 2005a; Facione & Facione, 1994). Standardized tests used to assess critical thinking found during this review of nursing education literature included the California Critical Thinking Skills Test (CCTST) and

California Critical Thinking Skills Disposition Inventory (CCTSDI), the Watson-Glaser Critical Thinking Skills Appraisal (WGCTSA), and the ERI Critical Thinking Process Test (CTPT). Although The Cornell Critical Thinking Test and Ennis Weir tests were mentioned in the literature, no instances of their use were found (Oermann & Gaberson, 1998; Worrell & Profetto-McGrath, 2007).

The Watson-Glaser Critical Thinking Skills Appraisal, WGCTA, revised in the 1980's (Facione & Facione, 1994), has been widely used on college students, as well as on nursing students, and has 80 items. It is a multiple-choice test with 5 subtests: inference, recognition of assumptions, deduction, interpretation, and evaluation of arguments. Each subset consists of 16 items. The WGCTA is not specific to any domain.

The most widely used instrument for measuring cognitive processes in critical thinking in nursing is the California Critical Thinking Skills Test (CCTST). The CCTST is a 34-item multiple-choice instrument designed to measure critical thinking in college-age students, based on the APA Delphi study. The CCTST assesses areas similar to the WGCTSA, including the cognitive skills of analysis, evaluation, inference, inductive, and deductive reasoning. Researchers administering the CCTST, CCTSDI, and WGCTSA to nurses and nursing students found the following: prelicensure nurses may not have had adequate time to develop critical thinking, critical thinking needs to be taught more explicitly in nursing programs, and nursing-specific instruments need to be developed (Walsh & Seldomridge, 2006b; Drennan, 2009). The Health Sciences Reasoning Test, a version of the CCTST that uses health sciences contexts for multiple choice problems, requires no health sciences knowledge and showed no increase in critical thinking after a

nursing simulation exercise for prelicensure nurses (Shinnick & Woo, 2013), and is categorized with standardized domain-general instruments.

Abrami et al. in a systematic review of critical thinking interventions concluded that standardized tests should not be used for testing for critical thinking, and that it should be taught explicitly in the curriculum along with domain-specific exercises (2008). In spite of the strong content validity and wide use, results have also been inconsistent with these tests (e.g., Beckie et al., 2001). Researchers have documented the need for domain-specific measures of critical thinking. For example, a study of faculty in six different domains found wide differences in ratings of the relative importance of critical thinking skills in each domain (Powers &Enright, 1987). The skill of recognizing both sides of an issue (p. 664) was rated as a much less valuable skill by computer science and chemistry faculty than by education, psychology, and English faculty, whereas "knowing rules of formal logic" was less valued by education, English, psychology and chemistry, but highly rated by computer science and engineering faculty (Powers & Enright, 1987).

Teacher/Researcher-made instruments. Nursing faculty researchers have designed measures to analyze critical thinking. With written cases or scenarios, they have used rubrics, think-alouds, concept maps, or interviews to analyze critical thinking in nurses and nursing students. Many have used cognitive process categories, such as analyzing and evaluating from the APA or Nursing consensus statements, as the basis for their analysis (Göransson et al., 2007; Kennison, 2006; Kuiper Heinrich, Matthias, Graham, & Bell-Kotwall, 2008; Paans et al., 2010), although some only evaluated some dimensions (Carter & Rukholm, 2008; Eisenhauer, Hurley, & Dolan, 2007; Fero et al.,

2010; Forneris & Peden-McAlpine, 2007; Funkesson et al., 2007; Palese et al., 2008).

Concept maps have been used to measure critical thinking. Cruz et al. (2009) conducted

a pretest/posttest study of 39 nurses who took a short-term education course on medical

surgical knowledge. The instructors designed two case studies with questions afterwards.

The nurses were asked to provide evidence from the patient data for the diagnoses, and

the diagnoses were scored on how many cues the nurses were able to identify. They used

a previously-used scoring scale by Lunney (2001). There was a statistically significant

increase in the scores using this format.

Empirical Findings about Critical Thinking

Studies using WGCTA to assess change in critical thinking as measured by the

WGCTA over the course of the nursing program typically found no change or a decrease

in critical thinking (e.g., Walsh & Seldomridge 2006b; for exception, Drennan, 2009).

However, Hoffman (2006) found an increase in critical thinking from the beginning to

the end of the nursing program among three cohorts of students as measured by the ERI

CTPT. The study is notable for a large sample size and controls for potentially

confounding variables. Although the California Critical Thinking Skills Test is by far the

most commonly used standardized test, some studies found an increase in critical

thinking in nursing students (Blondy, 2011; Yuan, Kunaviktikul, Klunklin, & Williams,

2008), while others did not (Fero et al., 2010; Rubenfeld & Scheffer, 2000).

There are at least two possible explanations for the lack of consistent increase in

critical thinking as measured by CCTST/CCTSDI. One possible explanation is that

nursing education does not promote critical thinking. Another explanation is that the

domain-general instruments are not valid for this domain. Some authors have noted the

possibility that nursing curricula are not promoting critical thinking to the extent possible (e.g., Bråten & Olaussen, 2007). Walsh and Seldomridge (2006a) examined the types of thinking being reinforced in nursing curricula. They were concerned that the nursing classes were not contributing to critical thinking, due to lecture format, limited class time, multiple-choice examinations, publisher-made or pre-packaged presentation slides and administrative pressure to use them, and student expectations for "sage on the stage" entertainment.

As an alternative to standardized tests, Tanner (2006) offered a model of clinical thinking that includes contextual and patient cues as well as textbook knowledge, but did not include individual difference factors. According to Tanner's model, the nurse pursues one of the analytic processes, chooses an action, and evaluates. A rubric for evaluating clinical thinking according to this model was developed for a nursing simulation (Lasater, 2007). The Oregon Health and Science University School of Nursing faculty team have empirically validated this model and rubric using simulations and clinical evaluation (Lasater & Nielsen, 2009).

In summary of the findings of this review of critical thinking for maternity nursing: a) very few studies included multiple levels of providers; b) in conceptualization of the term critical thinking, many analogous terms were conflated; c) an analysis of themes in the definitions revealed that in addition to constructs related to individualized patient care, which is not the focus of this study, and affective factors, constructs aligned well with the APA/Nursing Delphi panel definition; d) although most studies of critical thinking in nursing used a standardized test to measure it, results have been inconsistent (Huber & Kuncel, 2015); rare exceptions to the use of domain-general measures have

occurred recently (Tanner, 2006), although early attempts occurred in the 1980's (Waltz & Jenkins, 2001); and finally, e) no studies included topic knowledge, individual interest, and relational reasoning as predictors of critical thinking (Zuriguel, Lluch Canut, Falcó Pegueroles, Puig Llobet, Moreno Arroyo, & Roldán Merino, 2014).

Therefore, for this study, a short-answer critical thinking task based on a patient scenario and follow-up questions that align with the critical thinking components from the nursing Delphi consensus report we used to assess critical thinking.

CHAPTER 3:

METHODOLOGY

The purpose of this study was to examine the relations among topic knowledge, individual interest, relational reasoning, and critical thinking for maternity nurses. The review of the literature identified questions about these interrelations that merited exploration, including: (a) whether the significant relations between topic knowledge and interest found in other domains exist in nursing; (b) if topic knowledge and interest contribute significantly to critical thinking performance among nurses; and (c) how much nurses' relational reasoning ability predicts their ability to engage in critical thinking about maternity nursing cases. This study addressed these questions by administering measures of these constructs in an online study delivered in two sessions, and analyzing relations among these variables. This chapter first provides an overview of a pilot study and recommended changes based on pilot findings, and then describes the main study participants, measures, procedures, and data analysis plan.

Pilot Study

Prior to the main study, a pilot study was conducted to examine overall feasibility of the measure and procedures and aid in instrument refinement (Fountain, 2011). This section will describe the pilot participants, measures, procedures, and recommendations for the proposed study based on the pilot results. Specifically, for this pilot study, the following factors were examined for participants from the domain of maternity nursing prior to a larger scale study: the time it took to complete the measures; the clarity, difficulty, and layout of the measures; variability of data from the included measures; types of questions; and response categories.

Pilot Participants

For the pilot study, a sample of 87 prelicensure nursing students from a large mid-Atlantic university was recruited. The participants were at different educational phases of prelicensure. The third-year junior students (n = 50; 57%) were just completing the maternity nursing rotation. The fourth-year senior students (n = 37; 43%) had just completed an advanced practicum in a maternity nursing or other specialties. The sample was 90% female and 10% male, 37% African-American, 48 % Caucasian, 14 % Asian; five percent reported Hispanic ethnicity. The mean age was 27.6 years ($SD = 6.0$), ranging from 21 to 48 years. Nineteen percent (7/37) of the fourth-year students were in the Maternity Nursing. This distribution was reflective of the demographic distribution of the whole school.

Pilot Measures

Three measures were administered during the pilot study: A knowledge measure; an interest measure; and a critical thinking task.

Knowledge measure. The 40-item knowledge measure consisted of two parts measuring domain knowledge and topic knowledge (Alexander et al., 1995; Alexander et al., 1994). The 20 domain-knowledge multiple-choice questions were chosen to cover the domain of maternal-newborn nursing, while the 20 short-answer topic knowledge questions addressed 6 topic areas covered by five commonly-used maternity nursing textbooks. For each question, participants were asked to provide a brief definition and describe the importance of the topic to maternity nursing.

Individual interest measure. The individual interest measure had 11 items, five items to assess participants' self-reported interest and six items to assess how often a

participant partook in nursing-related activities, such as participation in community health fairs or professional conferences that demonstrated individual interest in maternity nursing. This measure was adapted from interest instruments used in previous studies (Dinsmore et al., 2008b). For the five individual interest questions, a visual analog scale was used with a 100-mm line, and participants indicated their level of interest in maternity nursing topics, such as fetal monitoring, by marking an X on the line. The left endpoint was labeled *not at all interested* and right endpoint was labeled *very interested*. The distance from 0 was measured, and that distance was used to compute the raw score. For the six activity items, actual participation in maternity-nursing related activities was recorded in a similar manner to the self-reported interest items, with endpoints on the 100-mm line labeled *never* and *often.* All items were summed to produce a total score.

Critical thinking task. The critical thinking task used a typical performance activity for nurses, analyzing a case with standard follow-up questions. The purpose of this task was to measure the critical thinking processes described in the definition of critical thinking for the current study. This measure uses a scenario approach that is frequently used in nursing education and is a familiar task to participants. This measure and its scoring guide are described in detail under the main study.

Pilot Procedure

These measures were administered face-to-face to participants recruited during nursing classes in the junior and senior levels of a baccalaureate nursing program. After consenting to participate in the study, respondents were given ninety minutes to complete the instruments. They were provided with paper copies of the study measures and a

computer answer sheet for the multiple choice knowledge measure. As an incentive, a

canvas bag or a $10 Starbucks gift card was given to participants.

Changes Based on Pilot Findings

At the conclusion of the pilot study, the measures and procedures were assessed

for task clarity, adequate suitability of the measures, and adequacy of time to complete

tasks.

Time. All participants completed the two-part knowledge measure, the individual

interest measure, and the critical thinking measure in the allotted 90-minute time period.

Thus, this time allotted was deemed adequate for all measures.

Task clarity and variance of measures. The pilot participants' responses

indicated their ability to comprehend the items in the knowledge task. The responses

from the knowledge measure were examined for adequate variability. While the

variability on the topic-knowledge portion was adequate based on the means and standard

deviations, the domain-knowledge measure did not demonstrate adequate variability and

the anticipated differences in students at different levels failed to emerge.

Due to this deficiency, it was determined that only topic knowledge would be

assessed in the main study. Data from the pilot study indicated that the completion

percentage for the short-answer topic knowledge items was 89.75% for the definition

parts of the topic knowledge items and 67.82% for the importance section of the items.

Inadequate space for both parts of the topic items was provided in pilot study. The

placement of both definition and importance in the instructions, but without separate

space for completion, may have contributed to the lower completion for the importance

part of the question. In the main study, the online version participants were provided

separate boxes for definition and importance. The open-ended topic knowledge questions resulted in response content that was brief but appropriate for the instructions presented to participants.

The individual interest measure responses had adequate variability and the measure demonstrated a statistically significant difference between the two levels of student in the predicted direction. There were no problems with completion of items.

For the critical thinking task, adequate variability and differences between levels of experience were demonstrated. The vast majority of questions had very high completion rates. However, more than 29% of participants failed to complete the last question on the critical thinking task (i.e., "Describe discharge teaching for this patient."). The critical thinking task had six blank pages to allow room for the first six questions; this extended blank space that was not completely used by the vast majority of participants may have contributed to this failure to complete the last question after the blank pages by many participants. However, the main study took place online, with clear boxes for answers, and the completion rate was high. In addition, cognitive labs with education and nursing researchers were conducted to improve instrument instructions for the main study conducted online.

Summary of changes based on pilot. Although the critical thinking task with structured questions performed adequately, based on the pilot study, several changes or improvements were deemed necessary:

1. The domain-knowledge multiple-choice questions portion of the knowledge measure was eliminated due to poor performance of this section.

2. The terms used for the topic-knowledge measure were expanded to include more terms as appropriate for practicing nurses as well as prelicensure nurses.

3. The interest measure was expanded to include interests and activities relevant to practicing nurses.

4. A test of relational reasoning (TORR) was added as a gauge of strategic processing based on the theoretical model.

5. With the addition of the TORR, the time frame and the order of test presentation required adjustment.

Main Study

Participants

Sample size. For the main study, an a priori power analysis was conducted to determine the required sample size. A power analysis conducted using G*Power 3.1.9.2 indicated a sample size of 77 was necessary to detect a moderate effect size with α equal to 0.05 with a power of 0.80. A moderate effect size was chosen because in the pilot study the magnitude of the difference in the means [mean difference = -11.77, 95% CI (-21.37, -2.17)] was moderate and statistically significant for the differences between the levels of students on the pilot interest measure (*Cohen's d* = -1.34, effect size *r* = 0.55). Further, the review of literature revealed that the correlation of individual interest and topic knowledge had effect sizes in the moderate range (Lawless & Kulikowich, 2006).

This study included both prelicensure and practicing nurses to analyze the relations among predictors of critical thinking at differing levels of experience. Specifically, it was determined that there should be maternity nurses representing three levels of experience: prelicensure, less than 10 years of practice, and over 10 years of

practice. The years of experience targeted were based on previous research showing that ten years of experience has been found to be a necessary but not sufficient background for expertise (Chi, 2011; Ericsson, 2006).

The in-person recruitment rate approached 50% for the pilot for this study. A more recent study of learning outcomes in nursing students had a 72% in-person recruitment rate for an online measure with two sessions (Trocky et al., 2015). So, to maximize the probability of obtaining an adequate sample, 154 participants were sought. In order to maintain a cell size of at least 30, as recommended when comparing groups (VanVoorhis & Morgan, 2007), participants were recruited until at least 30 were obtained for each level of experience (prelicensure, less than 10 years of experience, 10 or more years of experience). The sample size needed for this study was computed a priori (N = 77, group size minimum = 30).

Inclusion and exclusion criteria. To participate in the study, each prospective participant was required to be either: a) a practicing maternity nurse, defined as a registered nurse currently working in a maternity position, or b) a student in an entry-level nursing program who has started or completed the maternity nursing rotation. The screening questions identified those who did not meet these criteria and they were not permitted to continue to the online study. The Screening, Demographic, and Background Questionnaire is shown in Appendix A.

Demographic variables. The study had 182 participants from 41 states. Seventy were at the prelicensure level, 42 were at the less than 10 years level, and 70 were at the more than 10 years level. The demographic statistics for the study sample are shown in Table 1. The participants were primarily female (97.3%; N = 177). The professional

organization for maternity nurses, AWHONN, reports that 96% of their membership is female (AWHONN, personal communication, April 24, 2015). For all nursing specialties nationally, 93% are female (HRSA, 2013). A higher mean percentage of males was found in the prelicensure and less than 10 years levels, but these differences were not statistically significant, $\chi2$ (2, N = 182) = 1.10, p > .05. Nationally, the number of men in nursing is increasing (U.S. Census, 2013).

The race/ethnicity of the sample was primarily White (86.3%); 5.5% were Hispanic, 3.8% Black, 1.6% Asian, 1.1% other, and 1.6% of participants described themselves as multiple races/ethnicities. The percentage of other races was higher at the prelicensure and less than 10 years levels of experience. However, this difference was not statistically significant, $\chi2$ (8, N = 182) = 9.41, p > .05. Nationally, 83% of registered nurses are White, 6% are African-American, 3% are Hispanic, 6% are Asian, and 2% are other (Budden, Zhong, Moulton, & Cimiotti, 2013; HRSA, 2013). Overall, this sample has a similar percentage of minorities compared to the national sample.

The first language of participants was primarily English (96.7%), with Spanish, Cantonese, French, and Swahili also identified as first languages by six participants. No statistically significant difference was found between levels, $\chi2$ (2, N = 182) = 1.26, p > .05. The mean age of the sample was 36.7 (*SD*= 13.74), ranging from 20 to 66, and the mean age of the practicing nurses in the sample was 44.1 years. Nationally, the mean age of nurses is 44.6 years (HRSA, 2013). The mean age of the sample prelicensure nurses was 24.7 (*SD*= 5.92), 34.2 (*SD*= 9.07) for nurses with less than 10 years of experience, and 50.1 (*SD*= 9.01) for nurses with more than 10 years of experience.

Table 1

Descriptive Statistics of Demographic Variables

Variable	All Participants N = 182 n (%)		Prelicensure N = 70 n (%)		Less than 10 Years N = 42 n (%)		10 or More Years N = 70 n (%)	
Gender								
Female	177	(97.3)	68	(97.1)	40	(95.2)	69	(98.6)
Male	5	(2.7)	2	(2.9)	2	(4.8)	1	(1.4)
Race/Ethnicity								
White	157	(86.3)	60	(85.7)	33	(78.6)	64	(91.4)
Hispanic	10	(5.5)	4	(5.7)	3	(7.1)	3	(4.3)
Black	7	(3.8)	4	(5.7)	2	(4.8)	1	(1.4)
Asian	3	(1.6)	1	(1.4)	1	(2.4)	1	(1.4)
Other	2	(1.1)	1	(1.4)	0		1	(1.4)
Multiple	3	(1.6)	0		3	(7.1)	0	
First language								
English	176	(96.7)	69	(98.6)	40	(95.2)	67	(95.7)
Spanish	3	(1.6)	1	(1.4)	2	(4.8)	0	
Cantonese	1	(.55)	0		0		1	(1.4)
French	1	(.55)	0		0		1	(1.4)
Swahili	1	(.55)	0		0		1	(1.4)
Age	36.7	(13.74)[a]	24.7	(5.92)[a]	34.2	(9.07)[a]	50.1	(9.01)[a]

[a]*M* (*SD*).

Professional characteristics variables. The descriptive statistics for the professional characteristics are displayed in Table 2. Examining the educational level of nurses was complicated by the fact that nurses may come into nursing with other degrees, and nurses may obtain other degrees after completing their basic nursing education. Education was examined for both the first nursing program, as well as highest completed educational level. Nursing education programs that are accredited for preparing students as registered nurses can be at four different levels: non-degree granting diploma programs based in hospitals, associate's degree programs, baccalaureate programs, and master's degree entry-level programs. Master's degrees and clinical doctorates and PhD degrees are also available for advanced practice nurses such as nurse practitioners, nurse-midwives, and clinical nurse specialists. For their entry-level nursing program, the greatest percentage of nurses in this study attended or are attending baccalaureate nursing programs (60%), with 8% from diploma programs, 26% from associate programs, and 6% from master's-entry programs.

When examined by level of experience, no prelicensure students were enrolled in diploma programs, which now comprise only 10% of nursing programs (AACN, 2011), and over 11 percent were enrolled in master's entry-level programs. For nurses with less than 10 years of experience, none graduated from diploma programs, whereas over 21% of nurses with more than 10 years of experience graduate from diploma programs. Nationally, 23% of nurses graduated from diploma programs, 39% graduated from associate programs, 36% graduated from baccalaureate programs, and 3% graduated from master's programs; more of the recent graduates are from baccalaureate programs (HRSA, 2013). Overall, this study sample had a higher percentage of nurses who

received their basic nursing preparation at the baccalaureate level; the trend toward more baccalaureate education for new nursing graduates is congruent with national data (HRSA, 2013).

For the highest completed education level, the highest mean percentage was 42.3% for bachelor's degree; 1.6% of the sample had completed a doctoral degree, 19.8% had completed a master's degree, 17% had completed an associate's degree, and 19.2% had completed a high school degree. This group includes diploma-prepared practicing nurses as well as student nurses in associate degree programs and students in baccalaureate programs that did not complete an associate's degree. Nurses with more than 10 years of experience had the highest means for doctoral and master's degrees, 2.9% and 38.6% respectively. Nationally, 55% of nurses have a bachelor's degree or higher (HRSA, 2013); for this sample, 64% had at least a bachelor's degree.

The final professional characteristic was self-reported competence in providing excellent maternity care. The sample mean was 79.6 on a 100-point scale, with the mean for prelicensure participants 62.4, 86.9 for nurses with less than 10 years of experience, and 92.3 for nurses with more than 10 years of experience.

Independent Measures

The three instruments proposed to measure topic knowledge, individual interest, and relational reasoning are described in the subsequent sections. The measures or sample items are displayed in Appendices B, C, and D, respectively.

Table 2

Descriptive Statistics of Professional Characteristics

Variable	All Participants $N = 181$ n (%)		Prelicensure $N = 70$ n (%)		Less than 10 Years $N = 41$ n (%)		10 or More Years $N = 70$ n (%)	
Nursing program								
Diploma	15	(8.3)	0	(0)[a]	0		15	(21.4)
Associate's	47	(26.0)	10	(14.3)[a]	17	(41.5)	20	(28.6)
Baccalaureate	109	(59.7)	52	(74.3)[a]	22	(53.7)	34	(48.6)
Master's	11	(6.1)	8	(11.4)[a]	2	(4.9)	1	(1.4)
Highest completed education level								
High school	35	(19.3)	34	(48.6)	0	(0)	1	(1.4)
Associate's	31	(17.1)	13	(18.6)	10	(24.2)	8	(11.4)
Bachelor's	76	(42.0)	22	(31.4)	22	(53.7)	32	(45.7)
Master's	36	(19.9)	1	(1.4)	8	(19.5)	27	(38.6)
Doctorate	3	(1.7)	0	(0)	1	(2.4)	2	(2.9)
Nursing role								
Student	70	(38.7)	70	(100.0)	N/A		N/A	
Staff nurse	68	(37.6)	N/A		32	(78.0)	36	(51.4)
Educator, multiple	43	(23.6)	N/A		9	(22.0)	34	(48.6)
Specialized maternity education								
Yes	69	(38.1)	N/A		11	(26.8)	58	(82.9)
No	42	(23.1)	N/A		30	(73.2)	12	(17.1)
Prelicensure	70	(38.7)	70	(100.0)	N/A		N/A	
Years of experience	9.6	(12.1)[b]	0[b]		4.13	(3.0)[b]	22.48	(9.9)[b]
Self-reported competence	79.6	(20.8)[b]	62.4	(19.0)[b]	87.3	(12.4)[b]	92.3	(13.4)[b]

[a]Students are enrolled in this type of program, but have not completed it. [b]M (SD).

Topic Knowledge Assessment. The TKA consists of 12 terms with two parts

for a total of 24 constructed response items. There were two terms each from the areas of

pregnancy, birth, newborn, postpartum, breastfeeding, and professional issues,

representing the six major content areas of maternity nursing (Lowdermilk et al., 2012).

Prior to the proposed research, three maternity nurses with over 10 years of maternity

nursing experience who are also nursing faculty with three or more years of teaching

experience established content validity. These three content specialists agreed that key

topics within maternity nursing were adequately represented (Haladyna & Rodriguez,

2013). The items are listed in Appendix B. The choice of constructed response format

for items in the topic-knowledge measure was based on the common use of short-answer

format for topic knowledge (Alexander et al., 1994; Billings & Halstead, 2012; Petty,

2011; Taboada et al., 2009) and the adequate performance of the measure during the

pilot.

The TKA terms were chosen to be of mid-level complexity and of high

importance to maternity nursing practice. A second term for each area was added to the

six pilot terms to better capture the expertise of practicing maternity nurses in the content

and to be challenging enough for all levels of participants. The 12 terms are: maternal-

newborn bonding, fetal-newborn physiologic transition, physiologic management of

labor, electronic fetal monitoring, breastfeeding latch, breastmilk production, involution,

postpartum support system, embryonic critical period, nutrition in pregnancy, evidence-

based practice in maternity care, and JOGNN (i.e., Journal of Obstetric, Gynecological,

and Neonatal Nursing, the professional organization for maternity nursing). The key was

also evaluated by a team of four maternity nurses and found to be representative of content and accurate.

Participants were asked to define each term and describe its significance to maternity nursing in two or three sentences or phrases. A holistic scoring rubric and key were developed that scored separately for content and importance; each response for each term was scored as 0 = *wrong or no evidence*, 1 = *some evidence but not complete*, 2 = *full evidence*, and 3 = *elaborate evidence* (Haladyna & Rodriguez, 2013). The 24 scores for the two areas of definition and significance for 12 terms were combined into a total topic knowledge score with a maximum value of 72 (24 items with a maximum score of 3).

To obtain the interrater agreement, this researcher developed a Rater Training Manual (Appendix I). That scoring guide included an orientation to the measure, the key, scoring instructions and examples, and data entry instructions. Two experienced nursing faculty were trained to score the knowledge and critical thinking measures. Once these raters demonstrated understanding of the scoring guide and the procedure, interrater agreement (IRA) for the scoring of the TKA was assessed using a randomly chosen 10% of responses (N = 19) and 2 experienced maternity nurse raters (Gwet, 2014). The specific interrater agreement was calculated. The IRA for the 4-point coding (0 = *wrong, absent*; 1 = *partial*; 2 = *full*; 3 = *elaborate*) was 73%. If collapsed into low (0, 1) and high (2, 3) categories, the IRA was 86%. The 4-point coding scheme was retained for analysis.

Professed and Engaged Interest Measure. The conceptualization, measurement, and empirical findings about individual interest led to its inclusion as an

independent variable in this study. This study was focused holistically on the individual

interest in maternity nursing, not situational interest, and does not measure feelings or

values or cognitive aspects separately from overall interest. Therefore, individual interest

was measured with items indicating level of interest in maternity nursing topics (i.e.,

professed interest). In addition, an activities inventory where participants indicate

activities they have performed captures the feelings and value aspects indirectly, as

individuals' participation in maternity nursing activities is a measure of sustained

individual interest. The use of activities items can lessen the social desirability bias of

self-reported interest measures alone (Dinsmore et al., 2008b; Wigfield & Cambria,

2010). The items were measured as a visual analog scale with continuous data.

The main study, thus, had 10 items that asking about professed interest in

maternity topics and 10 items that asked about engagement in activities that were judged

by experienced maternity nurses to encompass the scope of individual interest across the

stages of nurses' expertise development. This interest measure solicits interest level in

topics of maternity nursing chosen to be universal to all nursing programs in order to

avoid the criticism that participants should not be measured on unfamiliar topics, since an

individual can't be interested in something he or she knows nothing about (Schiefele,

2009). The use of both professed and engaged interest items was intended to strengthen

this study's claim that it captures enduring individual interest in these topics. The

evidence describes a role for both feelings and values, and the activities questionnaire

captures the relevant aspects of interest.

The Professed and Engaged Interest Measure (PEIM; Appendix C) was adapted

from other individual interest measures (Dinsmore et al., 2008b). The first of the two

sections measured self-reported interest in 10 areas that incite interest and passion for maternity nursing, such as "sharing the moment of birth with families" or "providing labor support," and the second section measuring self-report frequency of participation in 10 activities demonstrating interest in maternity-nursing activities, such as "Staffing a community health fair" or "Reading a book about maternity nursing." Prior to the study, three maternity nurses with over 10 years of maternity nursing experience, who are also nursing faculty with three years or more of teaching experience, established content validity by agreeing that the universe of possible interest areas and activities in maternity nursing was adequately represented by the items (Haladyna & Rodriguez, 2013).

Two experienced maternity nurses evaluated the revision of the items for practicing maternity nurses. For the 10 professed interest and 10 engaged interest items, a 100-mm line was displayed. The endpoints of the line were labeled *not at all interested* and *very interested* for the professed interest items or *never* and *often* for the engaged activities items. The participants were instructed to move the pointer to the place on the line representing their level of interest or level of participation in activities. The professed interest and engaged interest items were summed for an individual interest score. These were recorded by the Qualtrics™ (2012) platform.

To further test the structure of the interest measure, a principal components factor analysis was conducted. Prior to performing this analysis, the suitability of the data for factor analysis was assessed. The Professed and Engaged Interest Measure has 20 items that elicit responses about individual interest in maternity nursing topics and activities. The ratio of participants to items was 9:1; 5 to 10 participants for each item or >150 participants is recommended (Pett, Lackey, & Sullivan, 2003). Inspection of the

correlation matrix revealed the presence of many coefficients of 0.3 or greater. The Kaiser-Meyer-Olkin value was 0.848, compared to a recommended level of 0.6 or greater, indicating that the magnitude of the correlation coefficients between items is large enough compared to the partial correlation coefficients. Bartlett's Test of sphericity reached statistically significance (p < 0.000). All of these findings indicate an adequate level of support for factorability of the correlation matrix.

The 20 items were examined using oblimin rotation. The PCA analysis initially yielded 5 factors with an eigenvalue greater than 1. Inspection of the scree plot (Catell, 1966) suggested up to three factors with no clear "elbow." This was further supported by the results of the parallel analysis, which showed only three components with eigenvalues exceeding the corresponding criterion values for a randomly generated date matrix of the same size (20 items X 182 participants).

However, assessment of the component matrix loadings led to acceptance of a one factor solution, which explained a cumulative total of 34% of the variance. All 20 items loaded substantially on the first factor, with loadings ranging from .39 to .77 (Table 3). The two items that loaded slightly below .4, "volunteered as labor support person" and "wrote or reviewed journal article" had the two lowest means of the measure variables, but had loadings of .39. Only the one factor solution was found to be viable analytically and statistically. The Professed and Engaged Interest Measure was retained as a singular measure for this initial study, with a Cronbach's α of .89.

Test of Relational Reasoning. In addition to the three measures used in the pilot, the main study also included a measure of relational reasoning. The Test of Relational Reasoning (TORR; Alexander, Dumas, Grossnickle, List, & Firetto, 2016) consists of 32

graphical multiple choice items divided into four sections of eight items each: analogy, anomaly, antinomy, and antithesis. The analogy scale is designed to measure the ability to identify a pattern of similarity. The anomaly scale is meant to measure the ability to identify a pattern of discrepancy. The antinomy scale is designed to test the ability to distinguish mutually exclusive concepts. The antithesis scale is designed to measure the ability to identify opposites in a set of items. The test uses graphical items to represent each form of relational reasoning. The multiple-choice distractors were created to systematically differ from the correct answer. A sample item for each scale is displayed in Appendix D.

The TORR measure has been found to be psychometrically sound in prior research with adult samples (Alexander et al., 2014). For example, in a calibration of the TORR, the overall reliability was determined to be 0.84 (Dumas & Alexander, 2016). Further, data from the TORR showed appropriate convergent validity with Raven's Progressive Matrices (RPM), a figural intelligence test constructed of matrix analogies (Raven, 1941). Specifically, the correlation between the two measures was $r = .49$, $p<.001$. Since RPM measures only analogy, and not other forms of relational reasoning, this was deemed appropriate convergent validity. Discriminant validity was calculated with a visuospatial measure of working memory, Shapebuilder (Sprenger, Atkins, Bolger, Harbison, Novick, Chrabaszcz, & Dougherty, 2013), with a resulting low moderate correlation of r = .31, p = .02 (Alexander et al., 2016). The mean for the calibrated TORR (16.98) was comparable to that reported for this study (15.82); the Cronbach's α for the calibrated TORR was .84 and .76 for this sample.

Table 3

Factor Loadings for Principal Components Analysis with Oblimin Rotation of Individual

Interest Items

	Factors		
	1	2	3
Providing Labor Support	**.72**	-.37	-.02
Educating re: Birth Options	**.69**	-.40	.02
Supporting at Moment of Birth	**.65**	-.40	-.02
Assessing Fetus and Newborn	**.50**	-.21	-.06
Developing Care Guidelines	**.77**	-.19	-.22
Providing Pharmacologic Relief	**.53**	-.22	-.36
Promoting Continuity of Care	**.55**	-.29	.09
Providing Breastfeeding Education	**.58**	-.34	.23
Helping Parent Empowerment	**.56**	**-.47**	.01
Providing Discharge Instructions	**.53**	-.39	.08
Volunteered for Community Activities	**.50**	**.43**	**.40**
Participated in Hospital Journal Club	**.63**	.37	**-.47**
Volunteered as Labor Support Person	.39	.21	**.66**
Attended Maternity Conference	**.64**	**.53**	-.26
Completed Continuing Education	**.65**	.34	-.39
Provided Childbirth Education	**.51**	.17	**.55**
Read a Maternity Book	**.55**	.14	.20
Wrote or Reviewed Journal Article	.39	**.43**	.21
Consulted Another Discipline Member	**.64**	.40	.06
Examined Posters at Conference	**.56**	**.56**	-.17

Note: Factor loadings > .4 (before rounding) are in boldface

Dependent Measure: Critical Thinking Task in Maternity Nursing

The Critical Thinking Task in Maternity Nursing (CT^2MN) requires participants to analyze a case that is a typical task for nursing. A written case clinical scenario provides patient symptoms and background data (see Appendix E). Participants were instructed to list all the patient problems suggested by the case, the priority of each problem, the evidence that led to a patient problem being identified, the important missing data points, relevant nursing interventions, and legal and ethical issues inherent in the case. The participants were also asked to list relevant discharge instructions that tell the patient what to do upon arrival at home, as discharge planning demonstrates anticipation of implications of the current condition. Discharge planning is assumed to start at admission and has been associated with improved patient outcomes (Bernstein, Spino, Lalama, Finch, Wasserman, & McCormick, 2013; Bowles, Holland, & Potashnik, 2012).

Although written case scenarios have been criticized as being static and unable to reflect internal processes (Ericsson, 2009), others have found case studies to have strengths in capturing clinical problems (Dowd & Davidhizar, 1999). These strengths include efficient presentation of information about a case that takes a long period of time to collect in real time, presentation of a scenario with context that is educational to nurses, thereby increasing its true validity and realism, and flexibility for elaboration as needed for the purpose of the case study. Lunney argued that only with case studies will nurses obtain enough clinical experiences to become proficient in applying the cognitive skills of critical thinking (2009). One critical thinking instrument analysis (Kamin, O'Sullivan, Younger,& Deterding, 2001), comparing text medical case descriptions to

video descriptions, found that text cases are an excellent tool to assess critical thinking, as did the work of Del Bueno in nursing (1990, 1994, 2005). Thus, the literature provides moderate support for the short answer case scenario format for measuring critical thinking in a nursing case task. The study used an adapted form of the Kamin et al. (2001) coding scheme.

Specifically, participants are presented with a written clinical scenario, about a woman who presents to the hospital with labor symptoms and some complications, that provides explicit as well as implicit cues, and with critical pieces of information missing. During a follow-up-question task, participants are instructed to list the following:

1. all the patient problems, also known as nursing diagnoses, suggested by the scenario, along with each one's relative priority;

2. the evidence that led to a patient problem being identified;

3. the important missing data points;

4. relevant nursing interventions;

5. legal and ethical issues inherent in the case; and,

6. discharge teaching topics to be given to the scenario patient prior to going home.

During everyday patient care, nurses address questions similar to those in the critical thinking task (Gilboy & Kane, 2004; Huang, Chen, Yeh, & Chung, 2012; Popil, 2011; West, Usher, & Delaney, 2012). The critical thinking follow-up questions also align with the critical thinking definition used in this study (Scheffer and Rubenfeld, 2000; also see Table 4).

Table 4

Alignment of Critical Thinking Definition Processes and CT²MN Questions

Processes in Critical Thinking Definition	Manifestation as measured by Critical Thinking Task questions
1. Analyzing	Identify problems in list
2. Applying standards	Prioritize problems correctly
3. Discriminating	Focus correctly on the core problems
4. Logical reasoning	Identify cues and evidence to confirm problem
	List patient outcome goals
5. Transforming knowledge	List Interventions needed to care for patient
6. Information seeking	Identify missing data needed to care for patient
7. Predicting	List legal and ethical issues
	List discharge teaching topics

Operationalizing the critical thinking processes. A key for the case study was generated by a panel of 3 experienced maternity nurses, and the key was refined after the pilot by a different set of 3 experienced maternity nurses. The operational measure of each critical thinking process was as follows:

1. Analyzing: The correct patient problems identified by the participant, out of a possible 10 problems listed in the key. Each problem was identified and entered if it was a correct problem.

2. Applying standards: Each of the 10 possible problems was assigned a priority of Critical, Important, or Helpful. For example, fetal distress has a higher priority than breech presentation. The number of priority points assigned to each of the problems the participant identified were summed (see Scoring section).

3. Discriminating: The number of wrong problems the participant listed that were not in the key was counted. These were subtracted from the score, and scores for all subsequent items were lower due to decreased ability to obtain the full score due to presence of incorrect problems.

4. Logical reasoning: a) The number of correct cues or connections to evidence of patient problems listed in the scenario. For example, if the participant identifies preeclampsia as a problem, protein in the urine, headache, and elevated blood pressure might be cited as correct evidence for the problem, and each would be counted. The percentage of correct pieces of evidence identified compared to the number of keyed possible pieces of evidence was computed. b) The number of correct outcomes listed. For patient care, a key aspect of the nursing process is identification of desired outcomes (Gulanick & Myers, 2014). The number of correct outcomes was entered into the data, and the total computed. The percentage of correct outcomes compared to the number of keyed possible outcomes was computed.

5. Transforming knowledge: The number of correct nursing actions or interventions the participant listed compared to the key was counted. The percentage of interventions listed compared to the number of essential interventions identified by the key was computed. Expert maternity nurse faculty feedback determined which of the correct interventions were essential.

6. Information seeking: The number of missing information points, salient pieces of data needed to analyze the scenario, was entered. The percentage of points identified compared to the key was computed.

7. Predicting: Two questions addressed predicting. a) The number of categories of legal and ethical implications for the patient problem identified by the participant was counted. The percentage compared to the keyed possible legal ethical categories was computed. b) The number of correct anticipated patient teaching topics identified by the participant was identified. The percentage of topics identified compared to the keyed number of topics was computed.

In nursing education and continuing education programs across the country, these aspects of critical thinking are usually captured in summaries of the patient's plan of care called care plans. The nursing diagnoses (or patient problem) with the evidence for the problem, the interventions nurses use to treat these problems, and the sought after outcomes are central to these plans of care (Gulanick & Myers, 2014). Care plans are nearly universal in nursing education and practice.

Scoring the CT^{2}MN. In the pilot, each question-component in the critical thinking measure was weighted equally, e.g., the question about interventions used was weighted equally to the question about legal ethical issues. For the main study, in order to capture actual nursing teaching practice, an examination of nursing care plans used in 5 nursing programs across the country was conducted. Based on the analysis of these nursing care plans, a weighting scheme for the follow-up questions was developed that involved three components of varying weights.

1. Problem Identification and Prioritization (PIP)

2. Evidence, Interventions, and Outcomes (EIO)

3. Legal Ethical Issues, Missing Information, and Discharge Instructions (LMD).

Problem Identification and Prioritization (PIP). The first three critical thinking components (i.e., identifying the correct patient problems, correctly prioritizing them, and not listing wrong problems) were totaled to create a Problem Identification and Priority Score. This was allotted 40% of the CT^{2}MN score due to the importance of correct nursing diagnosis and prioritization.

Evidence, Interventions, and Outcomes (EIO). Next, the scores for identifying cues and evidence to support identification of the problem, listing correct nursing interventions for the specified problems, and correctly predicting outcomes desired for the patient. These aspects of critical thinking universally received the greatest points in care plans examined, so this subscore was allotted 45% of the weight of the CT^{2}MN score, 15% each for Evidence, Interventions, and Outcomes. Wrong or missing problems decreased the score on this section.

Legal Ethical Issues, Missing Information, and Discharge Instructions (LMD). Finally, information seeking and predicting were measured by identification of legal-ethical issues stemming from the case, such as informed consent with teenagers, identification of categories of missing information, such as due date, and anticipating needed patient education prior to discharge, such as danger signs after birth. These three factors were usually accessory to the other sections with less weight allotted; therefore, this subscore was assigned 15%, 5% each for legal-ethical issues, missing information, and discharge education. Wrong or missing problems decreased the score on this section as well.

Coding the scoring. For this open-ended assignment, participants could identify different numbers of problems; however, prioritization is important so that nurses do the

most important care first, and not defer critical or important care for care that is merely helpful. The ranking of problems is not robust or accurate to individual rankings but to tiers of criticality. Critical (red) tier problems are life-or-death problems, Important (yellow) tier problems have immediate health consequences, and Helpful (green) tier problems are opportunities for improved health if the nurse intervenes. For the key to the scenario, each of the 10 possible patient problems have been assigned by the researcher to one of three priority tiers: Critical, Important, or Helpful. The top two problems are Critical tier, problems 3, 4, 5, and 6 are Important tier problems, and the keyed problems 7, 8, 9, and 10 are Helpful tier problems.

When completing the study, the participants identified their list of problems and arranged them in order of their priority for best patient outcomes. The priority assigned to each listed correct problem by the participant for the purposes of computing the priority score was entered. The following steps were then followed in order to allocate the points for the problem identification and priority:

1. If the problem ranked first or second by the participant was indeed a first tier Critical or red problem, it was given 10 points.

2. If a problem ranked third, fourth, fifth, or sixth by the participant was indeed an Important or yellow problem in the keyed second tier, it was given 5 points.

3. If a problem ranked seventh, eighth, ninth, or tenth by the participant was indeed a Helpful or green 3rd tier problem, it was given 3 points.

4. For problems incorrectly ranked, the general principle was the further from the correct priority a problem was listed, the more points that were deducted

from the possible score. One point was deducted for each level of discrepancy

from the correct ranking (See Table 5).

5. Repeated problems that were similar to the keyed problems were marked as
   Repeat and were skipped with regard to assigning priorities.

6. The point allocation for all problems in the key were added up to compute the
   Total Prioritization score.

7. One (1) point was subtracted for each wrong problem listed by the participant
   from the Total Prioritization Score.

Table 5

Critical Thinking Problem Priority Points Determined by Participants' Prioritization by Correct Priority Tier

Correct Priority Tier	Participants' Priority Assignments									
	1	2	3	4	5	6	7	8	9	10
	Number of priority points assigned for data entry									
Tier 1	10	10	9	8	7	6	5	4	3	2
Tier 2	3	4	5	5	5	5	4	3	2	1
Tier 3	-3	-2	-1	0	1	2	3	3	3	3

A sample scoring sheet for critical thinking is shown in Figure 3, and the coding

scheme is described in detail in Appendix I under Coding and Data Entry for the CT^{2}MN.

Each of these individual scores was summed into three categories that are weighted

according to general nursing practice. The total critical thinking score was composed of

three subscores:

1. Problem Identification and Prioritization (PIP), weighted to 40% and composed of Priority Points of correct listed problems, minus 1 point for each wrong problem, as a percentage of highest possible points.

2. Evidence, Interventions, and Outcomes (EIO),weighted to 45% and composed of Evidence 15% + Interventions 15% + Outcomes 15% (percentage scores, not raw scores, so that subscores could be added).

3. Legal Ethical Issues, Missing Information, and Discharge Instructions (LMD), weighted to 15%, and composed of 5% Legal-Ethical Issues, 5% Missing Information, and 5%.

4. Discharge Instructions (percentage scores, not raw scores, so that subscores could be added). The next section discusses the procedures used to collect the data.

Procedures

In order to examine the relations among topic knowledge, individual interest, relational reasoning, and critical thinking for maternity nurses, an online study with two forty-five minute sessions was conducted; practicing maternity nurses and prelicensure nurses were the participants. Institutional Review Board approval was obtained. After reading the informed consent and agreeing to participate, respondents completed the Screening, Demographic, and Background Questionnaire (SDB; Appendix A), the Topic Knowledge Assessment (TKA; Appendix B), the Professed and Engaged Interest Measure (PEIM; Appendix C), the Test of Relational Reasoning (TORR; Appendix D), and the Critical Thinking Task in Maternity Nursing (CT2MN; Appendix E).

CTMNS CT SCORING SHEET				Rater:						Participant ID:				105le	Date:			
Correct Problems	Problem ID	#Repeat	NumWrong	Key & Tier	Priority	Pr Pts	Evidence Key	Evidence	Evidence pc	Interventions Key	Interventions	Interv pc	Outcomes Key	Outcomes	Outcome pc	Legal Ethical	Missing Data	D/C
Fetal Distress 1 ❶	1			1	2 ❹	10	2	BA ❺	100%	9	EACI ❻	56%	2	BA ❼	100%	CH ❽	ABD ❾	GDB ❿
Seizure/PreE 1				2	1	10	6	BAD	50%	12	DAE	25%	3	AB	67%	9 LE Key	6 MD Key	10 DC Key
Breech 1				3	4	5	1	A	100%	4	DC	50%	3	A	33%	LE pc	Md pc	DC pc
Cesarean				4		0	1		0%	6		0%	3		0%	22%	83%	40%
Pain				5		0	2		0%	4		0%	1		0%			
Preterm/GA 1				6	3	5	1	A	100%	5	AB	40%	1	A	100%			
PNC/ Risk				7		0	1		0%	3		0%	1		0%			
Labor Status				8		0	2		0%	2		0%	1		0%			
Teen Support System Single 1	1			9	5	1	3	B	33%	8	EA	25%	3	C	33%			
Primip Knowl Deficit 1	1			10	6	2	1	A	100%	2	A	50%	1	A	100%			
TOTAL 6	3 ❷	0 ❸		Priority Pts.		33	20		9	45%	21	15	71%	19	8	42%		
				Adjusted Priority Pts.		39												
				-Wrong		0												
				Priority Subscore		39												
				Priority pc		67%						EIOpc	53%				LMDp	49%

CTScore = 0.4 * (Priority PC + 0.45 * (EvidencePC + InterventionsPC + OutcomesPC) + 0.15 * (LE_PC + MD_PC + DC_PC)   ✪ 58%

Figure 3. Steps in scoring for the CT²MN.

The study measures were administered in the same order to all participants based on several considerations. The TORR was placed last due to its length and difficulty. Cognitive lab testing of the TORR with maternity nursing faculty demonstrated that it took approximately 45 minutes and was deemed challenging. Therefore, positioning it last was an attempt to minimize dropout due to a difficult section. For the first online session in the proposed study, after the Informed Consent and SDB, the TKA placed first so that the other measures would not influence what knowledge the participant recalled. The CT^{2}MNwas placed next due to its familiarity as a task to nurses and nursing students. For the second session, taken at the next time convenient to the participant, but within 10 days, the PEIM was offered first before the TORR since it was quickly completed and less cognitively taxing than the other measures. The TORR was the final measure, followed by a "thank you" message.

Incentives. For the main study, an incentive of a $25 online Amazon gift card upon verification of completion of 100% of the study was provided to participants. A log of receipts for the distribution of the gift cards was maintained. When participation closed, a drawing for an iPad mini was conducted, and it was awarded to a lucky nurse in Indiana.

Recruitment. Participants were recruited from three professional listservs. The recruitment flyer is shown in Appendix H. The three national listservs used for recruitment were the maternity nurses' professional organization, AWHONN (Association of Women's Health, Obstetric, and Neonatal Nurses), the perinatal nurses' listserv (PNATALRN), and the National Association of Nursing Students (NANS) listserv. No other national maternity listservs were located. These three listservs

produced an adequate number of participants, and no further recruitment was necessary.

Approval was obtained from listserv managers prior to posting the recruitment letter.

The prospective participants were provided a URL to the study's consent form, and the

link to the study after consent.

The Association of Women's Health, Obstetric, and Neonatal Nurses

(AWHONN) is the professional organization for maternity nurses and has 21,000

members. Perinatal RN, with 800 members, has a focus on evidence-based practice and

solving practical problems on maternity units. The National Student Nurse Association

(NSNA) is an organization for student nurses, all of whom study maternity nursing, and

has 60,000 members.

The study invitation was sent to all members of Perinatal RN, due to its small

size, by a posting of the invitation to the listserv by the researcher. The study invitation

was distributed to a subset of members of the large AWHONN (Association of Women's

Health, Obstetric, and Neonatal Nurses) mailing list. Both practicing and prelicensure

members were included. The study invitation was sent under AWHONN letterhead to

two groups of members: all student members, N = 1036, since that group has been shown

to have low recruitment rates and is a small percentage of AWHONN members

(1036/21000 = 0.5%; AWHONN, personal communication). For the second group, only

non-retired members of AWHONN who are in labor and delivery or mother/baby-

postpartum were included in a random selection to receive the invitation. Exactly 1000

RN members were randomly selected from the database of 15,197 maternity nurses. The

invitation was sent to a total of 2,036 AWHONN members. For the student nurses, the

invitation to the study was sent to all members of NSNA, due to historical low

recruitment from students in online studies (Lipka, 2011). The National Student Nurse Association sent the study invitation to all 60,000 members.

Historically, for this type of study, recruitment is much higher when done in person. Recruitment estimates were changed after information on response rates to research questionnaires was obtained from listserv managers. Published recruitment rates for online studies (Dillman, Smyth, & Christian, 2009) and feedback from the list managers (AWHONN, personal communication, April 9, 2015) changed the estimate from over 50% to 3%. Although the recruitment from each listserv cannot be definitely determined since the same URL for Part 2 was distributed to the 3 listservs, based on the responses in relation to release date, the recruitment rates for the three listservs were approximately 2.8% from Perinatal RN , 3.6% from AWHONN , and 3.3% from NSNA, for a total mean recruitment rate of 3.2%. When the third and final listserv was recruited, the National Student Nurse Association, the number of prelicensure participants stood at 17. Although a minimum of 30 was the goal, a quota for this listserv was established based on highest N in the other groups; the number of nurses with more than 10 years of experience was 70. Within 12 hours the 70 participant quota was reached, and participation from the listserv was closed, with the remaining 1,930 applicants screened out. Ten participants completed Part 1 but not Part 2 within the 10 day limit and were deleted from the database after several reminders. All of the student participants completed Parts 1 and 2.

Online study administration. Although the pilot study was conducted using "paper and pencil," in order to allow a large number of working professionals to complete the study at their convenience, the measures used in the main study were

administered online. Participants were asked to complete measures in two sessions, estimated to be forty-five minutes each, but not time delimited. The Demographic Questionnaire, the Topic Knowledge Assessment, and the Critical Thinking Task in Maternity Nursing (CT^{2}MN) were completed during the first session, and the Professed and Engaged Interest Measure and Test of Relational Reasoning were administered during the second session. The survey management software Qualtrics™ was used to design the online platform and collect the data (Appendices F & G).

Data Analysis

First, data screening and checks for the regression assumptions were conducted. Next, descriptive statistics for the independent and dependent variables were generated for all participants and for each level of experience. The relation of professional experience to the study variables was measured in two ways: as the continuous variable years of experience for correlation and regression, and as the ordinal variable level of experience for examining differences. The levels of experience were delimited at three levels, using the common benchmarks of prelicensure and 10 years of experience: a) prelicensure, b) less than 10 years of experience, and c) more than 10 years of experience. One way analysis of variance (ANOVA) was used to examine the means and standard deviations of topic knowledge, individual interest, relational reasoning, and critical thinking by level of experience. The effect size and statistical significance of any differences were examined, and post hoc comparisons were made to examine where the differences between levels were occurring.

Finally, the statistical analyses to answer the research questions were conducted.

Research Question One. What is the relation between domain-specific topic knowledge and individual interest in nurses? In order to answer the first research question, a Pearson correlation analysis was performed.

Research Question Two. To what extent do topic knowledge and individual interest predict critical thinking in nurses? To answer the second research question, multiple regression analysis was used. Hierarchical regression analysis was performed in order to separate out any variance explained by years of experience while examining the effect of topic knowledge and individual interest on critical thinking.

Research Question Three. To what extent does relational reasoning predict critical thinking in nurses above and beyond topic knowledge and individual interest? Hierarchical regression was used to analyze this research question.

CHAPTER 4:

RESULTS

This study examined the relations among topic knowledge, individual interest, relational reasoning and critical thinking in maternity nurses, using the theoretical framework of the Model of Domain Learning (Alexander, 1997, 2003a). First this chapter reports on the data screening, statistical assumption checks, and descriptive statistics for the study variables. Next, the results and discussion for the following research questions are presented.

1. What is the relation between domain-specific topic knowledge and individual interest in nurses?

2. To what extent do topic knowledge and individual interest predict critical thinking in nurses?

3. To what extent does relational reasoning predict critical thinking in nurses above and beyond topic knowledge and individual interest?

For the first research question, data analysis was performed using bivariate correlation of the individual difference variables, namely, topic knowledge and individual interest. For the second research question, the prediction of critical thinking by topic knowledge and individual interest was examined using multiple regression. The role of professional experience was examined through ANOVA and its addition to a hierarchical regression of critical thinking on topic knowledge and individual interest. For the third research question, hierarchical regression was used to determine whether the addition of a third individual difference variable, relational reasoning, explained critical thinking scores beyond the variance explained by topic knowledge and individual interest.

Data Screening and Statistical Assumption Checks

Prior to analysis, all data were screened for abnormal means or standard deviations. Missing data were not an issue in this investigation in that participants were required to complete all items presented in the online system. Further, all non-substantive answers such as "." or "Unsure," which occurred rarely in the topic knowledge assessment, were scored as 0. Participant data for the CT^2MN that included less than 2 entered problems were not included (n = 2) because no priority score could be generated. Finally, no abnormal means were detected using descriptive statistics.

In addition, in order to have valid results for the statistical analyses planned for this study, certain assumptions had to be upheld: independence of errors, linearity of the relation between the predictors and dependent variable, homoscedasticity of residuals, no multicollinearity, no significant outliers or influential points, and normality (Field, 2013; Lund & Lund, 2012; Osborne, 2013). All of these diagnostic statistics were explored using SPSS.

Independence of Observations

To ensure that for any two pieces of data, the residual terms (errors) were independent or uncorrelated, a Durbin-Watson test was conducted to examine whether adjacent residuals were correlated, with a value near 2 indicating lack of correlation between the residuals. There was independence of residuals, as assessed by a Durbin-Watson statistic of 1.97. This statistic ranges from 0 to 4, so a value near 2 is generally accepted as evidence that there is independence of errors as represented by the residuals (Field, 2013).

Linearity

A linear relation is assumed in regression analysis, so a test of linearity was conducted for both the overall model and the individual predictors. The regression standardized residuals were plotted in a scatterplot against the standardized values of the outcome predicted by the full model (Figure 4). Since the points appeared evenly and randomly dispersed along the zero value line, linearity for the independent variables collectively was indicated (Bannon, 2013).
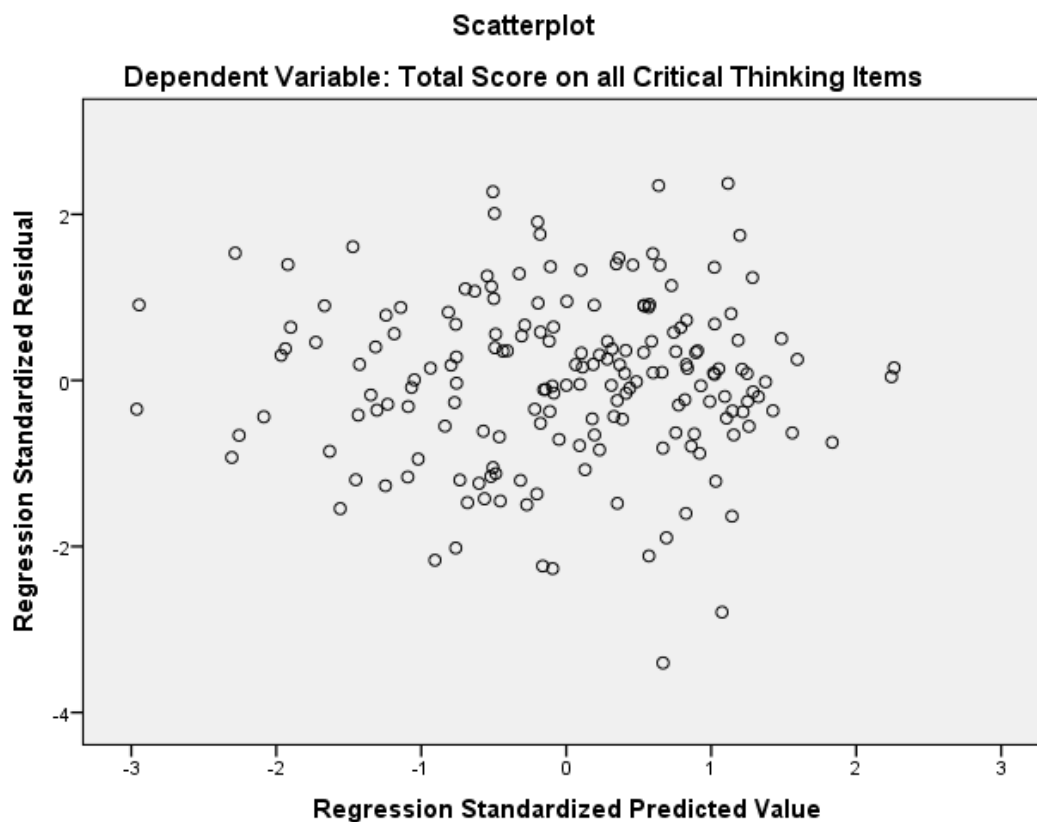
Figure 4. Scatterplot of the standardized regression residual as a function of the standardized regression predicted value for the dependent variable critical thinking score and the independent variables

The linearity of each of the predictor variables, topic knowledge, individual interest, and relational reasoning with the dependent variable critical thinking, are
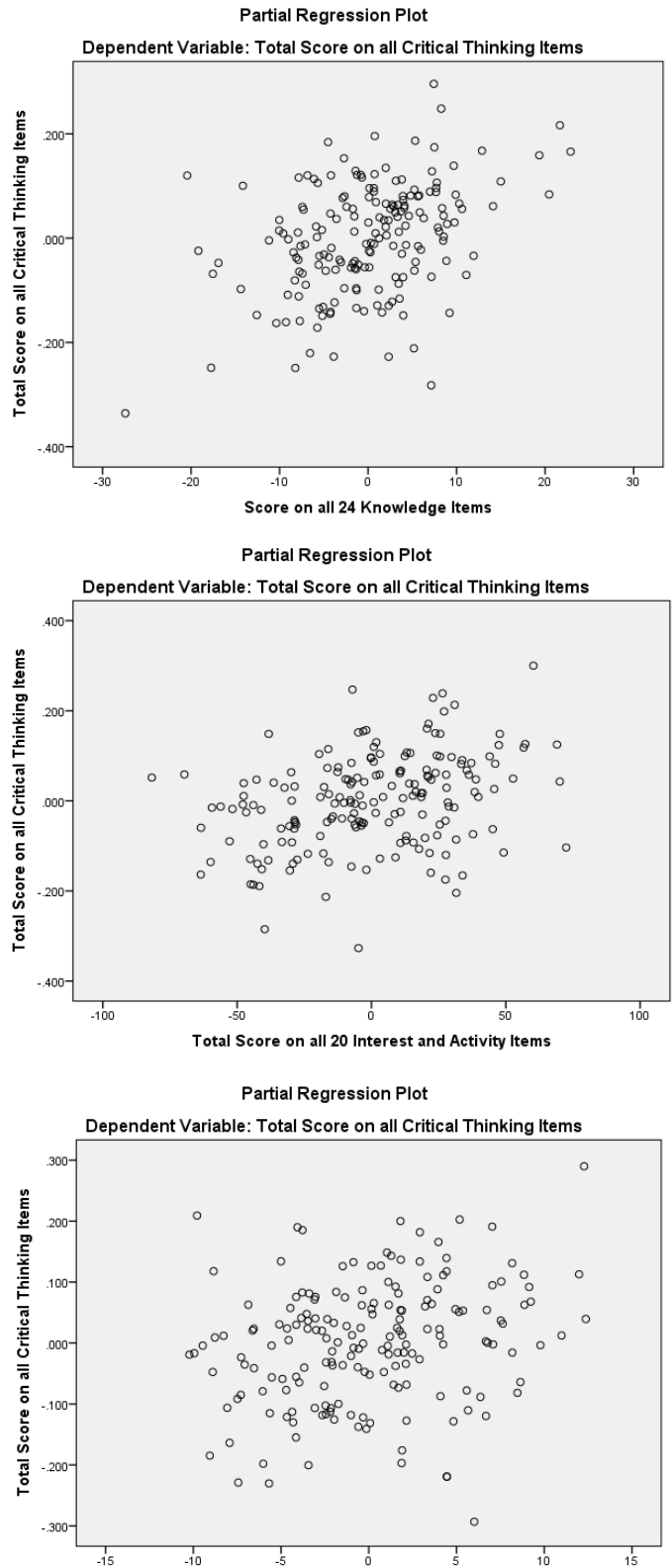
Figure 5. Partial regression plots of predictor variables
topic knowledge, individual interest, and relational reasoning with the dependent variable
critical thinking.

illustrated by partial regression plots in Figure 5. All of the individual predictors appear to have a linear relation with the dependent variable.

Homoscedasticity

The assumption of equality of variance of residuals for each level of a predictor variable was investigated by examining Figure 4. The variance appeared to be relatively equal at all levels with a rectangular shape of the points, with little difference in the spread across the predicted values, indicating homoscedasticity.

Multicollinearity

Multicollinearity was first checked by examining a correlation matrix of the variables (Table 6). Substantial correlation among the variables was demonstrated, with the exception of a trivial insignificant correlation between relational reasoning and years of experience. However, none of the variables had a correlation over .7, suggesting multicollinearity. All the correlations were positive and significant at $p < .05$ unless noted otherwise.

An overview of the correlations reveals a range of -0.09 to 0.55 (Table 6). The strongest correlation was between critical thinking and years of experience. There was also a strong correlation between critical thinking and topic knowledge, and a moderate to strong correlation between individual interest and critical thinking. There was a small correlation between critical thinking and relational reasoning. Relational reasoning also had a small correlation with topic knowledge, and a trivial insignificant correlation with years of experience. The small correlation between relational reasoning and topic knowledge was not predicted a priori. None of the correlations are in the high range (> .7- .9) that could lead to untrustworthy standard errors of b coefficients, limited R size, or

incorrect weighting of predictor importance, so the variables meet that diagnostic standard for non-multicollinearity.

Multicollinearity was also examined via the variance inflation factor (VIF) and tolerance statistics, to see if any strong linear relations were identified among the predictors (Table 7). All the tolerances were above 0.2 (range = 0.77-0.91) and all the VIFs were below 10 (range = 1.10-1.31), indicating there was no cause for concern regarding multicollinearity (Field, 2013).

Outliers

Scores that are outliers can cause bias in regression results, so outliers, leverage points, and points of influence were examined (Table 8). First, univariate extreme scores were examined via boxplots. Two possible outliers were identified. Cases within each variable that were more than two standard deviations above or below the mean were examined, and many were identified. However, since bivariate outliers are more important, standardized residuals, Studentized deleted residuals, and Mahalanobis distances were examined. Unusual cases are indicated when the standardized residual exceeds ±3.0 SDs, when the Studentized deleted residuals are above ±3.0 SDs, when the Mahalanobis distances are greater than 11.34 (the cutoff value computed for three independent variables and an N of 182), and when the leverage values are less than 3 times the average value (Field, 2013). Any persistent outlier cases were examined individually.

If the standardized residual is outside the normal range, the case may cause too much error in the model, and if the Studentized deleted residual exceeds the

Table 6

Correlation Matrix of Study Variables

	1	2	3	4	5	6	7
1. Critical Thinking	--	--	--	--	--	--	--
2. Years of Experience	.55***[a]	--	--	--	--	--	--
3. Topic Knowledge	.53***	.27***[a]	--	--	--	--	--
4. Total Individual Interest	.49***	.43***[a]	.28***	--	--	--	--
7. Relational Reasoning	.27***	.13[a]	.23**	-.08	-.04	-.09	--

Note. Correlations are Pearson unless noted.
* $p < .05$, ** $p < .01$, *** $p < .001$, two-tailed.

Table 7

Multicollinearity Statistics

Predictors	Model 1: Experience Level		Model 2: Plus Topic Knowledge and Individual Interest		Model 3: Plus Test of Relational Reasoning	
	Tolerance	VIF	Tolerance	VIF	Tolerance	VIF
Years of experience	1.00	1.00	0.78	1.27	0.77	1.29
Topic knowledge			0.89	1.13	0.84	1.19
Individual interest			0.79	1.26	0.76	1.31
Relational reasoning					0.91	1.10

Table 8

Outlier Analysis

Outlier casewise diagnostic	Meaning	Acceptable Range	Cases outside Acceptable Range
Boxplot	Univariate outlier	Any value *NOT below* Q1 – 1.5 Interquartile Range (Q3-Q1) or NOT above Q3 + 1.5 IQR.	178, 171
SD Deviation	Univariate examination whether case falls in range of 95% of values	$< \pm 2$ *SD* from Mean	TK >55 = 121, 166, 168, 297 TK < 21 = 170, 183, 202,252, 262,263 II >190.7 = 183; 208 II <59.9 = 247,252,258,260,263,270,288,298 RR >26.4 = 157,265,272 RR<5.2 = 142, 267 CT >.64 = 107,127,197,223,260,288 CT<.08 = 259,261,263,271
Standardized residual	Residuals (differences between model predicted by regression and observed in sample/error) converted to *z*-scores	$> \pm 3.0$ *SD*	223
Studentized deleted residuals	Case can be deleted and model stays the same	$> \pm 3.0$ *SD*	223
Mahalanobis distance	Distance of case from mean of predictor	For 3 predictors: >7.81 for *p*<.05 >11.34 for *p*<.01	>7.81 = 121,166,183,211,263,252,272,297,298 >11.34 = 183
Leverage	Influence of the observed value of the outcome variable over the predicted values	>2X leverage value = .044, >3X = .066	X2 = 121,183,211,252,263,272,297,298 X3 = 183
Cook's distance	Considers effect of single case on model	< 1.0	None

recommended range, the model changes if the case is deleted. There was only one case that had a standardized residual and Studentized deleted residual greater than 3.0: case 223. Upon individual case examination, participant 223 had 6 months of clinical experience, had a higher than average topic knowledge score, a lower than average individual interest score, a much higher than average relational reasoning score, and a very low critical thinking score.

Several factors were considered in evaluating this case. Given the amount of experience this participant had, a low critical thinking score was not unexpected. New nursing graduates don't always start employment in their area of passionate interest, so it is not extremely unusual for a new graduate to have a low interest in maternity nursing at this early time in her/his career. In larger samples it is not unusual to have at least one residual in this range (Tabachnick & Fidell, 2007). This case is from the smallest group, with an N of 42 (less than 10 years of experience group), compared to N of 70 for the prelicensure and more than 10 years of experience groups. These factors weakened the argument for deleting case 223. Conversely, the R^2 in the model did increase by 2% when the case was deleted. However, caution should be exerted toward case deletion when the case values make sense in context (Kline, 2005), and consideration was also given to the fact that this conceptual model is new and being tested.

Further outlier analysis was done by examining the Mahalanobis distance that indicates the distance of the case from the mean of the predictor. Leverage indicates the impact of the observed value of the case compared to the predicted value. Both the Mahalanobis distance and leverage recommended ranges were exceeded only by case 183. Participant 183 had a low topic knowledge score, the highest individual interest

score in the sample, a lower than average relational reasoning score, a very low critical

thinking score, 28 years of experience, and Cantonese as first language. However, there

was trivial change (0.9%) in the model R^2 when the case was deleted. For the final

outlier criterion, Cook's Distance was examined, which shows the influence of each case

on the outcome values, and is considered a very powerful outlier evaluation statistic

(Field, 2013). Cook's distance was checked for the benchmark of values over 1.0, and all

values were below 1.0 for the complete model (maximum = 0.098). It is therefore highly

unlikely they had any undue influence on the model. In summary, the two cases 223 and

183 did have unusual patterns of performance, but did not affect the model enough to

warrant deletion. In light of all the diagnostics, all 182 cases were retained.

Normality

In order to maximize the accuracy of the statistical tests and regression model,

normality of the data was examined both descriptively and statistically.

Descriptive examination of normality. Histograms of the data were visually

examined (Figure 6). The shapes were generally normal. Next, skewness and kurtosis

were examined.

Statistical examination of normality. The skewness and kurtosis values did not

approach positive or negative 1.0, the rule of thumb for concerning levels of skewness or

kurtosis (Osborne, 2013). Although two of the four variables had Kolmogorov-Smirnov

and Shapiro-Wilk normality statistics that were significant (Table 9), a sign of possible

non-normality, these tests are controversial for examining larger data sets, so Q-Q plots

that describe the data in relation to a normal distribution were examined (Figure 7). All

four variables were relatively close to the normal distribution line, obscuring it most of
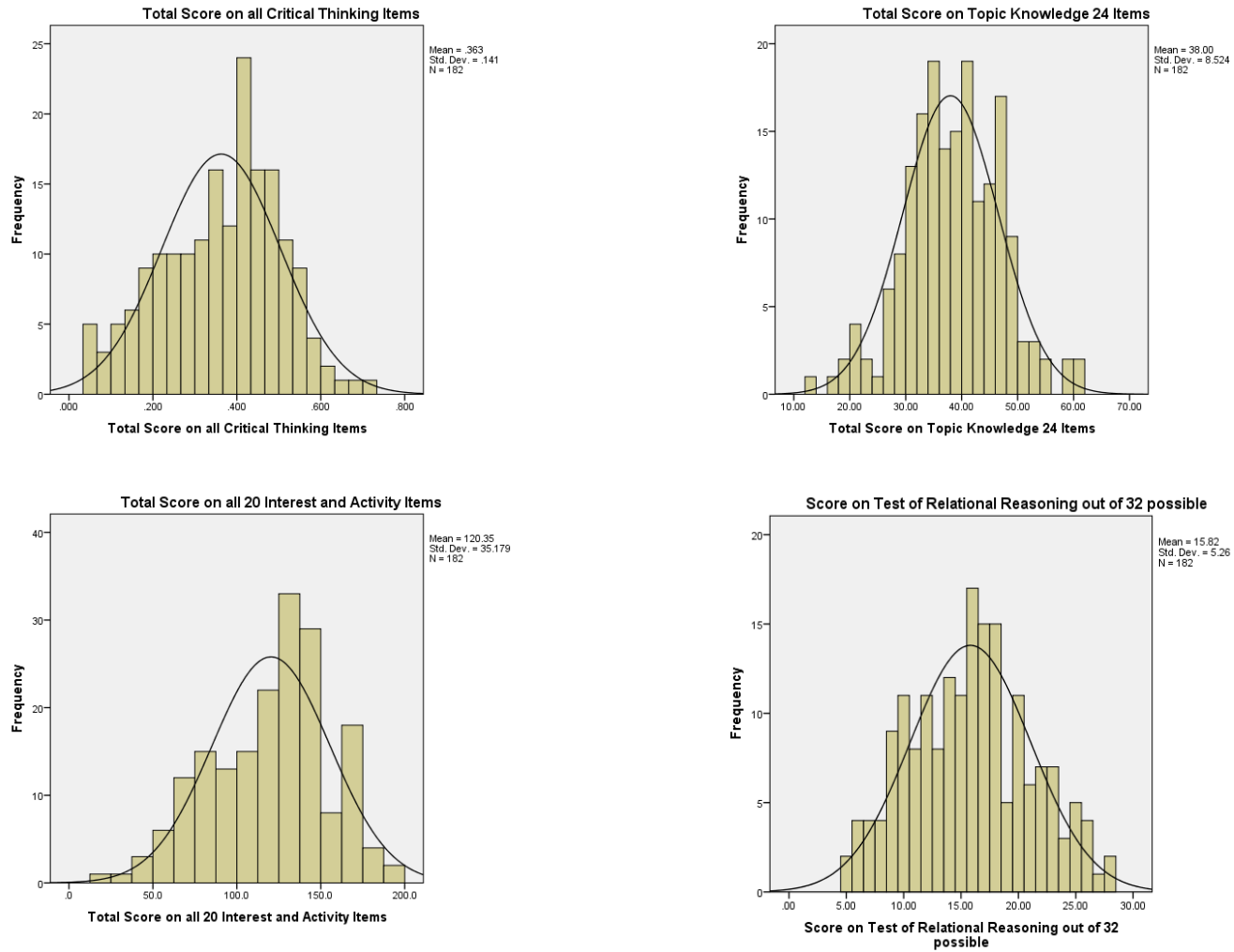
Figure 6. Histograms for examining normality of study variables.

Table 9

Skewness and Kurtosis Statistics for Study Variables

	Kolmogorov-Smirnov		Shapiro-Wilk		Skewness	Kurtosis
Variable	Statistic	Sig.	Statistic	Sig.	Statistic (*SE*)	Statistic (*SE*)
Topic Knowledge	0.06	0.20	0.99	0.39	-0.10 (0.18)	0.22 (0.36)
Individual Interest	0.08	0.01	0.98	0.01	-0.37 (0.18)	-0.36 (0.36)
Relational Reasoning	0.06	0.20	0.99	0.06	0.12 (0.18)	-0.57 (0.36)
Critical Thinking	0.07	0.02	0.98	0.03	-0.27 (0.18)	-0.43 (0.36)
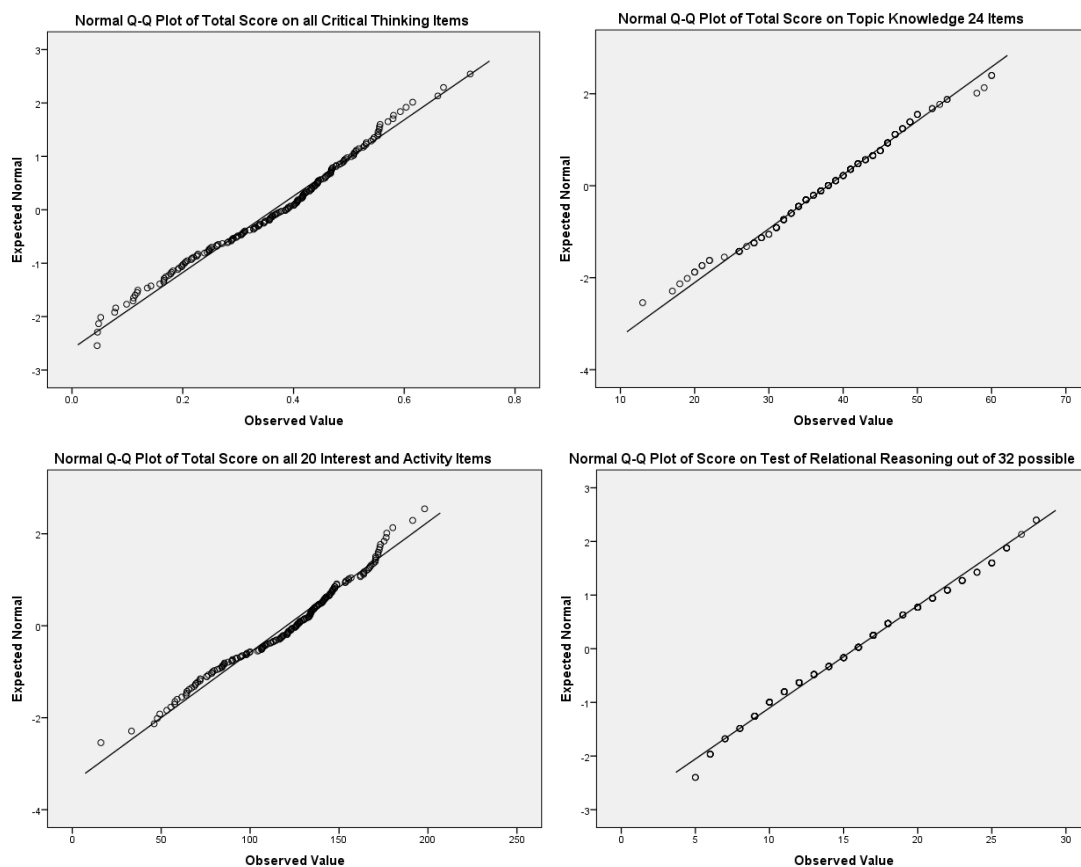
Figure 7. Q-Q plots of study variables.

the time. The residuals were deemed to have adequate normality for the analysis to

proceed.

Given the results of the data screening and data assumption checks, the data set is

deemed adequate for the types of analysis to be conducted. The next section will

examine the descriptive statistics.

Descriptive Statistics

The descriptive statistics were examined for all participants by each variable and

then by groups delineated by level of experience. First, the means, standard deviations,

and reported range for the variables topic knowledge, individual interest, relational

reasoning, and critical thinking were examined for the 182 participants (Table 10). No

ceiling or floor effects were observed for these variables.

Table 10

Descriptive Statistics of Study Variables

Variable	MAX[a]	*M* (*SD*)		%[b]
Topic Knowledge	72	38.15	(8.36)	53.0%
Individual Interest	200	120.35	(35.18)	60.2%
Relational Reasoning	32	15.82	(5.26)	49.4%
Critical Thinking	1.0	0.36	(0.14)	36.0%

[a]Maximum possible score. [b]Score as percentage of possible points

The variable mean scores were generally in the midpoint range. This is

acceptable since mean scores lower than tests given in a classroom on taught material

were expected. In addition, the topic knowledge and critical thinking open-ended

questions had keyed answers developed by a panel of experienced nursing faculty that

included *all possible* answers, so single participants would not be expected to identify all

the answers.

Specifically, the Topic Knowledge Assessment scores ranged from 13% to 83% of the possible 72 points, with a mean of 38 points, 53%. Further, the total individual interest scores from the Professed and Engaged Interest Measure ranged from 16.1 to 198.1 out of a possible 200 points, with a mean of 120.35, 60%. The mean score on the professed interest items was 80.81 out of a possible 100 points, ranging from 13.8 to 100. The mean score on the engaged interest items was 39.4 out of a possible 100 points, and had a relatively large spread of values ($SD = 23.95$). This finding is consistent with the pilot study where scores on professed interest items were much higher than scores on engaged interest items. The Test of Relational Reasoning has been calibrated. The mean of the calibrated TORR was 16.98 ($SD = 6.15$), and the mean of this sample was 15.82 ($SD = 5.26$). A normed Relational Reasoning Quotient has been derived from the Test of Relational Reasoning (RRQ: Dumas & Alexander, 2016). The RRQ has a mean of 100 and a standard deviation of 15 for ease of interpretation, with the advantage of IRT-normed scores for evaluating performance. The mean of the RRQ for this sample of nurses was 97.39 ($SD = 10.86$). Finally, the Critical Thinking Task scores ranged from 4.5% to 71.9%, with a mean of 36.4% ($SD = 0.14$).

Level of Experience and Study Variables

Next, each of the study variables was examined by level of experience for significance and effect size of the difference, and to pinpoint where the differences between levels were located, using ANOVA and post hoc tests. Previous statistical assumption checks found no heteroscedasticity. However, when assessed by Levene's Test of Homogeneity of Variance, this assumption was sometimes violated, and the group sizes were unequal in the ANOVA analysis, so the Welch F and the Games-Howell post

hoc test were used to examine the study variables by level of experience (Field, 2013).

Next, the results of these comparisons between levels of experience and individual

difference variables are described.

Topic Knowledge and Level of Experience. Total topic knowledge increased

from prelicensure, M (SD) 34.04 (7.67), to less than 10 years of experience, 39.50 (8.45),

to more than 10 years of experience, 41.46 (7.25), out of a possible 72 points (Table 11).

Topic knowledge was statistically significantly ($p< .001$) different by level of experience,

Welch's F (2, 17.73). With Welch's F, the df are reported from the Robust Equality of

Means table with within-groups degrees of freedom reported. The effect size of the

difference was large, per Cohen's effect size benchmarks of η^2 of small = .01, medium =

.06, and large = .14 (1988).

The post hoc tests revealed that the increase in total topic knowledge from

prelicensure to less than 10 years [5.46, 95% CI (1.65, 9.26)] was statistically significant

($p = .003$), as well as the increase from prelicensure to more than 10 years [7.41, 95% CI

(4.43, 10.40)], at a significance level of $p< .001$. However, the positive difference in

topic knowledge between less than 10 years and more than 10 years of experience levels

[1.96, 95% CI (-1.79, 5.70)] was not statistically significant. This "prelicensure effect"

pattern, where the difference was significant between prelicensure and practicing nurses

but not between the two levels of practicing nurses, was the most commonly seen pattern

of differences.

The subcategories of topic knowledge were also examined by level of experience

to determine if level of experience was a significant delimiter for these variables (Table

12). For each of the 12 maternity nursing terms, participants defined the term and then

Table 11

Means, Standard Deviations, and One-Way Analyses of Variance for the Effects of Level of Experience on All Study Variables

	All Participants	Level of Experience				
		Prelicensure	Less than 10 Years	10 or More Years		
	$(N = 182)$	$(N = 70)$	$(N = 42)$	$(N = 70)$		
Variable	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*	*F*	η^2
Topic Knowledge	38.15 (8.36)	34.04 (7.67)$_a$	39.50 (8.45)$_b$	41.46 (7.25)$_b$	17.73***	.16
Individual Interest	120.35 (35.18)	98.65 (35.70)$_a$	129.93 (24.57)$_b$	136.28 (28.67)$_b$	25.13***	.24
Relational Reasoning	15.82 (5.26)	15.30 (5.53)	14.98 (5.77)	16.84 (4.52)	2.42	.02
Critical Thinking	0.36 (0.14)	0.25 (0.11)$_a$	0.38 (0.12)$_b$	0.46 (0.09)$_c$	74.81***	.44

Note: Means in a row sharing subscripts are not significantly different from each other.
***$p< .001$, two-taile

Table 12

Means, Standard Deviations, and One-Way Analyses of Variance for the Effects of Level of Experience on Topic Knowledge

Variables

Topic Knowledge	All Participants ($N = 182$) M (SD)	Level of Experience			F	η^2
		Prelicensure ($N = 70$) M (SD)	Less than 10 Years ($N = 42$) M (SD)	10 or More Years ($N = 70$) M (SD)		
Knowledge Total	38.15 (8.36)	34.04 (7.67)$_a$	39.50 (8.45)$_b$	41.46 (7.25)$_b$	17.73***	.16
Definitions/Importance						
All definitions	19.43 (4.69)	17.64 (4.22)$_a$	19.81 (5.08)$_{ab}$	21.00 (4.32)$_b$	10.93***	.10
All importance	18.72 (4.49)	16.40 (4.24)$_a$	19.69 (4.14)$_b$	20.46 (3.94)$_b$	18.26***	.17
Knowledge Topics						
Newborn	5.79 (2.30)	5.10 (2.01)$_a$	6.02 (2.82)$_{ab}$	6.34 (2.08)$_b$	6.67**	.06
Birth	4.95 (1.90)	3.99 (1.37)$_a$	5.02 (2.03)$_b$	5.86 (1.84)$_b$	23.71***	.19
Breastfeeding	7.61 (1.61)	7.07 (1.73)$_a$	7.90 (1.61)$_b$	7.97 (1.35)$_b$	6.33**	.07
Postpartum	6.71 (1.83)	6.27 (2.01)$_a$	6.83 (1.82)$_{ab}$	7.09 (1.56)$_b$	3.57*	.04
Pregnancy	6.55 (1.94)	6.69 (1.91)$_a$	6.38 (2.02)$_a$	6.53 (1.94)$_a$	0.32	.004
Professional issues	6.54 (2.32)	4.93 (2.29)$_a$	7.33 (1.92)$_b$	7.67 (1.53)$_b$	35.59***	.31

Note: Means in a row sharing subscripts are not significantly different from each other.

* $p < .05$, two-tailed , ** $p < .01$, two-tailed, ***$p < .001$.

described the importance of the term. The prelicensure effect was present for the differences between definitions at each level and the importance scores for each level. Although the possible score was the same for both definitions and importance (36), the mean was lower for students on the importance scores.

The topic subcategories of topic knowledge were newborn, birth, breastfeeding, postpartum, pregnancy, and professional issues, and these were also examined by level of experience to determine if it was a delimiter (Table 12). The highest mean score was in the breastfeeding topic area. This is a key public health initiative and is commonly taught in both nursing education and continuing education for maternity nurses (Radzyminski & Callister, 2015; U.S. Breastfeeding Committee, 2015). The lowest score was in the birth topic area. One of the terms is a new term to nursing practice: physiologic management of labor (Hanson & VandeVusse, 2014). The scores were noticeably low on the definition and importance for this term but higher for the other birth term, electronic fetal monitoring, which has been a common intervention for decades in maternity care (Albers & Krulewitch, 1993).

Post hoc tests showed that the aforementioned "prelicensure effect" pattern, where the difference was significant between prelicensure and practicing nurses but not between the two levels of practicing nurses, was repeated for total topic knowledge and for birth, breastfeeding, and professional issues. For the newborn and postpartum topics, the prelicensure level was statistically different from more than 10 years but not less than 10 years ($p < .05$). This "slow-grow" effect, where only the difference between prelicensure nurses and the most experienced nurses is significant, is the second most common pattern. For the pregnancy topic there was negligible effect size and no

statistical significance (*p*> .05) for the group differences. Practicing maternity nurses do not have exposure to early pregnancy patients as these women are usually managed in the emergency room. Hence, their knowledge on the pregnancy topic would not be expected to be as current as their knowledge in other areas.

Individual Interest and Level of Experience. The mean for total individual interest increased from prelicensure [*N* = 70, *M* = 98.65 (*SD* = 35.70)] to less than 10 years of experience [*N* = 42, *M* = 129.93 (*SD* = 24.57)] to more than 10 years of experience [*N* = 70, *M* = 136.28 (*SD* = 28.67)], out of a possible score of 200. The differences were statistically significant (*p*< .001) for different levels of experience groups, Welch's *F* (2, 25.13). The differences between levels of experience on total individual interest were statistically significant (*p*< .001) with a medium large effect size (Table 11).

To examine these differences more closely, a Games-Howell post hoc test was conducted. The prelicensure effect was present for the total individual interest. The increase in total individual interest from prelicensure to less than 10 years [31.28, 95% CI (17.72, 44.84)] was statistically significant (*p* = .002), as was the increase from prelicensure to more than 10 years [37.63, 95% CI (24.66, 50.61)], at a significance level of *p*< .001. However, the positive difference in total individual interest between the less than 10 years and more than 10 years of experience levels [6.35, 95% CI (-5.81, 18.52)] was not statistically significant.

Relational Reasoning and Level of Experience. The descriptive statistics reveal that the mean score for the TORR and its four subscales decrease from the prelicensure to the less than 10 years level, with the highest mean for the nurses with more than 10 years

of experience (Table 13). However, the effect size of these differences is small and not statistically significant (range $\eta^2 = .009\text{-}.03$). Since the TORR is a measure of domain-general relational reasoning, it was not expected that the level would increase over time in a professional domain. In addition, there is no specific education in relational reasoning in maternity nursing.

There were no significant differences in the RRQ by level of experience (p>.05) (Table 14). A derivative variable of the RRQ, Relational Reasoning Quotient Level, has 3 levels. The low level is scores equal to or below 85 (one standard deviation below 100, the normed average); the medium level is scores from 86 to 114; and the high level scores are 115 and higher (one standard deviation above 100, the normed average). Table 14 shows the frequency of participants by level of experience in each of the levels of RRQ. Very few participants were in the high level of the RRQ (6.6%), and the nurses with 10 or more years of experience had the fewest scores in the low range (10%). A chi-square test indicated no significant association between level of experience and level of RRQ, χ^2 (4, n = 182) = 5.74, $p > .05$, $phi = .18$.

Critical Thinking and Level of Experience. The descriptive statistics and ANOVA for the final study variable, critical thinking, are displayed in Table 11. The total critical thinking score had a mean percentage score of .36 ($SD = 0.24$). For prelicensure student nurses the mean percentage score was .25 ($SD = 0.11$); for nurses with less than 10 years of experience, the mean percentage score was .39 ($SD = 0.11$);

Table 13

Means, Standard Deviations, and One-Way Analyses of Variance for the Effects of Level of Experience on Relational Reasoning Variables

| | All Participants (N = 182) M (SD) | Level of Experience | | | | |
| | | Prelicensure (N = 70) M (SD) | Less than 10 Years (N = 42) M (SD) | 10 or More Years (N = 70) M (SD) | F | η^2 |
Variable						
TORR score	15.82 (5.26)	15.30 (5.53)	14.98 (5.77)	16.84 (4.52)	2.42	.02
Analogy	3.51 (1.88)	3.21 (2.11)	3.55 (1.93)	3.79 (1.57)	1.65	.02
Anomaly	3.87 (1.86)	3.84 (1.85)	3.57 (1.94)	4.07 (1.81)	0.93	.01
Antinomy	4.18 (1.86)	4.17 (1.92)	3.64 (1.83)	4.51 (1.78)	3.02	.03
Antithesis	4.26 (1.85)	4.07 (1.96)	4.21 (1.91)	4.47 (1.71)	0.86	.009
RRQ	97.30 (10.83)	96.33 (11.41)	95.22 (11.73)	99.50 (9.36)	2.25	.02

Table 14

Frequencies by Level of Experience for Relational Reasoning Quotient Levels from Low to High

RRQ Level	All (N = 181) Frequency (%)	Prelicensure (N = 70) Frequency (%)	Less than 10 years (N = 41) Frequency (%)	10 or more years (N = 70) Frequency (%)
Low	34 (18.8)	17 (24.3)	10 (24.4)	7 (10)
Medium	135 (74.6)	49 (70.0)	28 (68.3)	58 (82.9)
High	12 (6.6)	4 (5.7)	3 (7.3)	5 (7.1)

and the total critical thinking score was .46 ($SD = 0.09$) for nurses with greater than or equal to 10 years of experience. When examined with a one-way ANOVA, this difference was statistically significant (Welch's F (2, 99.01) = 74.81, $p<.001$, and the effect size was large. This is consistent with the theoretical framework that critical thinking, an important component of expertise, would increase across the professional lifespan.

These findings provide support for including experience in the study model, since it might function as a confounder. Placing years of experience in step 1 of the hierarchical regression will enable any variance in critical thinking that it explains to be separated out from the other independent variables (Pedhazur & Schmelkin, 1991).

In summary, the descriptive statistics for the four major variables by level of experience are reported in Figure 8. Expected increases in topic knowledge, individual interest, and critical thinking were seen, but not in the domain-general measure of relational reasoning across levels of experience. Which of the three groups were similar varied in a statistically significant manner by variable. Statistically significant differences between the levels were seen for topic knowledge, individual interest, and critical thinking ($p< .001$), but not for relational reasoning. Exactly where the differences by level were located varied for each construct. These data provide evidence of adequate variability in the data set and viability of including experience as a variable in the regression. The next sections will describe the results of the analysis of the research questions.
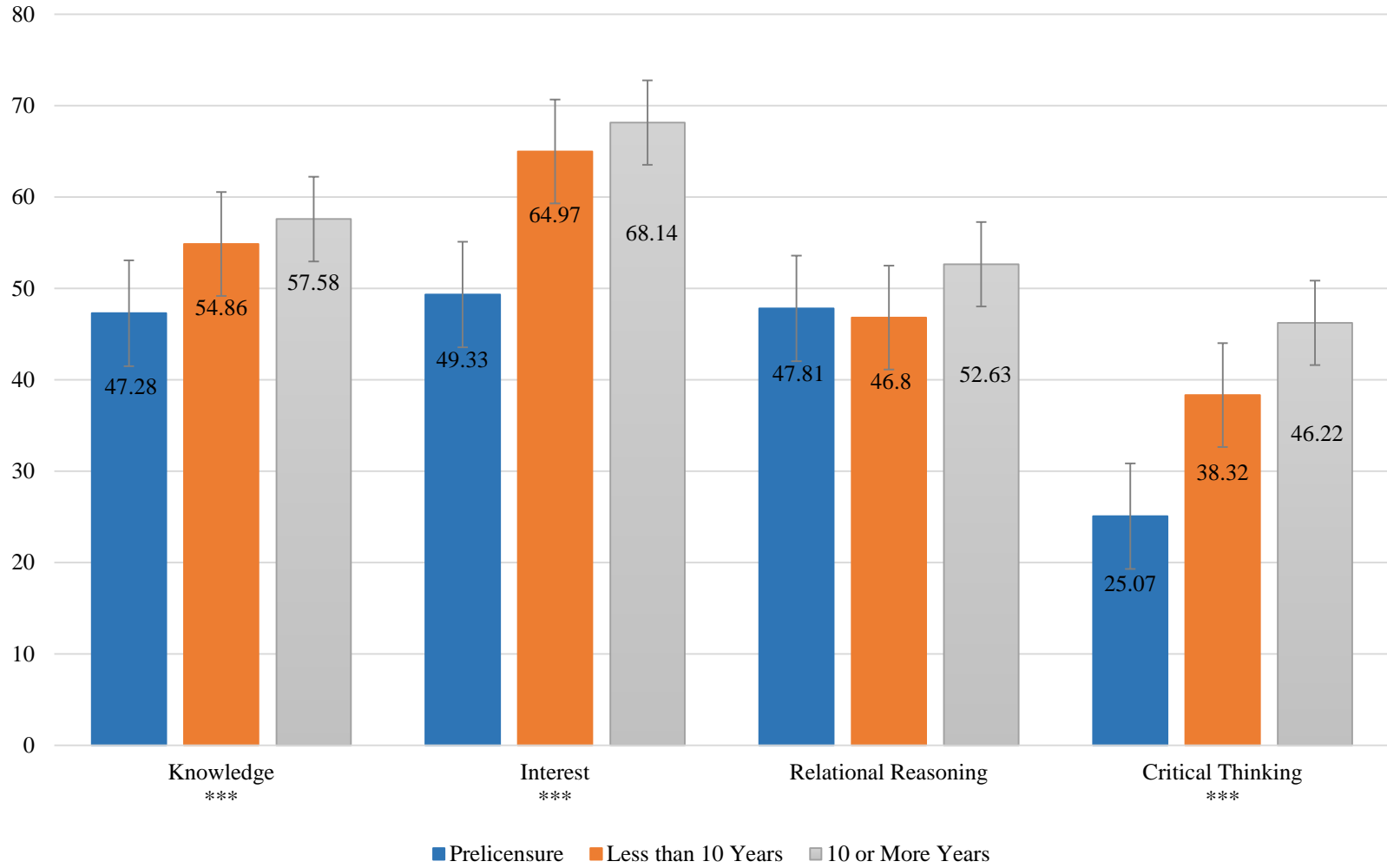
Figure 8. Percent correct on study variables by level of experience with standard error bars.

Research Question 1:

Correlation of Topic Knowledge and Individual Interest

To answer the first research question about the relation between topic knowledge and individual interest, a Pearson's product-moment correlation was run to assess the relation between the two variables (Table 6). There was a small to medium correlation between topic knowledge and total individual interest [$r(180) = .29$, $p< .001$], with each explaining 8.4% of the variation in the other variable. This correlation is consistent with the a priori prediction and similar to that seen in prior research ($r =.29$, $p< .05$; Alexander et al., 1995). This finding provides further evidence that topic knowledge and individual interest have a significant positive relation with each other.

A supplemental analysis of the correlation between topic knowledge and individual interest by level of experience was therefore performed. The data file was split into the three levels of experience and the Pearson correlation between the two variables was executed. The correlation at each level was as follows: prelicensure $r = .25$ ($p< .05$); less than 10 years of experience, $r = .03$; greater than 10 years of experience, $r = -0.04$. However, the Fisher z test of differences between these correlations was not statistically significant for the prelicensure and less than 10 years groups, ($z = 1.12$, $p = .13$), nor for the prelicensure and more than 10 years groups ($z = 1.25$, $p = .11$).

Research Question 2:

Regression of Critical Thinking on Topic Knowledge and Individual Interest

To answer the second research question, examining the extent to which topic knowledge and individual interest predict critical thinking in nurses, a multiple regression was first conducted using SPSS. The predictors were topic knowledge and individual

interest, measured with 24 short-answer questions and 20 VAS items. The outcome variable was critical thinking as measured by CT^2MN, a maternity nursing case followed by questions typical in nursing care plans and corresponding to components of critical thinking such as linking to evidence, and predicting outcomes.

Multiple Regression of Critical Thinking on Topic Knowledge and Individual Interest

The regression model predicting critical thinking based on topic knowledge and individual interest (Table 15) was significant [$F(2,179) = 62.$, $p< .001$], with an R^2 of 0.41, explaining 41% of the variance in critical thinking. Topic knowledge individually was a significant predictor of critical thinking [$B = 0.007$, $SE (B) = 0.001$, $\beta = 0.43$, $p <.001$], uniquely explaining 16.8% of the variance in critical thinking. Individual interest was also a significant predictor of critical thinking [$B = 0.001$, $SE (B) = 0.000$, $\beta = 0.37$, $p< .001$], explaining 13.0 % of the variance in critical thinking.

Table 15
Multiple Regression of Critical Thinking on Topic Knowledge and Individual Interest

Variable	B	$SE\ B$	B	t	sr
Topic Knowledge	0.007	0.001	0.43	7.18***	0.41
Individual Interest	0.001	0.000	0.37	6.18***	0.36

Note: DV: Critical Thinking, $R^2 = 0.41$. B = raw regression coefficient, $SE\ B$ = standard error of B, B = standardized regression coefficient, sr = semipartial correlation
***$p<.001$

Hierarchical Regression of Critical Thinking on Level of Experience, and Topic Knowledge and Individual Interest

This finding is consistent with initial predictions. However, given the prominent role of experience in previous nursing studies of the development of expertise, the role of

years of experience as a predictor of critical thinking was examined using hierarchical

regression analysis. Table 16 presents a summary of this hierarchical regression model.

The model predicting critical thinking based on years of experience alone was significant

[$R^2 = 0.30$, $F(2, 178) = 76.63$, $p<.001$], explaining 30% of the variance in critical

thinking. Step 2 of the model with level of experience, topic knowledge, and individual

interest as predictors offered a significant improvement in fit over predicting critical

thinking via level of experience alone [$(R^2 = 0.50)$, $\Delta R^2 = 0.20$, $\Delta F(2, 178) = 35.81$, $p<$

.001]. In this model, topic knowledge uniquely explained 12.3% of the variance in

critical thinking, and individual interest uniquely explained 4.8% of the variance.

Table 16

Hierarchical Regression of Critical Thinking on Years of Experience, Topic Knowledge

and Individual Interest

Variable	B	SE B	CI	β	T	sr
Step 1: Years of Experience	0.006	0.001	[0.005-0.008]	.55	8.75***	.55
Step 2: Individual Differences						
Topic Knowledge	0.006	0.001	[0.004-0.008]	.37	6.56***	.35
Individual Interest	0.001	0.000	[0.001-0.001]	.24	4.07***	.22

Note: DV: Critical Thinking, Step 1 R^2 = .30***; Step 2 R^2 = 0.50***. *B* = raw
regression coefficient, *SE B* = standard error or *B*, CI = confidence interval for *B,* β=
standardized regression coefficient, *sr* = semipartial correlation.
 ***$p< .001$

Although years of experience was used as a variable in step one of the

hierarchical regression, several other demographic and professional characteristics

variables also had moderate correlations with critical thinking in this study. Therefore, a

supplementary hierarchical regression analysis was conducted that was identical to the

one conducted for Research Question 2, with 5 demographic and professional

characteristic variables entered instead of just years of experience. Step one was composed of years of experience, age, highest education level, specialized maternity education, and self-rated competence. Step two added topic knowledge and individual interest, and step three included relational reasoning. The explanatory power increased 2% from 53% to 55%. Therefore, based on previous literature and these findings, only years of experience was retained as a variable.

In summary, the addition of years of experience increased the explanation of variance in critical thinking from 41% to 50%. Topic knowledge and individual interest contributed a significant amount of variance explanation even when years of experience were entered in the first step. This is congruent with the MDL in demonstrating an increase in the critical thinking aspect of domain expertise across the professional lifespan.

Research Question 3:

Adding Relational Reasoning to the Hierarchical Regression

Prior to examining the additive predictive power of relational reasoning to the conceptual model, collinearity between the constructs of relational reasoning and critical thinking was tested. In order to check for possible overlap between the relational reasoning construct as measured by the Test of Relational Reasoning (TORR) and critical thinking as measured by the Critical Thinking Task (CT^2MN), a correlation analysis was performed (Table 17). The correlation between total relational reasoning and total critical thinking was found to be low ($r = .29$, $p < .001$), indicating that the two measures were sufficiently different in the content and processes they assessed. Therefore, it was determined that the regression analysis could proceed.

Table 17

Correlation Matrix among Critical Thinking and Relational Reasoning Variables

Variables	Total Relational Reasoning (RR)	RR Analogy	RR Anomaly	RR Antinomy	RR Antithesis	Total Critical Thinking (CT)
Total Relational Reasoning (RR)	--	--	--	--	--	--
RR Analogy	$.76^{**}$	--	--	--	--	--
RR Anomaly	$.70^{**}$	$.41^{**}$	--	--	--	--
RR Antinomy	$.67^{**}$	$.33^{**}$	$.30^{**}$	--	--	--
RR Antithesis	$.69^{**}$	$.40^{**}$	$.27^{**}$	$.28^{**}$	--	--
Total Critical Thinking (CT)	$.27^{**}$	$.25^{**}$	$.16^{*}$	$.10$	$.24^{**}$	--

In order to ascertain the degree to which relational reasoning predicted critical thinking in nurses above and beyond topic knowledge and individual interest, the scores for the TORR were entered as a final step to the hierarchical regression. Relational reasoning contributed a small but statistically significant amount of change to the model's explanatory power $[R^2 = 0.53, \Delta R^2 = 0.028, \Delta F(4, 177) = 10.32, p < .01]$. In effect, the full model with years of experience, topic knowledge, individual interest, and relational reasoning provided a significant improvement over Step 2. The three models are summarized in Table 18. The full model (Figure 9) with years of experience ($\beta = .31$) and independent variables topic knowledge ($\beta = .33$), individual interest ($\beta = .28$), and relational reasoning ($\beta = .17$), explained 53% of the variance in critical thinking, and was significant $[F (4,177) = 49.38, p < .001]$. Thus, in answer to Research Question 3, relational reasoning improved the model's explanation of the variance in critical thinking. To be more precise, all three independent variables were significant predictors ($p < .001$); topic knowledge uniquely contributed 9.0%, individual interest contributed 5.8%, and relational reasoning uniquely explained 2.9% of the variance in critical thinking.

It was predicted a priori that topic knowledge and individual interest would explain variation in critical thinking. The findings support this prediction, and were statistically significant with a large effect size. This is also consistent with this study's theoretical framework, which depicts topic knowledge, individual interest, and strategic processes as the drivers of expertise development across the professional lifespan.

Table 18

Hierarchical Regression of Critical Thinking on Years of Experience, Topic Knowledge, Individual Interest, and Relational Reasoning

Predictor	R^2	ΔR^2	B	SE B	CI	β	T	sr
Step 1: Years of Experience	.30***	. 30	0.006	0.001	[0.005-0.008]	.55	8.75***	.55
Step 2: Add Individual Differences	.50***	.20						
Years of Experience			0.004	0.001	[0.003-0.005]	.34	5.68***	.30
Topic Knowledge			0.006	0.001	[0.004-0.008]	.37	6.56***	.35
Individual Interest			0.001	0.000	[0.001-0.001]	.24	4.07***	.22
Step 3: Add Relational Reasoning	.53***	.028						
Years of Experience			0.004	0.001	[0.002-0.005]	.31	5.32***	.28
Topic Knowledge			0.006	0.001	[0.004-0.007]	.33	5.77***	.30
Individual Interest			0.001	0.000	[0.001-0.002]	.28	4.72***	.24
Test of Relational Reasoning			0.005	0.001	[0.002-0.008]	.18	3.21**	.17

Note: DV = Critical Thinking. *B* = raw regression coefficient, *SE B* = standard error or *B*, CI = confidence interval for *B*, β = standardized regression coefficient, *sr* = semipartial correlation.
***$p<.001$
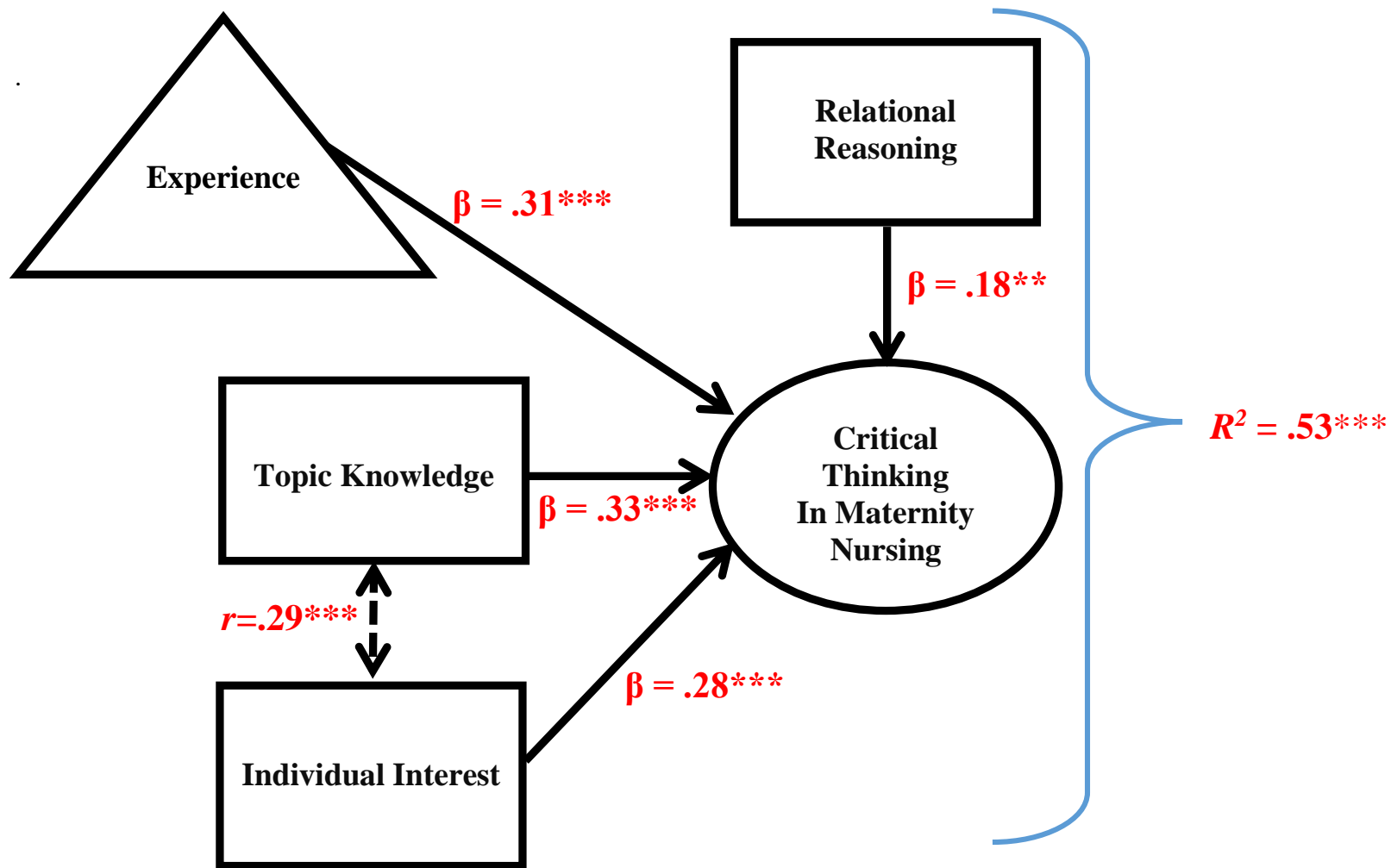
Figure 9: Full model of relations among topic knowledge, individual interest, relational reasoning, and critical thinking in maternity nurses controlling for years of experience.
The R^2 is for the full model.

CHAPTER 5:

SUMMARY, LIMITATIONS, AND IMPLICATIONS

Individual Differences and Critical Thinking

The purpose of this study was to examine the relations among maternity nurses'

topic knowledge, individual interest, relational reasoning, and critical thinking. The

Model of Domain Learning (MDL) was the theory used to frame the study (Figure 1).

The research questions included the relation between topic knowledge and individual

interest; the extent to which topic knowledge and individual interest predict critical

thinking; and, the additional explanatory power of relational reasoning. To analyze these

relations, correlation, ANOVA, principal components analysis, and regression analyses

were used to study data from 182 practicing and prelicensure maternity nurses in the US,

recruited from professional listservs. The study participants were tasked with a short-

answer maternity topic knowledge assessment, a measure of interest and activities in

maternity nursing, a test of domain-general relational reasoning, and a maternity case-

based critical thinking task. All measures were administered online.

This final chapter begins with a summary and interpretation of the key findings of

the study. The functioning of the theoretical model is discussed in the context of these

findings. Limitations of the study are presented, and lastly, implications for theory,

research, and practice are considered.

Key Findings

The key findings of this study can be summarized as follows:

- This study established the construction of a psychometrically sound, precise, and domain-specific measure of critical thinking suitable for maternity nurses at different levels of experience.

- Topic knowledge and individual interest were positively related.

- Topic knowledge and individual interest were strong contributors to critical thinking.

- Relational reasoning was a significant contributor to critical thinking above and beyond topic knowledge, years of experience, and individual interest.

- The full model of topic knowledge, individual interest, and relational reasoning, along with the non-modifiable variable years of experience, explains over half of the variation in critical thinking.

Improved Measurement of Critical Thinking

Critical thinking has been identified as a crucial goal for health professionals (Institute of Medicine, 2010), yet few measures have looked deeply and broadly at critical thinking in nursing. Most of the previous research used domain-general measures of critical thinking such as the California Critical Thinking Skills Test (Facione & Facione, 1994) and the Watson-Glaser Critical Thinking Skills Appraisal (Watson & Glaser, 1980). Studies using these measures have had inconsistent findings for nursing (Huber & Kuncel, 2015; Walsh & Seldomridge, 2006a). Very few domain-specific measures were located (Tanner, 2006; Waltz & Jenkins, 2001). Further, teacher or researcher-made instruments have sometimes been domain-specific, but often the conceptualization did not match the measurement in studies of critical thinking (Fountain, 2016). Thus, in this study, the goal was to develop a psychometrically-sound, domain-

specific measure of critical thinking, systematically based on a definition derived through a Delphi study within the nursing profession (Scheffer & Rubenfeld, 2000). The components of this definition were the cognitive processes of analyzing, applying standards, discriminating, information seeking, logical reasoning, predicting, and transforming knowledge (Scheffer & Rubenfeld, 2000).

The measure used in this study was pilot tested and refined. It was composed of a case scenario about a woman in labor with standard follow-up questions, and paralleled case-based education in which nurses regularly engage. The validity of the measure was also confirmed by the correspondence between the measure and rubrics for nursing plans of care, a central analysis tool in the education of nurses across the country. Excellent interrater agreement was demonstrated. In addition, although most previous studies examined participants at a single level of experience, usually prelicensure, new graduate, or expert nurses, the measure of critical thinking in this study was successfully used with participants at multiple levels of professional experience.

Further, the psychometrics of the measures were a strength of this study. The data from the Topic Knowledge Assessment were assessed for interrater agreement, which was found to be high. Cohen's κ or another chance-corrected reliability measure was deemed unnecessary due to the technical and detailed nature of the key (see Appendix I), rendering it highly unlikely that ratings were due to chance (Gwet, 2014). The topic knowledge data demonstrated content validity as evidenced by the agreement of the panel of experienced nursing faculty on the topics included and the keyed answers.

For the Professed and Engaged Interest Measure, high internal consistency was demonstrated for the instrument. In addition to the face validity for the self-reported

passion for maternity nursing topics and engagement in professional activities, the

agreement of the experienced nursing faculty on the revised items provided evidence of

content validity. Further, content validity evidence was provided by determining the

topic categories (i.e., pregnancy, birth, postpartum, newborn, breastfeeding and

professional issues) on the basis of a review of the top five maternity nursing textbooks.

The Test of Relational Reasoning demonstrated a Cronbach's α similar to

previous studies and above the recommended level (Alexander et al., 2016; Dumas et al.,

2014). In addition, previous research with the TORR demonstrated test-retest stability

and internal consistency. Earlier TORR data also demonstrated predictive validity for the

prediction of the SAT math and verbal, and the expected range of correlation for

convergent validity with a similar measure that measured one type of relational reasoning

(Dumas & Alexander, 2016).

The Critical Thinking Task data had very high interrater agreement and high

internal validity. Discriminant validity was examined in the correlation matrix between

critical thinking and relational reasoning (Table 17). As indicated, the correlations

between critical thinking and the relational reasoning scales indicated a good level of

discriminant validity (i.e., low correlations between critical thinking and relational

reasoning variables), as was expected. Evidence for content validity was provided by the

agreement of the panel of experienced nursing faculty on the key, and the congruence on

the questions used to follow up the case study in nursing care plans as demonstrated by a

check of national nursing curricula and textbooks. Overall, the independent and

dependent variables demonstrated a low level of measurement error (Field, 2013;

Hancock & Mueller, 2010).

Covarying Relation between Topic Knowledge and Individual Interest

In addition to offering a solution to some of the problems in the measurement of critical thinking in nursing, this study had a key finding relating to an area of scarce research, namely the covarying relation between two constructs relating to critical thinking, topic knowledge and individual interest. Topic knowledge and individual interest had statistically significant positive correlations, as expected, and the relation had an effect size similar to previous studies in other domains (Alexander et al., 1995). Examining the interaction of cognitive factors with motivational factors is essential to understanding academic achievement (Lawless & Kulikowich, 2006; Winne & Nesbit, 2010). The cognitive factor *conceptual knowledge* has been a mainstay of teaching, and has been found to have a covarying relation with the motivational factor *individual interest* (Alexander et al., 1995). The deliberate alignment of the topics for the interest and knowledge measures may have contributed to the confirmation of the positive relation between topic knowledge and individual interest.

The mean of topic knowledge showed an increase across the levels of experience, and the increase was statistically significant between prelicensure and practicing nurses. The theoretical framework for this study, the MDL, predicts an increase in topic knowledge over the course of domain expertise development. Although current research clearly documents that experience is not equivalent to expertise (Ericson, Whyte, & Ward, 2007), relative expertise was demonstrated by the variability in topic knowledge from the prelicensure to practicing nurse levels. As the level of experience of nurses increased, a small, non-statistically significant difference was seen. This minimal, non-significant difference in topic knowledge between the two levels of practicing maternity

nurses was a surprise finding. For the overall pattern of topic knowledge across the nursing career or professional lifespan, there may be a horizontal asymptote or limit for declarative knowledge. Acclimating students might have a fairly high level of conceptual knowledge as required by the licensing exam. Conceptual knowledge has been found to support and lead to procedural knowledge in other domains (Rittle-Johnson, Schneider, & Star, 2015). The conceptual knowledge captured by the measure does not address increasing conditional and procedural knowledge that develops as more experienced nurses contextualize nursing care to the patient and environment (Alexander et al., 1991; Ericsson, White, & Ward, 2007).

With respect to individual interest, the mean was slightly lower for the most experienced nurses, but this difference was not statistically significant. As discussed in the literature review of interest in maternity nursing, passion for the profession is high for many nurses. These results are consistent with the MDL, which predicts an increase in individual interest from the prelicensure to practicing nurse stages of professional development.

The high levels of interest might be indicative that the nurses are, in fact, being very honest about their strong passion for maternity nursing. Alternatively, the lower scores on items about participation in maternity nursing activities by prelicensure nurses might arise because such activities are impractical while in school. Another confounder could be the types of student nurses who responded to the call for this study; students who belong to the National Student Nurse Association listserv may have a higher passion for maternity nursing than other student nurses or differ in other ways that resulted in high scores on professed interest items. Other studies have noted lower levels of

enthusiasm in practicing nurses (Aiken, Clarke, Sloane, Sochalski, & Silber, 2002). However, this was not demonstrated in this sample, although the most experienced nurses had a non-significant, slightly lower mean on professed interest items compared to nurses with less than 10 years of experience.

Topic Knowledge and Individual Interest Predict Critical Thinking

In addition to their covarying relation with each other, topic knowledge and individual interest were found to be strong contributors to critical thinking. However, they have seldom been included as predictors in previous studies of critical thinking in nursing (e.g., Sorensen & Yankech, 2008). These two variables explained a large percentage of the variation in critical thinking. This percentage increased when years of experience was added. The strongest unique predictor was topic knowledge, followed by years of experience, followed by individual interest. This provides evidence that topic knowledge should be included in studies of critical thinking for its strong predictive value. Previous studies of thinking strategies have noted the importance of topic knowledge, but often did not include it as a variable (e.g., Göransson et al., 2007). This also might partially explain why domain-general measures of critical thinking in nursing have had inconsistent results.

One of the most notable findings of this study was the strong performance of individual interest as a predictor of critical thinking. General education literature documents the contribution of individual interest to learning outcomes (Wentzel, Wigfield, & Miele, 2009). In nursing, interest, in the form of commitment, was found to be one of the most frequent contributors to successful patient care in Zhang et al.'s think-alouds by experienced nurses (Zhang, Luk, Arthur, & Wong, 2001). However, few

studies of critical thinking in nursing include individual interest as a variable. Much of the critical thinking research in nursing has used a domain-general measure of interest, such as the California Critical Thinking Skills Disposition Inventory (Facione, Sanchez, Facione, & Gainen, 1995), which asks questions such as, "We can never really learn the truth about most things." Studies using this standardized domain-general measure of dispositions had inconsistent but overall positive effects on performance. In this study, the conceptualization and measurement of individual interest led to improved prediction of critical thinking.

In addition to the predictors topic knowledge and individual interest, years of experience was included in order to study any confounding effect on critical thinking, based on previous research on performance in nursing (Ericsson et al., 2007; Pedhazur & Schmelkin, 1991). Although expertise was once equated with experience in prior nursing research, modern nursing expertise researchers find years of experience alone a poor predictor of critical thinking performance (Sitterding, Broome, Everett, & Ebright, 2012). This study's finding coincides with this research, which found that experience does not necessarily predict non-self-reported measures of competence (Ericsson et al., 2007). Overall, in this study, topic knowledge and individual interest were significant predictors of critical thinking.

Relational Reasoning Contributes to Critical Thinking

In addition to topic knowledge and individual interest, this study found that a third individual difference factor, relational reasoning, was a significant contributor to critical thinking over and above topic knowledge, years of experience, and individual interest. The monitoring aspects of nursing care suggest that analysis of patterns would be a type

of meta-strategy used by nurses. This contention is supported by previous research in medical education (Dumas et al., 2014) as well as in other domains (Alexander & Baggetta, 2014; Jablansky, Alexander, Dumas, & Compton, 2015). Further, in nursing literature, immediate grasp of a clinical situation was initially called "intuition" in Patricia Benner's classic volume, *From Novice to Expert* (1982), and later was described as "recognition of a pattern" in Christine Tanner's Clinical Judgment Model (2006).

However, unlike the other independent variables, relational reasoning did not increase over the professional lifespan in a statistically detectable manner, although higher percentages of higher RRQ scores were found in the most experienced group. There are currently no known published studies of targeted interventions to increase relational reasoning in nursing practice, and it is not currently an articulated part of nursing education or continuing education. This study found no correlation between relational reasoning and specialized education in nursing. Further, this study expanded the knowledge on relational reasoning by including participants from young adults to older adults with results that were similar to previous research using the TORR (Alexander et al., 2016). In addition, the untested domain of nursing provided data on the role of relational reasoning in critical thinking in maternity nurses.

A Robust Model of Critical Thinking

Using measures of knowledge, interest, and relational reasoning strategies to predict critical thinking as part of expertise development, while separating out the variance explained by the demographic variable experience, produced a strongly predictive model. These three constructs have been shown to affect critical thinking in other fields, but have seldom been tested empirically for their effects on nurses' thinking

about clinical care. This study provides evidence that the MDL can be extended to the profession of nursing as an explanatory theoretical framework. First, the MDL suggested the major constructs used in this study, topic knowledge, individual interest, and strategic processing (Figures 1 and 2). Findings from this study that were congruent with the MDL were a) an increase in topic knowledge and individual interest from prelicensure to practicing nurses, b) a positive correlation between topic knowledge and individual interest, and c) an increase in critical thinking as an indicator of expertise development.

This study used a case study approach to in the critical thinking measure. Case studies must be carefully crafted with specific nursing problems in mind and specific cues provided in order to assess a nurse's skills (Lunney, 2014). The case in this study had a lengthy answer key, explicit cues constructed for level of difficulty, number, and specifically missing cues. Yin (2014) described cases studies as effective for answering "how and why" questions and for testing propositions. The case study format apparently functioned effectively for the participants in this study, as identified by the fact that the majority of participants identified the critical problems. It also functioned well as an online measure of critical thinking for those at various points in their professional careers.

Scope, Delimitations, and Limitations

Scope and Delimitations of the Study

The scope of this study included the effects of the individual difference factors topic knowledge, individual interest, and relational reasoning on critical thinking in maternity nurses. This delimitation of the scope means that further research would have to validate the findings for other specialties in nursing, and by extension to the medical profession as a whole. The study was also delimited by the specific individual difference

factors it examined. Future theoretical work would need to examine the inclusion of other individual difference factors that might be predictive. A further delimitation of this study was that it examined nursing practice at the level of registered nurse, not at the advanced practice level, such as that performed by a nurse-midwife or nurse practitioner, where the scope of practice is very different. For instance, among many other differences in practice, registered nurses cannot make medical diagnoses, nor can they prescribe diagnostic tests and medications. Future studies would be needed to examine whether these individual difference factors affect critical thinking in advanced practice nurses in the same manner.

Limitations

Limitations for this study include issues related to a) the comprehensiveness of the topic knowledge and critical thinking measures, b) research design, c) sampling issues, and d) content validity assessment.

First, the topic knowledge measure was limited by its focus on conceptual knowledge. Including other forms of knowledge, such as procedural and conditional knowledge, may more accurately capture the differences across levels of experience. Additionally, a limitation of the critical thinking measure was that it was primarily cognitive in nature. Other affective and social-contextual factors could account for variance in critical thinking among maternity nurses. Further, a single case study for the CT^2MN restricts the generalizability of this study in that it is not clear if results would be the same with more complex or less well-known complications.

The second limitation for this study was the research design. This was a cross-sectional study. Confidence in the predictions would be stronger if longitudinal data

were available. For example, the difference in topic knowledge topics that appeared

between prelicensure and practicing nurses could be examined longitudinally.

Longitudinal studies at the beginning and end of nursing school using standardized,

domain-general measures were located but not across levels of professional experience.

In addition, since this was not an intervention study, the gains seen in the independent

variables may have been influenced by other factors besides topic knowledge, individual

interest, and relational reasoning.

The third limitation was the sampling method. Although this sample was deemed

representative of the national population of nurses, future investigations could compute

the statistical significance and effect size of the difference between this sample and the

national population. Although the number of men in maternity nursing is low and this

was accurately reflected in the sample, it is possible that these individual difference

variables perform differently for men. In addition, greater cell sizes for the

underrepresented racial/ethnic groups would be needed to determine if the findings hold

across these groups. Future studies could access a more representative sample by

utilizing random sampling, recruiting nurses from licensure registries and not

professional organizations, and possibly by stratifying for gender and race/ethnicity to be

sure these strata are adequately represented to ensure that the findings are generalizable

to them.

Another possible limitation to generalizability was the self-selection by

participants. Nurses chose to accept the listserv invitation to participate in the study.

Those opting not to participate, as well as nurses who did not belong to the listservs or

the professional organization for maternity nurses may differ in significant ways. In spite

of the similarities to the national population of nurses, this sample does not completely represent all maternity nurses. A methodological challenge for the study early in data collection was the initially low response from prelicensure nurses from the first two maternity nurse listservs due to their low membership in these professional listservs. However, with the addition of a national student nurse listserv, the ultimate sample size and the group sizes were adequate to meet the a priori power analysis goals.

The fourth limitation was the reliance on content validity for the validity assessment of resulting data. Further testing of construct validity through comparison to instruments that purport to measure the same or different constructs would be required to establish alternative forms of validity for data from the CT^2MN, such as convergent or discriminant validity.

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Implications for Future Theory and Research

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The limitations of the study provide a springboard for follow-up studies in several areas. These areas of future research include an improved knowledge measure, an expanded critical thinking measure, longitudinal study of critical thinking, and alternative forms of validation for CT^2MN data. Some other fertile areas of future research are also identified, including the addition of individual difference factors to models of critical thinking.

Enhanced Knowledge Measurement

The findings of this investigation suggest that future studies could further refine the study of topic knowledge as a contributor to critical thinking. For topic knowledge, nursing studies using knowledge measures that capture procedural and conditional in addition to conceptual knowledge could be conducted. For example, in this study,

knowledge about concepts such as fetal newborn physiologic transition and breastmilk production were elicited. Procedural knowledge could be tested by asking such questions as, "For the fetal newborn physiologic transition, what is the first step in nursing assessment?" Conditional knowledge could be tested by such questions as "What factors would influence breastmilk production?" The responses to these additional types of knowledge questions may produce a greater distinction between nurses at different levels of expertise.

Expanded Critical Thinking Measure

The critical thinking measure in this study could be further developed through expanded case studies, inclusion of affective factors, and including competencies besides critical thinking to measure expertise. Future investigations of case studies should seek to gauge critical thinking by testing expanded critical thinking cases that vary in terms of structure, number of cases, complexity of cases, severity or acuity of complications, and the nursing specialty where the case takes place. A variation in structure is the unfolding case study, where the clinical situation is incrementally presented to the student or practicing nurse, instead of all at once as in a static case study. This more realistically represents how information about a patient is communicated to a nurse in the field. Assessing an increased number of case studies would strengthen the reliability of the findings. The number of complications in the case could be varied and the number of cues provided could adjusted to change the difficulty. The severity of the illness could be altered in the case, requiring changes in the order of care. Whether clinical diagnoses presented in the case were rare or common could be varied.

The final area of future research using case studies would be to adapt the case study to specialties other than maternity in order to further understanding of the generalizability to other specialties of nursing. The CT^2MN could be adapted to other specialties in nursing by using different case scenarios but the same follow-up questions and methodology for scoring. Pediatrics would be a possible choice for adaptation due to its similarity to maternity nursing. All of these changes in the case study could further understanding of whether life-threatening cases, or case about unusual clinical conditions, would produce similar findings regarding the role of these individual difference factors, and the strength of the model.

In addition to expanded case studies, more affective factors could be included in the conceptual model, such as compassion, anxiety, need for speed in action, and wisdom. In the field, these variables may play important roles in nurses' critical thinking, as well as cognitive and motivational factors.

This study measured critical thinking. However, expertise in nursing is not just marked solely by nurses' critical thinking ability. Critical thinking is a necessary but not sufficient skill for expertise in this domain. To increase effectiveness in evaluating the bedside practice of nursing, the measurement of critical thinking will need to also include other important competencies. These include: a) quality communication with patients; b) identifying and resolving ethical dilemmas in nursing care; and, c) applying evidence-based practice (EBP; Melnyk & Fineout-Overholt, 2011). EBP includes not only using the best research evidence, but also considering relevant background and contextual issues such as availability of expertise and physical resources, as well as patient and family preferences.

In addition to these implications for research and theory, this study also has implications for the teaching and practice of nursing.

Longitudinal Research Design

There is a need to conduct longitudinal research using the CT^{2}MN measure to provide the opportunity for causal analyses. These studies should include multiple levels of practitioners when appropriate; some researchers may have access to learners at only one level of experience. To really understand the relations between the variables, the same nurses should be tested across time. A particularly rich time in terms of professional change is the first years of practice after licensure. Although no longitudinal studies of professional growth in nurses after prelicensure were located, the longitudinal Nurses' Health Study began in 1979, and Nurses' Health Study II, established in 1989 by Dr. Walter Willett, are long-term epidemiological studies conducted on women's health (Colditz & Hankinson, 2005). Given this example of a long-term longitudinal study conducted among nurses, similar studies could be conducted on professional growth. Such studies require substantial funding and well-developed research teams.

Additional Construct Validity Assessment

Future studies could explore for the presence of convergent validity by comparing the CT^{2}MN, with a short answer form of measurement, to a multiple choice measure of critical thinking such as the California Critical Thinking Skills Test (CCTST). A moderate effect size would be expected since the CCTST does not measure CT specific to nursing. A more thorough evaluation of convergent and discriminant validity would be possible with the multitrait-multimethod (MTMM) approach that measures the constructs with more than one method of measuring and multiple measures. In order to

make the final judgment of convergence or discrimination between measures, differences between instruments in the degree of overlap also need to be taken into account, as in the example of the TORR and RPM, where a high overlap between the measures was not expected since only one form of analogy was measured by RPM.

Another type of validity, predictive validity, could be examined by comparing performance on the CT^{2}MN with later performance, such as on the National Council of State Boards of Nursing Licensure Exam, the NCLEX. A high correlation would be expected since critical thinking is measured in the NCLEX. For practicing nurses who have already passed the NCLEX, predictive validity could be established by comparing nurses' performance on the CT^{2}MN to performance benchmarks for clinical training simulations, which are regularly conducted on hospital units.

Improved Measure Clarity and Field Testing of Scoring Burden

Other issues for further research relate to measure clarity and scoring burden. In the CT^{2}MN, some participants incorrectly differentiated problem and evidence, as well as intervention and outcome, as requested in the instructions for the study. Therefore, future studies could benefit from increased definition of terms used in the instructions and increased explanation of expectations for short answer questions. Grading detailed care plans is a standard expectation for nursing faculty, so the scoring burden was not deemed high, but the study does provide a rubric differentiated by level to a greater extent than is usually seen in the academic scoring of case studies, so the scoring burden in the field could be examined. For the PEIM, the list of possible activities is comprehensive, but perhaps a clearer definition of what constitutes "frequent" engagement in activities might show distinctions between nurses more clearly. Further, the professed interest topics

could be more detailed; for example, instead of "prenatal testing," the topic for professed interest could be "ethical aspects of genetic testing." If the longitudinal studies described above were conducted, changes in level of interest over time might be more accurately measured.

Further Exploration of Relational Reasoning in Nursing

Additionally, given the influence of domain-general relational reasoning on critical thinking found in this study, relational reasoning in nursing should be examined in future research. Specifically, the role of relational reasoning in nursing could be explored using *in vivo* studies that observe practicing and prelicensure nurses in action. For example, a discussion between a student nurse and a more senior nurse about the management of a patient problem could be studied for examples and patterns of relational reasoning. Nurses receiving change-of-shift report from oncoming nurses could be asked to think aloud as they decide the next step in their care based on incoming data and their analysis of the patient situation.

Further, think-alouds could be integrated into the debriefing process already used in patient simulations. Specifically, during debriefing when student and practicing nurses examine positive and negative outcomes of actions during a simulated patient care exercise, they can be prompted to provide a rationale for their actions. This could be expanded to include prompts for relational reasoning ("Were you thinking about any previous patients you have encountered?") or by discourse analysis of responses to questions about rationales for actions. The relational reasoning nurses verbalize during these patient care instances could be audio-recorded, coded, and examined for forms of

relational reasoning and frequency of use. The methodology for this type of discourse analysis has been demonstrated in the medical domain by Dumas et al. (2014).

Also, given the contribution of relational reasoning to critical thinking, explicit classroom interventions to improve relational reasoning could be designed. Techniques such as using a familiar source analog, and visual and spatial cues, have been shown to increase relational reasoning in other educational settings (Richland et al., 2007). For example, if a teacher were explaining breastmilk production, the process could be compared to supply and demand as a familiar source analog. She could explain that breastmilk supply increases in response to the infant's demand, in contrast to a source analog of the breast as a pitcher that is emptied. Visual cues such as a 3-D model of the breast showing all the grape-like clusters of breastmilk-producing cells could be shown. Students could be asked what analogies in their own experience captured the process. Follow-up studies could also be conducted to explore the unexpected finding of a small but significant correlation between topic knowledge and relational reasoning. This relation could be explored with an intervention study examining whether educating nurses about relational reasoning techniques would change the correlation.

Adding Individual Difference Factors to Models of Critical Thinking

Finally, further research on the components of critical thinking models should be conducted. Although this model had strong explanatory power, researchers could test additional variables in a model of critical thinking. A promising construct for future theoretical research is deliberate practice, which has been distinguished from experience. Experience may decrease the amount of effort required to complete a domain task but not improve the quality of performance. Deliberate practice, on the other hand, requires

extended and concentrated practice. Indicators of deliberate practice include continued

formal schooling, Continuing Education Units (CEUs), specialty certification, self-

regulatory seeking out of more information, precepting students, and professional

memberships (Bathish, Aebersold, Fogg, & Potempa, 2016).

The findings of this study suggest that since both topic knowledge and individual

interest predicted critical thinking, both of these constructs should be included in future

models of critical thinking. Current models of critical thinking are either based on

domain-general standardized tests, or do not include extensive information on individual

differences that contribute to the quality of critical thinking. For example, Tanner's

Clinical Judgment Model (Tanner, 2006) includes cognitive processes, and although

knowledge, dispositions, and values are discussed as important in nursing care, they have

not been measured in studies using the model (Lasater, 2007). Future conceptual models

undergirding critical thinking research could include the measurement of knowledge and

interest constructs that were found in this study to strongly influence critical thinking.

This study also provided evidence that another variable, years of experience, should be

included in models of critical thinking, until the aspects of experience that contribute

most to improved performance in patient care tasks such as the CT^{2}MN are more fully

understood.

Implications for Practice

For prelicensure and practicing nurses and their educators, these study findings have direct implications. These implications relate to the critical thinking measure and the role of the individual difference factors. The instruments developed for this study showed that brief constructed-response measures of knowledge and critical thinking are administratively feasible and offer quantitative measurement of these varied constructs. Such measures provide a means of setting up appropriate expectations or benchmarks for nurses at different levels of expertise. Additionally, the CT^2MN measure employed in this study could be used for the evaluation of teaching interventions and nursing curricula. Being able to reliably evaluate whether a specific pedagogy increases not only knowledge but also the ability to solve relevant patient care scenarios would be useful information for nursing faculty.

The effectiveness of nursing curricula could also be evaluated using the CT^2MN as a model for multiple cases to test the effectiveness of a curricular change. This instrument could also provide a mechanism for studying adherence to clinical guidelines for specific clinical entities. For instance, this case featured a patient with several indications of preeclampsia. Adherence to recommended guidelines for assessment and treatment of preeclampsia could be analyzed. So, too, knowledge about general nursing principles such as physiologic birth could be examined.

There are also practice implications for this study's findings relating to individual difference factors. Given the covarying relation between topic knowledge and individual interest, nurse educators could monitor levels of knowledge and interest in students in order to encourage academic and professional development. The seeds of individual

interest could be nurtured through appropriate classroom assignments and clinical placements in areas of beginning interest. Relational reasoning could potentially be infused into the analysis of teaching cases.

For those supervising practicing nurses, the influence of educational and administrative activities on the individual interest of practicing nurses could be considered in staffing and continuing education experiences. The findings demonstrated a small, non-significant leveling off of professed interest in highly-experienced nurses. Continuing education nurse educators could examine the role of activities to promote individual interest later in the nursing career, such as more complex practice case studies. For practicing nurses, promoting their personal professional development by seeking to increase knowledge in all its forms during years of practice and nurturing their individual interest in subtopics of the specialty may advance their individual performance, and could contribute to improved unit and patient outcomes.

Further, teaching interventions could be developed to increase relational reasoning among nurses. Edelman identified teacher-guided analogy exercises (2009). Nurse educators could provide didactic and clinical experiences that promote the development of relational reasoning in school by constructing cases that compare and contrast different forms of relational reasoning. For example, a postpartum hemorrhage case study could focus on many cues that are consistent with postpartum hemorrhage, but include some cues such as temperature or rash that would be anomalous, and some laboratory results such as a high hematocrit (iron) level that would be antinomous findings. Overall, this study suggests many avenues of investigation in theory and research, as well as applications to practice.

Concluding Thought

This study sought to examine the relations among individual difference factors and critical thinking. It found a significant relation between topic knowledge and individual interest. Critical thinking, defined as the cognitive processes used to solve patient problems, was precisely measured with an instrument that can be tested in other specialties in nursing. The domain-specificity was a strength of the Critical Thinking Task in Maternity Nursing (CT^{2}MN); few previous studies have identified effective domain-specific measures. This study adds a domain-specific measure of critical thinking to the literature.

Topic knowledge was found to be the strongest predictor of critical thinking, and this finding implies that emphasis on mastering the maternity topic knowledge needed to care for patients should continue to be one of the foci of prelicensure and continuing education, while opening the door to consideration of the measurement, testing, and development of other forms of knowledge across the professional lifespan.

But the chief contribution of this study may be the identification of individual interest and relational reasoning, which are not strongly emphasized in nursing education, as significant predictors of critical thinking. Individual interest, composed of both professed passion for the topics of maternity nursing, as well engagement in professional development activities, was found to predict critical thinking to a statistically and practically important degree. Relational reasoning, measured with the domain-general graphical Test of Relational Reasoning, composed of not only analogy but also anomaly, antinomy, and antithesis forms of reasoning questions, also improved the prediction of critical thinking, to a lesser extent than knowledge and interest. This provides evidence

that the role of relational reasoning in nursing should be explored further. Moreover, the study contributed to the literature by showing how selected concepts and measures from educational psychology can be effectively used in the domain of nursing education. As the profession of nursing strives to improve patient outcomes, strong measures of critical thinking and an increased understanding of the role of individual differences in critical thinking will enable nurse educators to promote the progress of nurses on their journey from acclimation to competency to proficient expertise.

APPENDICES

Appendix A

Screening, Demographic, and Background Questionnaire

1. Which best describes you:

    ○ Student Nurse

    ○ Maternity Nurse

    ○ Neither of the above

Group A Questions (Maternity Nurses)

2. Are you currently working as a maternity nurse in a Maryland agency?
   (This includes working as a staff nurse, CNM, other advanced practice nurse, educator, administrator, policy analyst, researcher, etc. in maternal newborn health.)

    ○ Yes ○ No

3. Which of the following best describes your role in maternity nursing?
   (Check all that apply)

    ○ staff nurse

    ○ certified nurse-midwife

    ○ other advanced practice nurse, specify _____

    ○ educator

    ○ administrator

    ○ researcher

    ○ policy analyst

    ○ other _____

4. Which best describes your original student nurse program?

    ○ Diploma Program

    ○ Associate's Degree of Nursing

    ○ Bachelor's Degree

    ○ Master's Degree entry level

5. Do you have any specialized education in maternity nursing?(Check all that apply)

  ◉ Advanced Practice Nursing in a maternity field (e.g., nurse-midwife, OB-GYN clinical nurse specialist, women's health nurse practitioner)

  ◉ RN-C Perinatal Nursing Specialty Certification

  ◉ Other, please specify _____

  ◉ No

6. How many total years have you been practicing as a maternity nurse?

(in years and months, e.g., 2 years/ 0 months or 0 years/ 9 months)

  Years [ ]   Months [ ]

Group B Questions (Prelicensure Nurses)

7. Have you started or completed your maternity nursing rotation?

  ○ Yes ○ No

Group C Screen (ineligible for survey)

"Unfortunately you are not eligible for the survey, but thanks anyway."

8. **Directions: Please complete all the questions below.**

 Age [ ]

9. Sex

 ◉ Male

 ◉ Female

 ◉ Other

10. Your race: (click all that apply)

 ◉ White

 ◉ Black or African American

 ◉ American Indian or Alaska Native

 ◉ Asian

 ◉ Native Hawaiian or Pacific Islander

 ◉ Other _____

11. Are you of Hispanic, Latino, or Spanish origin?

 ◉ Yes ◉ No

12. Your first language:

○ English

○ Spanish

○ Chinese

○ Other, please specify_____

13. Your highest completed education level:

○ High School

○ Community College

○ Bachelor's

○ Master's

14. Please rate how certain you are that you can provide excellent maternity care.

Move the downward arrow slider with your mouse to the point on the line that describes your level of certainty.

Extremely Uncertain   Extremely Certain

Appendix B

Topic Knowledge Assessment

Directions: Please answer the questions about the following 10 terms to the best of your ability. Do not use any outside resources to answer these questions. You can answer in phrases; you don't need to use complete sentences. Define each of the following terms in 1-2 sentences/phrases and explain its importance in maternity nursing in 1-2 sentences/phrases.

[*One term per page appears with the instructions and a text box for both Definition and Importance.*]

Definition: Importance:

a. Maternal-Newborn Bonding   Definition:

      Importance:

b. Fetal-newborn Physiologic Transition   Definition:

      Importance:

c. Physiologic Management of Labor   Definition:

      Importance:

d. Electronic Fetal Monitoring   Definition:

      Importance:

e. Breastfeeding Latch   Definition:

      Importance:

f. Breastmilk Production   Definition:

    Importance:

g. Involution   Definition:

    Importance:

h. Postpartum Support System   Definition:

    Importance:

i. Embryonic Critical Period   Definition:

    Importance:

j. Nutrition in Pregnancy   Definition:

    Importance:

k. Evidence-based Practice in Maternity Care   Definition:

    Importance:

l. JOGNN   Definition:

    Importance:

Appendix C

Professed and Engaged Interest Measure

Part 1: For the following 10 items, please indicate your level of interest in each subject.

Move the downward arrow slider with your mouse to the point on the line that describes your level of interest.

Not At All Interested   Very Interested
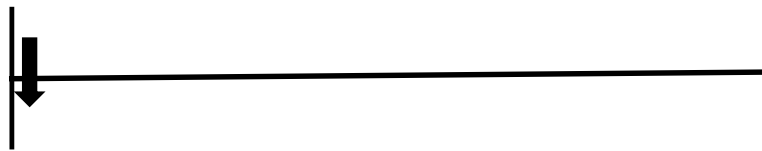
1. Electronic Fetal Monitoring

2. Quality and Safety Metrics in Labor Care

3. Labor Support

4. Prenatal Clinical

5. Pharmacologic Management of Pain

6. Continuity of Care from community to hospital

7. Breastfeeding education

8. Prenatal Testing

9. Discharge instruction to first-time parents

10. Use of Electronic Medical Records in Maternity Care

Part 2: For the following 10 items, please indicate how often you have engaged in each activity during the **last year**.

Move the slider to the point on the line that describes your frequency of participation.

Not at All   Frequently
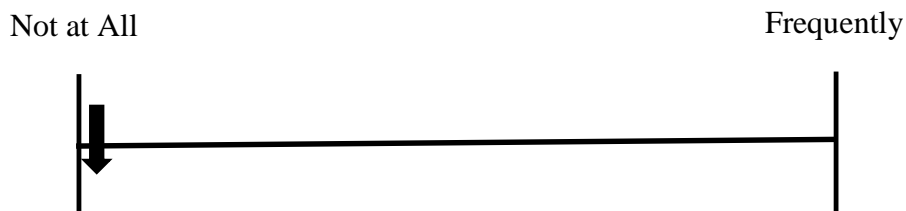
[*Each question is on a separate page with the bolded instruction.*]

1. Volunteered for health activities related to maternal, newborn, and women' health

2. Participated in journal club or unit/hospital committees

3. Volunteered as a labor support person

4. Attended conference, seminar, or workshop related to maternity nursing

5. Completed continuing education beyond organizational requirements

6. Provided childbirth or parenting education for a friend or community institution

7. Read a book or watched a DVD related to pregnancy, birth, breastfeeding, newborns, or maternity nursing

8. Participated in the writing or reviewing of an article for a maternity nursing journal or newsletter.

9. Consulted with a member of another discipline in maternity nursing project

10. Examined posters at an obstetrical nursing conference

Appendix D

Test of Relational Reasoning Sample Items

Directions: Below is a pattern that is not yet complete.

Select the figure from those shown below that completes the pattern.
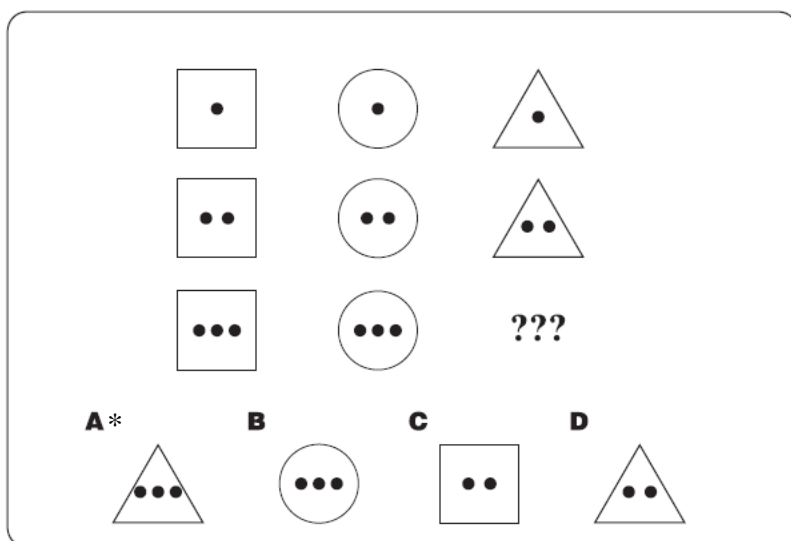
Directions: All these figure **but one** follow a particular pattern or rule.

Find the one figure that does not follow the pattern.
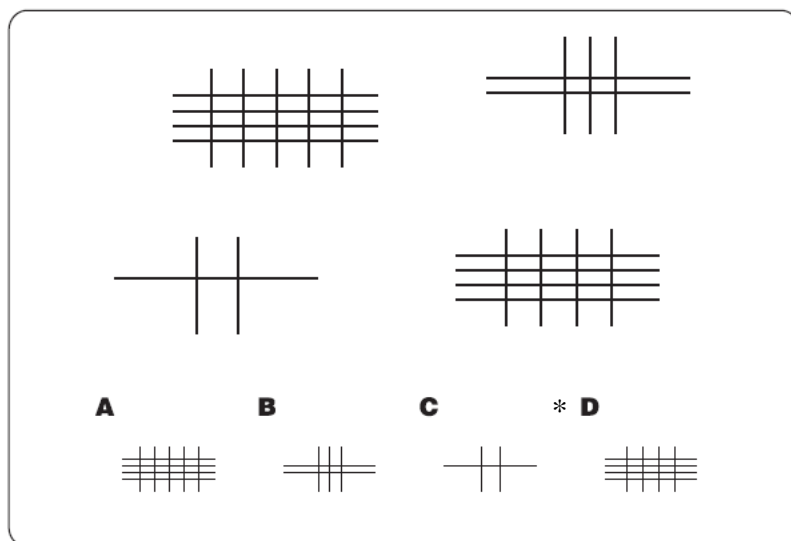
Directions:

- The problems in this section ask you to compare sets of objects that vary in certain features

- Each set has a specific rule that decides what objects can be included in that set. Some of the objects included in each set are pictured, enough to allow you to determine its rule for inclusion.

- Every problem asks you to identify which ONE of the four sets that are shown could NEVER have an object in common with the Given set based on the compatibility of their rules for inclusion.

- There will always be EXACTLY ONE set this is compatible with the Given set.
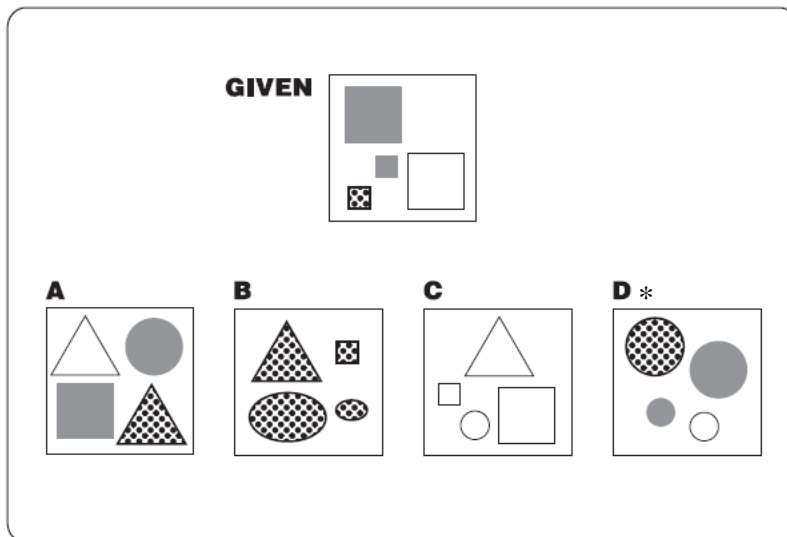
Directions: The given figure below depicts a *process* in which X becomes Y. In the figure, the arrow represents the rule by which the change occurs. Select the answer choice that shows the *opposite* of the given process.

GIVEN x.   y.

A   B
x.   y.   x.   y.

C *   D
x.   y.   x.   y.
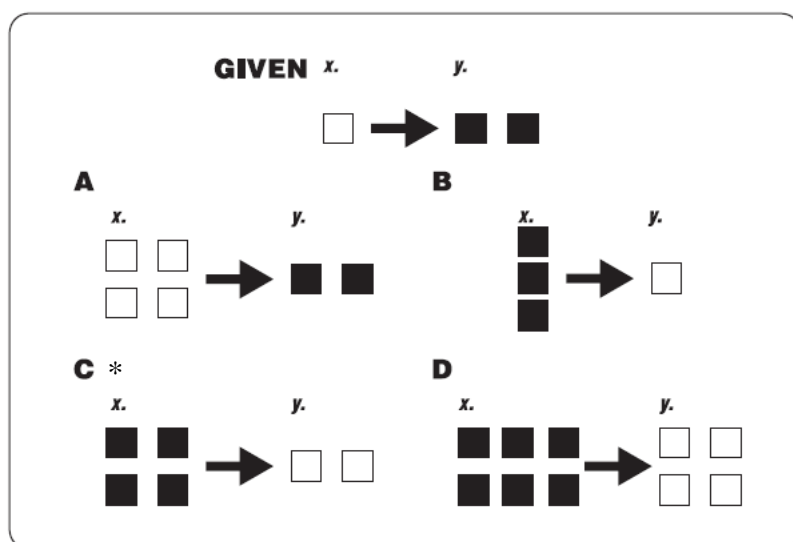
Would you like to be emailed a copy of the results at the conclusion of the analysis of this study?

○ Yes

○ No

Appendix E

Critical Thinking Task in Maternity Nursing

Please consider the following case study:

A.W., an 18 y. o. G2P0010, came to labor and delivery with her boyfriend with a complaint of spontaneous onset of contractions beginning at 1 am. It is now 6 am. She goes to the bathroom to put on a patient gown and to give a urine sample, and stops to breath with a contraction. She says she has had a bit of a headache, for which she took some acetaminophen, and she reports some heartburn. When she returns to bed, she mentions she had recently voided and had a bowel movement. Her membranes have not ruptured. She lies down in bed and you place her on the fetal monitor. The heart tones are heard in the upper right quadrant. You assess the contractions as every 5 minutes and mild to moderate intensity. The fetal heart is 150 bpm with 2-5 bpm variability with the fetal heart going to the 140's after the peak of a contraction. A.W.'s blood pressure is 146/88; her urine sample has +2 protein and trace glucose.

1. **Please list all the nursing diagnoses (also known as patient problems) that you can identify from this scenario.** There are more spaces than problems. You will not need all the spaces. Please list all the problems you can think of for this scenario.

   a ⬚   b ⬚   c ⬚ …d. ⬚ … j ⬚

2. **Please rank the priority of all the nursing diagnoses you have entered in the previous question in this scenario.** Rank the problems in terms of importance to patient outcomes. Click on the most important problem and move it to the top line with the up and down arrows on the left, the second most important problem to the next line, and so on until you have arranged all your problems in order of importance. [*The participant will be prompted to answer to arrange the problems s/he lists under the problem list. For this and each subsequent question, the question is listed on a separate page with the original scenario displayed under the question.*]

   a ⬚   b ⬚   c ⬚ …d. ⬚ … j ⬚

For the problem _____, [*The participant will be prompted to answer these three questions for each problem that s/he lists under the problem list.*]

3. What evidence is present to support your problem priorities? How good is the evidence?

4. What nursing interventions are appropriate in this situation (based on my priorities and evidence)? In what order should these interventions be implemented?

5. How do I evaluate outcomes in this situation?

[*Then, each participant is asked to answer the following three questions in relation to the scenario.*]

6. Are there any legal and/or ethical implications inherent in the scenario or in the nursing interventions I should implement?

7. What else do I need to know? What am I missing?

8. Please list all discharge planning topics you would plan for this client base on the scenario data.

Appendix F

Screenshots of Qualtrics™ Online Platform

Welcome Screen
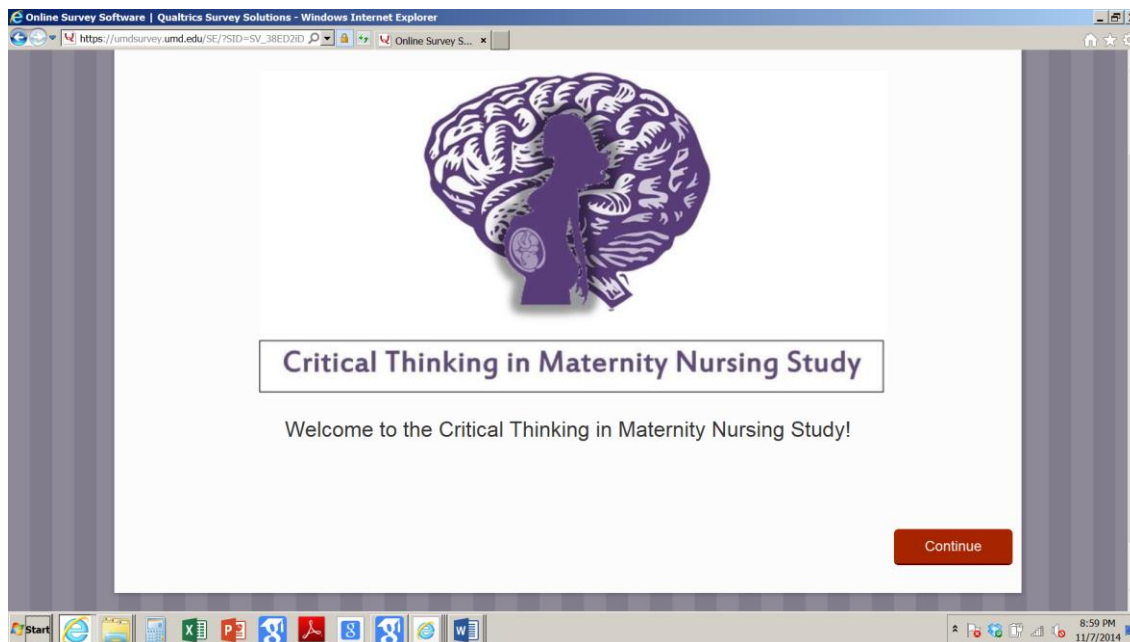
Question for the Critical Thinking Task in Maternity Nursing
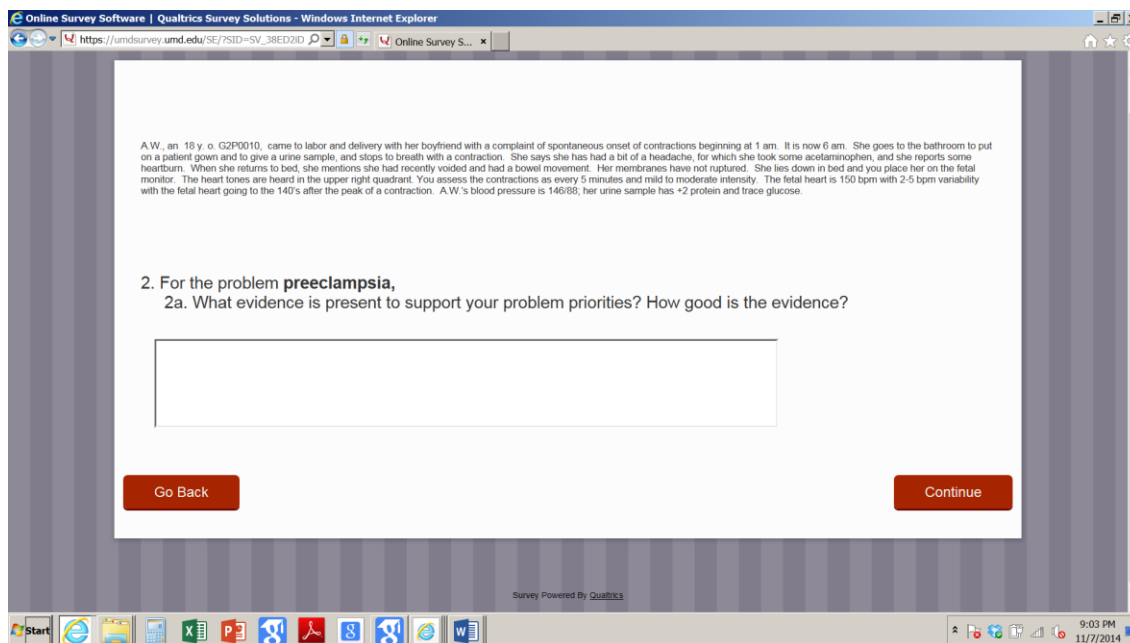
Appendix G

Online Instructions

Instructions

- Please do not use outside resources while completing either part of this study, or have any other windows open, as this may invalidate your results.
- Because this study examines nurses at all levels of experience, do not worry about the correctness of your answers. Just do the best you can with your knowledge at this time. We appreciate your best effort.
- You cannot go back, so be sure you are satisfied with your answer before hitting Continue.
- If your system crashes or you must leave the survey before finishing, you can return to the survey using the same survey link that you were given.
- If you have any problems email us at ctmnstudy@gmail.com.

Appendix H

Recruitment Flyer

Dear Colleague,

Congratulations on your work in a rewarding area of nursing! I would like to invite you to participate in a research study about how maternity nurses engage in patient care. I am seeking practicing maternity nurses such as staff nurses, educators, administrators, policy advisors and researchers, as well as student nurses who have started or completed their maternity nursing rotation. This online study is composed of two sessions of about 45 minutes each. Once your completion of the survey has been verified you will receive an Amazon™ gift card valued at $25 to thank you for your time, and a chance to win an iPad Mini in a drawing. This study can be accessed using the link identified below. If you have questions about the study, please feel free to contact me at the phone number or email address listed below.

Thank you for considering this request,

Lily Fountain, MS, PhD candidate, CNM, RN

University of Maryland College of Education

Benjamin Building, Room 3242 College Park Maryland 20742

fountain@umd.edu 301-405-6956

 Follow this link to the Survey: Take the Survey

Or copy and paste the URL below into your internet browser:

https://umdsurvey.umd.edu/xxxxxx

Appendix I

Rater Training Manual

Critical Thinking in Maternity Nursing Study

RATER TRAINING MANUAL

Critical Thinking Task in Maternity Nursing Measure

Topic Knowledge Assessment Measure

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Coding

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Introduction

The Critical Thinking in Maternity Nursing Study is a doctoral dissertation research project that examines the role of the individual difference factors topic knowledge, individual interest, and relational reasoning in critical thinking in maternity nurses. Expert Nurses score the responses to the Critical Thinking in Maternity Nursing Measure, and the Topic Knowledge measure. For the Critical Thinking in Maternity Nursing measure, a written clinical case study provides patient symptoms and background data. Participants list all the patient *problems,* also known as nursing diagnoses, suggested by the case, the *priority* of each problem, the evidence that led to a patient problem being identified, relevant nursing *interventions*, the *outcomes* or goals of patient care. Then the important *legal and ethical* issues and *missing data* are described. Finally, the participants list relevant *discharge* instructions that tell the patient what to do upon arrival at home. For the Topic Knowledge measure, participants define and describe the importance of 12 maternity nursing key terms. This training manual will explain the scoring process, data entry, and provide the key for scoring these study variables.

Training Procedure

Critical Thinking Task in Maternity Nursing Measure (CT^{2}MN)

1. Orient rater via Introduction and Case Study and Follow-up questions.

2. Orient rater to Data Sheet, Scoring Sheet, and Training Manual.

3. Practice scoring several sheets until trainee rater is comfortable with instructions and key.

4. Randomly select 20 participants. Provide rater with these 20 data sheets, the Excel file with 20 scoring sheets, and a paper copy of the Training Manual.

Topic Knowledge Assessment Measure

1. Orient rater to knowledge key and scoring sheet.

2. Show rater locations of Topic Knowledge responses on the data sheets.

3. Practice scoring several sheets until trainee rater is comfortable with instructions and key.

4. Provide rater with 20 data sheets from the same participants randomly selected for use for the Critical Thinking Measure, and the Excel file for recording scores.

Critical Thinking Task in Maternity Nursing Measure

Case Study and Follow-up Questions

      For the Critical Thinking Scenario measure, the participants read the following maternity nursing case study and answered the follow-up questions:

A.W., an 18 y. o. G2P0010, came to labor and delivery with her boyfriend with a complaint of spontaneous onset of contractions beginning at 1 am. It is now 6 am. She goes to the bathroom to put on a patient gown and to give a urine sample, and stops to breath with a contraction. She says she has had a bit of a headache, for which she took some acetaminophen, and she reports some heartburn. When she returns to bed, she mentions she had recently voided and had a bowel movement. Her membranes have not ruptured. She lies down in bed and you place her on the fetal monitor. The heart tones are heard in the upper right quadrant. You assess the contractions as every 5 minutes and mild to moderate intensity. The fetal heart is 150 bpm with 2-5 bpm variability with the fetal heart going to the 140's after the peak of a contraction. A.W.'s blood pressure is 146/88; her urine sample has +2 protein and trace glucose.

1.   Please list all the nursing diagnoses or patient problems that you can identify from this scenario.
2.   Please prioritize your nursing diagnoses/problems in order of importance to patient outcomes.

      For each problem:

3.   What evidence points to this problem?
4.   Please list appropriate nursing interventions in priority order
5.   What is/are your patient goal(s)/desired outcomes?

6.   Please list any legal and/or ethical implications of the scenario.
7.   What are the pieces of missing data you need to care for this patient?
8.   Please list all topics to be included in the discharge plan for this client.

Scoring the CT²MN

The goal of the scoring and point assignment for the case study is to accurately capture the true differences in quality of responses among nurses in the solving of the case study. Most of the variables are scored as continuous variables based on the number and percentage of correct entries compared to the key. For this open-ended assignment, participants could identify different numbers of problems; however, prioritization is important so that nurses do the most important care first, and not defer critical or important care for care that is merely helpful. The ranking of problems is not robust or accurate to individual rankings but to tiers of criticality. Critical or red tier problems are life-or-death problems, Important or yellow tier problems have immediate health consequences, and Helpful or green tier problems are opportunities for improved health if the nurse intervenes. For the key to the scenario, each of the 10 possible patient problems have been assigned by the researcher to one of three priority tiers: Critical, Important, or Helpful. The top two problems are Critical tier, problems 3, 4, 5, and 6 are Important tier problems, and the keyed problems 7, 8, 9, and 10 are Helpful tier problems.

When completing the study, the participant identifies as many of the possible problems as s/he can and arranges them in order of their priority for best patient outcomes. The rater will record the priority assigned to each listed correct problem by the participant for the purposes of computing the priority score. The following steps are then followed in order to score and allocate points to the prioritization:

The point allocation is summarized in a rubric below. An explanation of the rubric for assigning points for each listed correct problem is as follows:

1. If the problem ranked first or second by the participant is indeed a first tier Critical or red problem, it is given 10 points.

2. If a problem ranked third, fourth, fifth, or sixth by the participant is indeed an Important or yellow problem in the keyed second tier, it is given 5 points.

3. If a problems ranked seventh, eighth, ninth, or tenth by the participant is indeed a Helpful or green 3rd tier problem, it is given 3 points.

4. For problems incorrectly ranked, the general principal is the further from the correct priority a problem is listed, the more points that are deducted. One point is deducted for each level of discrepancy from the correct ranking.

5. Failing to identify correct Critical, Important, and Helpful problems at all results in a penalty of 5, 3, or 1 point respectively for each missing problem.

6. Repeated problems that are similar to the keyed problems are marked as Repeat and are skipped with regard to assigning priorities.

7. The point allocation for all problems in the key are added up to compute the Total Prioritization score.

8. One (1) point is subtracted for each wrong problem listed by the participant from the Total Prioritization Score.

Priority Points Allocation Rubric

Here is the summary rubric for how each problem listed by the participant is scored using rubric:

1. Scan down the keyed list of correct problems on the scoring sheet to locate the first problem identified by the participant.

2. Determine the priority entered for that problem by the Participant in the Assigned Priority column (see Data Entry 6, 7, and 8 below).

3. Look at the row for the tier that the problem SHOULD be in according to the keyed color for the ranking for that problem assigned by the key, Column 5.

4. Look at the points in that tier's row for the priority column assigned to that tier in the table below.

5. That number should be entered as the Priority Point Allocation for that problem's row.

6. Repeat this process for all correct problems identified by participant.

Correct	**Priority Assigned by Participant**										
Problem Tier	1	2	3	4	5	6	7	8	9	10	Missing
Tier 1	10	10	9	8	7	6	5	4	3	2	-5
Tier 2	3	4	5	5	5	5	4	3	2	1	-3
Tier 3	-3	-2	-1	0	1	2	3	3	3	3	-1

| CTMNS CT SCORING SHEET | Rater: | | Participant ID: | | Date: |

Correct Problems	Problem ID	#Repeat	NumWrong	Key & Tier	Priority	Pr Pts	Evidence Key	Evidence	Evidence pc	EssentialInterventions Key	Interventions	Interv pc	Outcomes Key	Outcomes	Outcome pc	Legal F
Fetal Distress	❶			1		❹	2	❺		5	❻		2	❼		❽
Seizure/PreE				2			6			5			3			9 LE Key
Breech				3			1			1			3			LE p
Cesarean				4			1			1			3			
Pain				5			2			2			1			
Preterm/GA				6			1			1			1			
PNC/ Risk				7			1			1			1			
Labor Status				8			2			1			1			
Teen Support System Single				9			3			3			3			
Primip Knowl Deficit				10			1			1			1			
TOTAL	❷		❸	Priority Pts.			20			21			19			

Adjusted Priority Pts.	
-Wrong	
Priority Subscore	
Priority pc	

EIOpc | | LMDp

CTScore = 0.4 * (Priority PC + 0.45 * (EvidencePC + InterventionsPC + OutcomesPC) + 0.15 * (LE_PC + MD_PC + DC_PC)

Steps in Scoring for the Critical Thinking Task

Coding.

The scoring sheet for scoring the Critical Thinking Test is shown in Figure 3. The
❶ indicates where the presence of a correctly identified problem is entered. The
❷ indicates where the number of times problems are repeated is indicated. The
❸ indicates where the number of wrong problems listed by the participant is
entered. The ❹ indicates where the priority points for that problem are entered by
the computer based on the Point Allocation Rubric. The ❺ indicates where the
code for each correct piece of evidence, each one represented individually by a
letter of the alphabet, is entered. The ❻ indicates where each intervention's code
is entered to be summed by the computer. The ❼ indicates where each outcome's
code is entered to be summed by computer. The ❽ indicates where each legal
ethical code, the ❾ each missing information code, and ❿ each discharge
teaching topic code is entered.

The minimum possible priority score is -6 based on the minimum and maximum
of correct and incorrect problems possible. The maximum possible priority score
is 52. The priority points is the sum of all the points for the problem order
identified by the participant. The adjusted priority points is the priority points
minus the minimum possible priority score. The number of wrong problems is
then subtracted from the adjusted priority points to get the Priority Subscore. The
priority pc is the priority subscore divided by the range of possible values: 58 (=
52 - -6). The *evidence pc* is the total number of evidence identified divided by the
maximum possible (20). The *interventions pc* is the total number of evidence

interventions divided by 21, the number of essential interventions identified by expert nurses, a subset of the maximum possible interventions of 55. The *outcomes pc* is the total number of outcomes identified divided by the maximum possible (19). *LE pc* is the number of legal/ethical issues identified divided by the maximum possible (9). M*issing data pc* is the number of missing data identified divided by the maximum possible (6). D*C pc* is the number of D/C identified divided by the maximum possible (10). A computer program totals the columns and computes the percentages and writes them back into the spreadsheet for each participant.

Data Entry: General Principles

1.   There are 182 participants and you have a data sheet and a scoring sheet for each participant, along with this training manual.

2.   You will be entering data for nine variables.

3.   Enter the participant Study ID and your initials at the top of the scoring sheet.

4.   Read all the way through the data entry before scoring.

5.   Data is scored once. Entries that are essentially the same data are rewarded or penalized only once. For example, if preeclampsia is entered as a problem, then the problems headache and hypertension if entered are scored as repeats.

6.   The Rater enters data in white spaces. The computer does arithmetic in grey spaces.

Data Entry: Critical Thinking Scenario Measure Procedure

1.   Have the **data sheets, scoring sheets**, and **training manual** in front of

you. The scoring sheet is shown on page 8 of this manual, and a sample data

sheet starts on page 12 of this manual.

2.   Go to the data sheet, beyond the definitions section, past the first Timing,

to the **area marked "2. Please prioritize** your nursing diagnoses/problems…"

The problems entered by the participant are listed with a number that is the

ranking assigned to that problem by the participant. This section is highlighted on

the sample data sheet on page 16. The page number will vary for each data sheet.

You will enter two columns of tracking data for each problem to the left of the

problem on the participant's data sheet.

3.   First you will **examine the problem list on the data sheet and put a √**

next to the listed problem on the data sheet if the problem is present in the key

in some form**. If the problem is not present put an X. If it is repeat or variant**

on a previously listed problem, put an R next to the problem. This will help

you find entries to add to the totals for Evidence, Interventions, and Outcomes

when you score these sections. Annotate all the problems on the participant's

priority list on the data sheet in this fashion.

4.   Go to **Part A** on the scoring sheet. **Complete the second column,**

Problem ID'd, for each problem by inserting a 1 if that problem is present in

some form in the participant's priority list. If the problem is **not present enter**

zero or leave blank. If it is a repeat or variant on a previously listed problem, put

a **1 or number of times repeated under Times Repeated**, 3rd column.

5.   To complete the box in the 4th column, **NumWrong, add up the number of X's** for the prioritized problem **list on the data sheet** and put that number on the scoring sheet in the NumWrong column in the Total row. Example 1: If the problems listed on the data sheet priority list are fetal distress 1, risk for PROM 2, and preeclampsia 3, then you would put a √ next to fetal distress, an X next to PROM 2 because it is not a keyed problem, and √ next to preeclampsia. There is one X, so you will enter 1 for NumWrong on the scoring sheet in the 4th column.

6.   Next you will **examine the prioritized problem list on the data sheet next to your problem identification** √'s, X's, and R's. **If there are no wrong or repeated problems, the Priority Assigned is the number listed after the problem**.

7.   If the problem is a **repeat, the assigned priority of the problems after the repeated problem skips that number that was repeated by 1.** Example 2: if the listed problems are fetal distress 1, preeclampsia 2, headache 3, breech 4, on the data sheet you would enter fetal distress √, preeclampsia √, headache R, and breech√. Then you would enter 1 next to fetal distress, 2 next to preeclampsia, and 3 next to breech. On the scoring sheet you would enter 1 next to fetal distress, 2 next to preeclampsia, and 3 next to breech and enter 0 or leave blank for the remaining problems. Note that headache was skipped in assigning the priority.

8.   On the scoring sheet, go to column 6 **Priority Assigned**. For each problem listed in column 1, enter the rank assigned by the participant as you recorded on the data sheet. There is no need to enter a number for repeats, and

there is no way to enter a priority ranking number for wrong problems. So for the Example 1 listed in #6 above, if the problems listed on the data sheet as fetal distress 1, risk for PROM 2, and preeclampsia 3, on the scoring sheet you would enter a 1 next to fetal distress, a 3 next to preeclampsia, and 1 under NumWrongProbs. You would enter 0 for the remaining problems. You have now completed the Priority section of Part A.

9.   Next, move to the next question on the data sheet, "for the problem [participant's first problem], what evidence points to the problem", question 3, listed for each problem from the participant's list. **Circle the problem number (in Key) next to each question 3, and if a repeat,** put **an R next to the problem, and the number of the problem.** If problem 2 (problem number from key) is repeated, write **R-2.** This will help you find entries to add to the totals for Evidence, Interventions, and Outcomes when you score these sections. For each piece of evidence (and outcomes and interventions later), put the letter of the evidence from the key. If that evidence does not match the key, put an X over or next to it.

10.   Add up the number of correct pieces of evidence on the data sheet, counting any non-repeated correct entries from repeated versions of the same problem.

11.   Go to the Scoring Sheet and put that **total number of correct entries** place where that problem is listed. For example, if their problem listed was breech, and under #3 for evidence the participant listed "FHR heard in upper right quadrant", you would enter 1 under Breech Evidence.

12.   Correct evidence for wrong problems cannot be used.

13.   For each problem the participant has listed questions 3, 4, and 5 are repeated. Count up the **number of correct entries for Interventions, and Outcomes** in the same manner.

14.   Note that correct data in the repeats are included as Evidence, Interventions, and Outcomes for the original problem. Mark the data sheet for these variables for the repeated problems. Example 3: The problem list is Preeclampsia 1, headache 2, breech 3. Your priority is Preeclampsia1, Breech 2 since headache is repeated. However, under headache, for evidence, "patient reports headache not relieved by Tylenol" is listed, and is counted as one of the correct pieces of evidence for preeclampsia, if not already mentioned.

15.   Legal ethical problems, Missing data and Discharge topics: Count the number of correct items on the data sheet according to the key below (one per category if categories are present) and add them up, and record the total number on the scoring sheet next to the variable the information applies to.

16.   Missing Data and Discharge Planning have categories. Any 1 item from the category gives the participant 1 point for that category, and only 1 point per category is allowed.

17.   A correct piece of missing data that is mentioned elsewhere than under missing data is counted.

CT²MNKey

Variable	Keyed Answers	Scoring
PROBLEM IDENTI-FICATION	1-Fetal Distress/Late Decelerations/Uteroplacental Insufficiency 2-PreEclampsia/Seizures/Risk for Injury/Ineffective Tissue Perfusion 3-Breech Presentation 4-Possible Cesarean 5-Pain 6-Preterm Birth/Unknown Gestational Age 7-Unknown Pregnancy Risk Factors/GDM r/t Glycosuria 8-Labor Status 9-Teen pregnancy/Weak support system/Single/Risk for Anxiety/Ineffective coping 10-Primip/Knowledge Deficit/Powerlessness	Data Sheet: √, X, or R Scoring Sheet 1 if present in data sheet for each correct problem listed. 0 if not present. 1 or # in Times Repeated Column if repeat. 0-10 possible.
UNKEYED PROBLEMS	*If not on list, problem is wrong.*	Put an X next to wrong problems on the data sheet. Add up for number of wrong problems listed for a total of 0-10 in the scoring sheet box for NumWrong problems.
PROBLEM PRIORITY	*If all listed, priority is what is printed on data sheet.* *If **REPEAT,** REPEAT'S PRIORITY NUMBER IS SKIPPED & GOES TO NEXT PROBLEM.* *If **UNKEYED,** UNKEYED PROBLEM DOESN'T GET PRIORITY NUMBER BUT NEXT PROBLEM GETS **NEXT** PRIORITY NUMBER.*	R Don't count priority Count priority of Wrong problems Once R's and Wrong problems out of list, enter priority number on Scoring sheet

Variable 1-FETAL DISTRESS	Keyed Answers	Scoring
EVIDENCE	A. Late Decelerations B. Minimal variability	0-2 for number of points of correct evidence listed
INTERVENTIONS	A. Left lateral side B. O2 therapy 8-10 L/min via face mask C. Insert/bolus IVF D. Vaginal exam per unit policy for RNs E. Notify provider F. Ask mother about prenatal/pre-admission history or medications that could affect fetal well-being. G. Anticipate delivery if pattern not resolved H. Educate mother and family regarding interventions I. Continuous monitoring	0-9 for number of correct interventions
OUTCOMES	A. Late decelerations cease B. FHR variability increases to 6-25 bpm,	0-2 for number of correct outcomes listed

Variable 2-PREE/ SEIZURES	Keyed Answers	Scoring
EVIDENCE	A. Elevated B/P, B. headache, C. heartburn (liver) or epigastric pain D. Proteinuria E. risk factor of Teen primiparous pregnancy increases risk of Preeclampsia F. Rule out benign/transient symptoms of pregnancy.	0-6 for umber of correct points of evidence
INTERVENTIONS	A. Left Lateral Side B. Preeclampsia labs and monitoring of changes C. Initial physical assessment and monitor for Preeclampsia Sx: edema, headaches, dyspnea, blurred vision or other visual changes, nausea vomiting, epigastric or RUQ pain, lethargy D. Notify provider after assessment E. Quiet environment F. Emergency supplies and Calcium gluconate at bedside; O2 and suction tested, seizure precautions G. Insert Foley catheter per protocol or orders H. Implement medications as ordered, including magnesium sulfate, anti-hypertensives, and pain I. Explain to woman and family purpose of medications and treatments and how she will feel (flushed, nauseated, sedated, "flu") J. Closely Monitor VS, FHR, Contractions K. IVF management, monitor I&O, proteinuria each hour, restrict intake to 125 ml/hr, ensure urinary output is 30ml hr or notify provider L. Notify NICU, Anesthesia, etc. as required.	0-12 for number of correct interventions
OUTCOMES	A. No seizures/healthy mom. B. Baby healthy/delivered safely C. S & Sx of Preeclampsia cease: WNL DTRs, BP, Labs, Urine output, and proteinuria	0-3 for number of correct outcomes listed

Variable 3-BREECH	Keyed Answers	Scoring
EVIDENCE	A. FHR heard in upper quadrants	0-1 for number of correct points of evidence
INTERVENTIONS	A. Leopold's Maneuvers to assist in determination of position B. Sterile Vaginal Exam C. Facilitate U/S D. Impact on route of delivery is discussed with patient	0-4 for number of correct interventions
OUTCOMES	A. Position of fetus is determined B. Safe birth for mother and infant C. Mother/family education and satisfaction needs met	0-3 for number of correct outcomes listed
Variable 4-CESAREAN	Keyed Answers	Scoring
EVIDENCE	A. 1. r/o Fetal Distress, 2. Severe Preeclampsia, 3. Primiparous Breech	0-1 for number of correct points of evidence
INTERVENTIONS	A. Possible insertion of Foley catheter B. Possible lower abdominal shave C. IV access and bolus if cesarean anticipated D. Assist with spinal, epidural, or general anesthesia as ordered E. Remain in communication with physician about labor management plan F. Educate parents regarding labor management plan; if cesarean called, educate parents about procedure	0-6 for number of correct interventions
OUTCOMES	A. Safe birth for mother and infant B. Mother/family has favorable feelings about birth C. Family receives needed education about birth	0-3 for number of correct outcomes listed

Variable 5-PAIN	Keyed Answers	Scoring
EVIDENCE	A. Contractions B. Stops to breathe with contraction	0-2 for number of correct points of evidence
INTERVENTIONS	A. Provide education regarding options B. Discern patient preferences C. Provide support measures/environmental/ non pharmacological/"natural" D. Provide pharmacological (medications) as requested and ordered	0-4 for number of correct interventions
OUTCOMES	A. Pt satisfied with coping strategy	0-1 for number of correct outcomes listed

Variable 6-PRETERM/GA	Keyed Answers	Scoring
EVIDENCE	A. Unknown Gestational Age: Term vs. preterm pregnancy	0-1 for number of correct points of evidence
INTERVENTIONS	A. Determine Gestational age via patient report B. Obtain prenatal record C. Fundal height measurement D. Leopold's to assist in determining fetal size E. Facilitate ultrasound if unknown dates	0-5 for number of correct interventions
OUTCOMES	A. Gestational age is determined.	0-1 for number of correct outcomes listed

Variable 7-Prenatal Risk/ Unknown GDM	Keyed Answers	Scoring
EVIDENCE	A. No information on prenatal care or complications that indicate high-risk pregnancy, glycosuria may indicate GDM	0-1 for number of correct points of evidence
INTERVENTIONS	A. Obtain prenatal record B. Facilitate history and exams C. Diagnostic tests and labs needed	0-3 for number of correct interventions
OUTCOMES	A. Actual and potential risk factors are identified.	0-1 for number of correct outcomes listed

Variable 8-Labor Status	Keyed Answers	Scoring
EVIDENCE	A. Unknown cervical dilation/effacement/station B. Contractions present	0-2 for number of correct points of evidence
INTERVENTIONS	A. Sterile Vaginal Exam B. Monitor contraction pattern	0-2 for number of correct interventions
OUTCOMES	A. Labor status is WNL	0-1 for number of correct outcomes listed

Variable 9-Teen/ Support/ Single/ Ineffective coping/Anxiety	Keyed Answers	Scoring
EVIDENCE	A. 18 y.o. B. Has boyfriend/not married C. Second pregnancy P0010	0-3 for number of correct points of evidence
INTERVENTIONS	A. Determine level of knowledge and education and provide age/developmentally appropriate education B. Determine plans for newborn, (e.g., adoption, etc.) C. Provide psychosocial support/presence D. Determine response of father and extended family to pregnancy E. Ensure adequate support system F. Determine if financial situation and home are adequate G. Ensure domestic violence and postpartum depression screens and resources provided H. Refer for Social Work/ Mental Health consult, home visits as needed	0-8 for number of correct interventions
OUTCOMES	A. Teen and family demonstrate adequate maternal and infant care B. Safe home environment verified for infant and mother C. Adequate support system.	0-3 for number of correct outcomes listed

Variable 10-Primip/ Knowledge Deficit	Keyed Answers	Scoring
EVIDENCE	A. P0010/Demonstrates lack of knowledge	0-1 for number of correct points of evidence
INTERVENTIONS	A. Increased amount of teaching and support for first time mothers and families. B. Determine cultural and religious preferences for birth, infant care, and maternal postpartum care	0-2 for number of correct interventions
OUTCOMES	A. Mother and family demonstrate adequate knowledge of birth, newborn, and postpartum	0-1 for number of correct outcomes listed

Variable	Keyed Answers	Scoring
LEGAL ETHICAL	A. Nurses legally required to evaluate quality of FHR, institute appropriate measures, document, and report to provider B. Refer to state laws regarding age of majority. C. Document standard of care. D. Risk of malpractice suit increased for vaginal breech delivery E. Ethical dilemma if nurse disagrees with provider decision F. Ethical duty to refer to Medical, Nursing, and Social Services as needed. G. HIPPA/confidentiality/paternity H. Informed consent, keep patient apprised of plan of care I. Adoption if requested	0-9 for number of correct legal/ethical concerns identified
MISSING DATA	A. Gestational Age/Due Date B. Prenatal History: Prenatal Care?, Prenatal labs, risk factors, medications, diabetes screening results, SAB miscarriage or TAB abortion C. Labor: Duration of contractions, results of cervical exam, status of Membranes/meconium, baseline VS, current labs, pain rating, coping, management preferences/birth plan D. Medical Surgical History E. Psycho Social History: Education, maturity, living arrangements, support system, financial status--means of support, involvement of parents and father and others, was pregnancy planned, preparation for baby F. Information Relation to Current Problems: peripheral edema, DTRs, Sx PreE such as abdominal pain, vision changes, shortness of breath, malaise, PreE labs, U/S for position done?, determination of route of delivery, fundal height	0-6 for number of correct missing data categories listed with at least one item.

Variable	Keyed Answers	Scoring
DISCHARGE PLANNING TOPICS	A. RISK FOR PREECLAMPSIA: continues through early postpartum; Follow-up per MD order, educate about signs of worsening preeclampsia; educate re: increased lochial flow after Magnesium sulfate therapy; allay patient and family any lingering fears re: wellbeing B. POSTPARTUM CARE OF MOTHER: PHYSICAL: Usual course of recovery; self-care in early postpartum period: normal bleeding/lochia, breasts, nutrition, follow-up visits C. POSTPARTUM CARE OF MOTHER: PSYCHOSOCIAL: sleep, emotions, activity and exercise D. DANGER SIGNS TO REPORT TO PROVIDER including infection E. POSTPARTUM CESAREAN CARE (Possible): Increased need for assistance for 1stmonth; information about nutrition, pain relief measures, exercise and activity restrictions, sleep/ rest needs, hygiene, breast care, incision care, resumption of sexual intercourse/contraception, signs of complications; infant care; support groups and psychological support as needed. F. PRIMIPAROUS PREGNANCY: First time mother; how to cope with infant, shaken baby syndrome; support systems, role changes (boyfriend); promoting parent/child interaction: Age appropriate expectations; discipline; ways to talk with infants; reading to infants; exploring parent goals in addition to parenting; incorporating father G. ASSESSMENT AND CARE OF THE NEWBORN: Sleep and scheduling routines; bathing and hygiene; safety: toys, car seat, storage of home hazards, including firearms; how to tell when infant is ill and report to pediatric provider; immunizations, schedules H. NEWBORN NUTRITION AND FEEDING: how to determine adequate intake; patterns of feeding; techniques for feeding I. COMPLICATIONS OF CHILDBIRTH AND NEWBORN: Problems Related to Gestational Age (if in NICU); loss and Grief re: NICU baby J. TEEN PREGNANCY: All information should be developmentally appropriate; involve baby's father as much as possible/appropriate; encourage verbal and nonverbal communication skills with infant; educate teens about infant development; identify sources of social support: her own mother, support groups, plans for completing high school if applicable; logistics re: birth certificate, social security number, etc.	0-10 for number of categories identified with at least 1 item.

Topic Knowledge Measure

Scoring the Topic Knowledge Measure

The topic knowledge measure is scored using the following four categories:

0=Wrong   Entry does not match key at all, circular definition
1=Partial   Entry is partially correct
2=Full   Entry has all essential aspects of answer, but not more or less
3=Elaborate Entry has full answer plus it expands with examples or explanations of definition.

Each of the 12 terms has a definition and importance section that is scored with one number.

Data Entry Procedure for the Topic Knowledge Measure

1. Enter data for each data sheet under that variables column (e.g., Maternal-Newborn Bonding Definition) in the row for that participant's study ID.
2. Variables Names as they appear on scoring and data sheets:

Variable Name Scoring Sheet	Corresponding Variable as appears on Data Sheet
Kbondefscore	Definition: Maternal-Newborn Bonding
Kbondimpscore	Importance: Maternal-Newborn Bonding
Ktransdefscore	Definition: Fetal-Newborn Physiologic Transition
Ktransimpscore	Importance: Fetal-Newborn Physiologic Transition
Kphysiodefscore	Definition: Physiologic Management of Labor
Kphysioimpscore	Importance: Physiologic Management of Labor
Kefmdefscore	Definition: Electronic Fetal Monitoring
Kefmimpscore	Importance: Electronic Fetal Monitoring
Klatchdefscore	Definition: Breastfeeding Latch
Klatchimpscore	Importance: Breastfeeding Latch

Kproddefscore	Definition: Breastmilk Production
Kprodimpscore	Importance: Breastmilk Production
Kinvoldefscore	Definition: Involution
Kinvolimpscore	Importance: Involution
Kppsupdefscore	Definition: Postpartum Support
Kppsupimpscore	Importance: Postpartum Support
Kembrydefscore	Definition: Embryonic Critical Period
Kembryimpscore	Importance: Embryonic Critical Period
Knutrdefscore	Definition: Pregnancy Nutrition
Knutrimpscore	Importance: Pregnancy Nutrition
Kebpdefscore	Definition: Evidence-Based Practice
Kebpimpscore	Importance: Evidence-Based Practice
Kjognndefscore	Definition: JOGNN
Kjognnimpscore	Importance: JOGNN

3. See sample Data Sheet, and Topic Knowledge Excel scoring sheet below.

Topic Knowledge Scoring Sheet (excerpt of cases)																								
	Kbondefscore	Kbondimpscore	Ktransdefscore	Ktransimpscore	Kphysiodefscore	Kphysioimpscore	Kefmdefscore	Kefmimpscore	Klatchdefscore	Klatchimpscore	Kproddefscore	Kprodimpscore	Kinvoldefscore	Kinvolimpscore	Kppsupdefscore	Kppsupimpscore	Kembrydefscore	Kembryimpscore	Knutrdefscore	Knutrimpscore	Kebpdefscore	Kebpimpscore	Kjognndefscore	Kjognnimpscore
105lemon																								
106grape																								
107plum																								
108lime																								
109grass																								
110tree																								
111car																								
112rose																								

Topic Knowledge Measure KEY

0=Wrong   Entry does not match key at all, circular definition, wrong
1=Partial   Part of entry is correct
2=Full   Entry matches keyed answer
3=Elaborate   Entry expands upon the full entry with examples and deeper
                     explanations.

1. a. Maternal-Newborn Bonding Definition:
            Closeness between mother and infant immediately after birth
1. b. Maternal-Newborn Bonding Importance:
            Reinforces positive parenting behaviors
2. a. Fetal-newborn Physiologic Transition Definition:
            Respiratory, cardiovascular, and other system changes allowing fetus to
            function outside uterus.
2. b. Fetal-newborn Physiologic Transition Importance:
            Vital to life
            3. a. Physiologic Management of Labor Definition:
            Low use of interventions to promote natural process
3. b. Physiologic Management of Labor Importance:
            Promotes optimal outcomes in birth.
4. a. Electronic Fetal Monitoring Definition:
            The use of an electronic monitor to record fetal heart rate concomitantly
            with the uterine contractions.
4. b. Electronic Fetal Monitoring Importance:
            Fetal and maternal surveillance to inform use of medical interventions.
 5. a. Breastfeeding Latch Definition:
            Connection between newborn mouth and maternal breast
5. a. Breastfeeding Latch Importance:
            Provides optimal transfer of milk and maternal comfort.
6. a. Breastmilk Production Definition:
            The creation of human milk by the breast.
6. b. Breastmilk Production Importance:
            Vital to adequate nutritional intake by infant.
 7. a. Involution Definition:
            Intermittent contraction of the uterus after childbirth to return to pre-
            pregnancy state.
 7. b. Involution Importance:
            Nurse tracks normality of involution to detect any problems such as
            postpartum hemorrhage.
 8. a. Postpartum Support System Definition:
            Availability of family or other persons to assist mother and infant after
            childbirth
 8. b. Postpartum Support System Importance:
            Prevents complications of parenting and breastfeeding
 9. a. Embryonic Critical Period Definition:

The early pregnancy period when organ systems are most vulnerable to disruption.

9. b. Embryonic Critical Period Importance:

Can help prevent birth defects

10. a. Nutrition in Pregnancy Definition:

The specific requirements for vitamins, energy and protein in pregnancy.

10. b. Nutrition in Pregnancy Importance:

Can prevent many health problems.

11. a. Evidence-based Practice in Maternity Care Definition:

The use of research evidence, patient variables, and background/contextual variables to determine the best choices for care provision to mothers and newborns.

11. b. Evidence-based Practice in Maternity Care Importance:

Improves the quality of care.

12. a. JOGNN Definition:

Journal of Obstetric, Gynecologic, and Neonatal Nursing.

12. b. JOGNN Importance:

High quality journal that supports evidence-based practice for maternity nurses.

Topic Knowledge Coding Examples

0=Wrong   Entry does not match key at all, circular definition, wrong,
            missing, Don't know, Unsure, No Clue.
1=Partial   Part of entry is correct
2=Full   Entry matches keyed answer
3=Elaborate Entry expands upon the full entry with examples and deeper
            explanations.

1. a. Maternal-Newborn Bonding Definition:
        0=repeating term, wrong concept, Don't know, etc.
        1=closeness but no mention of birth or vice versa
        2= Closeness between mother and infant immediately after birth
        Closeness ALSO interaction, relationship, connecting, attachment,
        bond, interest, Skin to skin, get to know.
        Birth ALSO newborn, delivery, postpartum, meet, new
        3=all of full definition PLUS elaboration of these ideas

1. b. Maternal-Newborn Bonding Importance:
        0= repeating term, wrong concept, Don't know, etc.
        1=partial such as trust, RN role, healthy outcomes, nl infant
        development, promote development
        2= Reinforces positive parenting behaviors
        ALSO physical and emotional health, prevents PPD, FTT, etc.
        3=all of full definition PLUS elaboration of these ideas

2. a. Fetal-newborn Physiologic Transition Definition:
        Respiratory, cardiovascular, and other system changes allowing fetus to
        function outside uterus.
        0= repeating term (e.g., transition, passage, intrauterine to extrauterine),
        wrong concept, Don't know, etc.
        1=adaptation, changes, adjustment,
        2=Respiratory, cardiovascular, and other system changes allowing fetus
        to function outside uterus.
        ALSO mention 1-2 systems
        3=all of full definition PLUS elaboration of these ideas
        ALSO mention >2 systems

2. b. Fetal-newborn Physiologic Transition Importance:
        0= repeating term, wrong concept, Don't know, etc.
        1=important adaptation, care practices, risks at birth
        2=Vital to life
        3=all of full definition PLUS elaboration of these ideas such as RN
            supports

3. a. Physiologic Management of Labor Definition:

0= repeating term, wrong concept, Don't know, etc. Medical
interventions to keep baby safe.
1=natural process, RN assists
2=Low use of interventions to promote natural process
3=all of full definition PLUS elaboration of these ideas. Explanation of
natural process and low interventions.

3. b. Physiologic Management of Labor Importance:
0= repeating term, wrong concept, Don't know, etc.
1=can support, emotional aspects, less stressful, physiology makes
labor work
2=Promotes optimal outcomes in birth.
ALSO safety, focus on OUTCOMES not processes
3=all of full definition PLUS elaboration of these ideas
Such as safer, comfort, decreased C-sec, IOL, augmentation

4. a. Electronic Fetal Monitoring Definition:
0= repeating term, wrong concept, Don't know, etc.
1=just contractions or FHR mentioned
2=The use of an electronic monitor to record fetal heart rate
concomitantly with the uterine contractions.
MUST mention FHR AND contractions
3=all of full definition PLUS elaboration of these ideas
such as mechanism of action

4. b. Electronic Fetal Monitoring Importance:
0= repeating term, wrong concept, Don't know, etc.
1=fetal tolerance, standard of care, oxygenation, progress, well-being.
2=Fetal and maternal surveillance to inform use of medical
interventions. ALSO guides interventions,
3=all of full definition PLUS elaboration of these ideas such as
overused, not evidence-based for low-risk women.

5. a. Breastfeeding Latch Definition:
0= repeating term, wrong concept, Don't know, etc.Baby breastfeeds.
1=Baby latch (no breast), Latch score no description
2=Connection between newborn mouth and maternal breast
ALSO baby on breast (mouth not necessary, can be assumed)
3=all of full definition PLUS elaboration of these ideas
Such as other aspects of good latch including suck, swallow, lips
flanged, most of areola, no pain.

5. b. Breastfeeding Latch Importance:
0= repeating term, wrong concept, Don't know, etc.
1=production or pain instead of both, RN role in promoting (only),
increased satisfaction

2=Provides optimal transfer of milk and maternal comfort.
ALSO production and comfort,
3=all of full definition PLUS elaboration of these ideas such as
Decreased desire to BF if poor latch, increased maintenance of BF,
incomplete emptying, avoid mom feeling like failure, RN role in
promoting.

6. a. Breastmilk Production Definition:
    0= repeating term, wrong concept, Don't know, etc. The production of
breastmilk.
    1=creation of milk w/o mention from where,changes with time,
lactation
    2=The creation of human milk by the breast.
    ALSO amount of milk produced by the breast
    3=all of full definition PLUS elaboration of these ideas such as role of
hormones prolactin and oxytocin, supply and demand, [colostrum is not
extra]

6. b. Breastmilk Production Importance:
    0= repeating term, wrong concept, Don't know, etc.
    1=breastfeeding is healthy, proper nutrition, RN role,
    2=Vital to adequate nutritional intake by infant.
    ALSO adequate nutrition, tailored, meet needs, optimal nutrition
    3=all of full definition PLUS elaboration of these ideas such as RN
supporting role, benefits of breastfeeding listed.

7. a. Involution Definition:
    0= repeating term, wrong concept, Don't know, etc.
    1=uterus
    2=Intermittent contraction of the uterus after childbirth to return to pre-
pregnancy state ALSO contract to pre-pregnancy, shrink
    3=all of full definition PLUS elaboration of these ideas such as RN role
in fundal massage

7. b. Involution Importance:
    0= repeating term, wrong concept, Don't know, etc.
    1=important for normal changes and healing
    2=Nurse tracks normality of involution to detect any problems such as
postpartum hemorrhage.
    ALSO detect problems such as PPH
    3=all of full definition PLUS elaboration of these ideas such as signs of
infection, teach moms normal progress

8. a. Postpartum Support System Definition:
    0= repeating term, wrong concept, Don't know, etc.
    1=no mention of human supports

2=Availability of family or other persons to assist mother and infant after childbirth

3=all of full definition PLUS elaboration of these ideas such as maternal infant programs, lactation support

8. b. Postpartum Support System Importance:

0= repeating term, wrong concept, Don't know, etc.

1="essential" but no reason cited, RN role, helpful, security

2=Prevents complications of parenting and breastfeeding

ALSO prevents PPD, helps with breastfeeding

3=all of full definition PLUS elaboration of these ideas such as RN needs to know how to help support moms.

9. a. Embryonic Critical Period Definition:

0= repeating term, wrong concept, Don't know, etc.

1=early in pregnancy, important period for embryo, 1st trimester, embryo growing fast

2=The early pregnancy period when organ systems are most vulnerable to disruption

MUST HAVE time PLUS susceptible to organ damage; 1st trimester or first 8 weeks ok for time.

3=all of full definition PLUS elaboration of these ideas such as mention of specific organs, negative effect of ETOH, drugs, fever

9. b. Embryonic Critical Period Importance:

0= repeating term, wrong concept, Don't know, etc.

1=development, proper health, occurs before mother knows she is pregnant, prenatal care, fragile, healthy outcome, organogenesis, monitor

2=Can help prevent birth defects

ALSO prevent exposure to teratogens during this period

3=all of full definition PLUS elaboration of these ideas such as improve diet, specific teratogens, specific defects, prepregnancy/ pre conception, environmental contaminants

10. a. Nutrition in Pregnancy Definition:

0= repeating term, wrong concept, Don't know, etc.

1=what she eats

2=the specific requirements for vitamins, energy and protein in pregnancy.

ALSO different nutritional requirements during pregnancy, meets needs in pregnancy, adequate calories, proper, well-balanced diet

3=all of full definition PLUS elaboration of these ideas such as decreased sugar, salt, fried foods, increased folic acid, Ca, B vits, protein

10. b. Nutrition in Pregnancy Importance:

    0= repeating term, wrong concept, Don't know, etc.
    1=RN promotes (only)
    2=Can prevent many health problems.
    ALSO optimal growth and development
    3=all of full definition PLUS elaboration of these ideas
    Such as prevent complications, anemia, NTDs, LBW, RN promotes,
    decreased maternal obesity.

11. a. Evidence-based Practice in Maternity Care Definition:

    0= repeating term, wrong concept, Don't know, etc. Tried and true.
    1=up-to-date, information, proven care [without research]
    2=The use of research evidence, patient variables, and
    background/contextual variables to determine the best choices for care
    provision to mothers and newborns.
    ALSO research evidence for best practice, studies, literature review
    3=all of full definition PLUS elaboration of these ideas such as peer-
    reviewed, rate evidence, patient perspective

11. b. Evidence-based Practice in Maternity Care Importance:

    0= repeating term, wrong concept, Don't know, etc.
    1=provide safety, best care, body of knowledge, professional
    development, best practice, up-to-date information
    2=improve quality of care outcomes
    ALSO betterment of patients
    3=all of full definition PLUS elaboration of these ideas such as
    professional development, decreased mortality and morbidity, not just
    tradition

12. a. JOGNN Definition:

    0= repeating term, wrong concept, Don't know, etc.
    1=leave out one of the types of nurses
    2=Journal of Obstetric, Gynecologic, and Neonatal Nursing.
    3=all of full definition PLUS elaboration of these ideas such as
    publication of AWHONN, promotes EBP in MCH,

12. b. JOGNN Importance:

    0= repeating term, wrong concept, Don't know, etc.
    1=good journal, up-to-date info
    2=High quality journal that supports evidence-based practice for
    maternity nurses. MUST HAVE EBP AND quality/peer reviewed.
    3=all of full definition PLUS elaboration of these ideas such as forum
    for ideas, professional development, new ideas, application in practice

Sample Data Sheet

Recipient Data:
Time Finished: 2015-04------
IP: ----------
ResponseID: -----------
Link to View Results: Click Here
URL to View Results: --------

Response Summary:
Signing this consent form indicates that you are at least 18 years of age, you have read this consent form (or have had it read to you), that your questions have been answered to your satisfaction, and that you voluntarily agree to participate in this research study.   If you do NOT agree to participate, thank you for your consideration. You may close your browser.
   If you AGREE to participate in this study, please type your first and last name and email address.
        First Name   ----------
        Last Name   ----------
        Email   ----------
        Date   ----------

Which best describes you:
   Student Nurse
About your maternity nursing rotation:
   I have completed my maternity nursing rotation
Which best describes your student nurse program?
   Bachelor's Degree
  Age (in years)

Gender:
   Female
Your race: (click all that apply)
   White
Are you of Hispanic, Latino, or Spanish origin?
   No
Your first language:
   English
Your highest completed education level:
   Bachelor's
Please rate how certain you are that you can provide excellent maternity care.
   I can provide excellent maternity care   61

TOPIC KNOWLEDGE ASSESSMENT
1. Maternal-Newborn Bonding   Definition:

Maternal-Newborn bonding is the term used to describe the physical, psychological, and emotional attachment facilitated between a mother and her baby. It begins from the time of conception, while the baby is still in utero, but manifests most beginning at the time of labor. It is the intangible, intimate relationship that forms between the mother and her baby through physical connection and dependence, mutual emotional processes, and psychological, hormonal exchanges.

Why Important:
Maternal-Newborn bonding is important for the overall health of both the mother and the newborn. A strong bond has also been believed to result in positive effects on physical, emotional, and psychological health of both the mother and her baby. The bond helps the baby rely on the mother for growth and development while it also helps the mother recover, return to self-care, and become a positive parental presence in her baby's life.

2. Fetal-newborn Physiologic Transition   Definition:
Fetal-newborn physiological transition describes the process that occurs as the fetus transitions into a newborn once he/she exits the womb. This transition includes several physiological processes including the closure of the fetal circulation adaptations such as the Ductus Arteriosus and the Foramen Ovale, temperature regulation, the production of glucose by the baby, the filling of the lungs with air by the baby, and the production of hormones by both the mother and baby. In general, the fetal-newborn physiological transition is the adaptation of the baby to extrauterine life.

Why Important:
This transition is important for the health of both the mom and baby after birth. It also is important for the success and survival of the neonate as he/she is transitioning from a warm, nurturing environment in the mother's uterus to the outside world in which the baby should no longer rely physically on the mother's body for food (Except breastmilk), energy, blood, immunity, etc. A successful transition is important to predict or anticipate the health needs of the baby. If the neonate cannot undergo a successful transition to eventually be able to survive physiologically, the neonate could be seriously ill or pass.

3. Physiologic Management of Labor   Definition:
Physiologic management of labor describes the interventions, assessments, and pharmacological measures used to progress or control the physiological occurences in labor. Pain medications are an example of physiological management of labor as the mother can be in a significant amount of pain and therefore an epidural is frequently used to treat that pain and relax the woman which can help facilitate labor.

Why Important:
Physiologic management of labor is important to control and relieve the body in order to continue the labor. It is also important to detect when something goes wrong and a c-section may be necessary to deliver the baby.

4. Electronic Fetal Monitoring   Definition:

EFM is the technology used to continuously monitor the baby's heartbeat, contraction pattern, and sometimes the intrauterine pressure. This monitoring is what all women who come to the labor floor are placed on so that the midwives, doctors, and nurses can discern if the labor is progressing well or not. EFM can indicate when the baby is in distress and can also indicate what stage of labor the mother is so that labor nurses can focus their care.

Why Important:
  EFM is important because it is an indicator of the mother and baby's wellbeing. EFM is used to decide if a baby needs to be c-sectioned because he/she is in distress for a variety of reasons. It is also used as a objective measure to monitor the labor. Once the nurses sees that the mother is having contractions 2-3 minutes apart, she may start to prepare more for the impending labor.

5. Breastfeeding Latch   Definition:
  The breastfeeding latch is the correct alignment and positioning of the newborn's mouth around the mother's nipple. A correct latch would not result in complications for the mother such as engorgement or mastitis. A healthy latch is necessary to ensure productive and effective feeding for the newborn to get enough calories and nutrients to grow. The breastfeeding latch that is most supported is the baby's mouth in the shape of a fish, with lips around the nipple of the mother. The mother's nipple should touch the back of the baby's mouth while the baby sucks around the nipple.

Why Important:
  The breastfeeding latch is the most important factor in being able to successfully breasfeed the neonate. Without an effective latch, the baby may not get enough milk and therefore will not grow and double their birth weight by 6 months. For the mother, the lack of a successful latch can result in a significant amount of pain, distress, and infection. The American Academy of Pediatrics recommends exclusive breastfeeding for at least 6 months, thus a good latch is important for a woman to be able to nurse her child for that long.

6. Breastmilk Production   Definition:
  Breastmilk production is the process the woman's body undergoes, influenced by hormones, to produce milk for her neonate. Labor stimulates the production of oxytocin, which works with Prolactin to trigger both the production and the let-down of milk. The woman's body should produce milk within 48-96 hours of labor, but colostrum will be produced as premature breastmilk for the first three days.

Why Important:
  Breastmilk production is imporant to provide for the breastfeeding baby. Adequate production is important for growth, development, and physiological needs of the neonate. Breastmilk is extremely good for the baby as it provides nutrients as well as passive immunity. An adequate production is necessary for the child to get what he/she needs.

7. Involution   Definition:

Involution is the process of "clamping down" that the uterus undergoes after labor. It can be stimulated by the fundal massage usually done by the labor nurse. The uterus expands and enlargens throughout pregnancy and most significantly during labor to allow the exit of the fetus. Hormones are naturally produced or given in synthetic form to stimulate involution in hospital settings and if the fundal massage does not result in a firm uterus after labor. An involuted uterus returns to its original anatomical position in the woman's body and firms down after delivering.

Why Important:
It is important for the uterus to undergo involution so that the mother does not experience a postpartum hemorrhage. If the uterus is "boggy" or soft after labor, the labor nurse must massage the fundus (top of the uterus) to promote involution. Involution allows the uterus to clamp down on itself and therefore stop bleeding that occurs during labor. It also is necessary for the delivery of the placenta. If involution does not occur, it may be synthetically stimulated. It is necessary for the woman to expel all components of the placenta and to stop bleeding during the immediate time period after delivery.

8. Postpartum Support System   Definition:
Postpartum support system can be comprised of a variety of providers, family members, and friends. It describes the physical and psychological support the women should ideally have available to her to help during this particularly vulnerable time period after delivery. Regular check ups after labor as well as family members and friends can help transition the woman into life with her new baby.

Why Important:
It is important for the woman to have a postpartum support system for a variety of reasons ranging from physical adaptations to psychological adjustments in the postpartum period. Postpartum depression is quite prevalent in the period after labor and an effective support system can help prevent the woman from becoming depressed after birth as this greatly interferes with her ability to provide comptent care to her newborn.

9. Embryonic Critical Period   Definition:
Embryonic critical period refers to those periods in utero when development and formation of the embryo occurs. There are many different periods in which teratogens or medications can have an effect on the embryo. The critical period specifically refers the the time in which the embryo forms in the woman's body.

Why Important:
This period is important for the proper formation of the embryo. Malformations often occur during this period of development so it is important to know when this period is and to avoid teratogens or strenuous activities that could result in defects or malformations.

10. Nutrition in Pregnancy   Definition:
Nutriiton in Pregnancy refers to the specific context of nutrition for pregnant women as they must take special considerations because they are eating for 2 (or more than 2).

Nutrition in pregnancy includes various recommendations that are evidence-based and made to women by their providers during the prenatal period. For example, folic acid is one major requirement for nutrition in the prenatal peroid to prevent neural tube defects.

Why Important:
  Nutrition in pregnancy is important for the health, development, and growth of the baby. It is also important for the woman as she must be as healthy as possible to be in the best shape to provide a healthy environment in utero, to labor effectively, and to provide for her neonate postpartum. It is also important for a pregnant woman to have proper nutrition to avoid developmental defects, congenital conditions, or any malformations that can occur due to various aspects.

11. Evidence-Based Practice in Maternity Care   Definition:
  EBP is important in any type of care, and therefore also applies to maternity care. It refers to the body of literature or research that reports on successes and/or failures or inadequate proof for certain interventions or aspects of maternity care. It attempts to answer questions or gaps in knowledge that exist in the context of maternity care.

Why Important:
  EBP is important in maternity care to enable those that work in maternity care to best serve their patients and ensure optimal care.

12. JOGNN   Definition:
  JOGNN is the shorthand name for the Journal of Obstetric, Gynecological, and Neonatal Nursing. It an important research for any healthcare providers or nurses that work in labor, delivery, or neonatal settings. It is a peer-reviewed journal and provides evidence-based updates and research on aspects of care.

Why Important:
  It is important because there are constantly new discoveries, changes, and evidence relevant to the field of obstetrics, gynecology, and neonatal nursing. Improvements to care are essential in today's society, and nurses should use JOGNN as a resource for evidence-based improvements or changes to nursing care that they provide. There are often important questions and topics discussed in the journal to answer questions or unknowns in regards to this context.

1. Please list all the nursing diagnoses or patient problems that you can identify from this scenario.
  a. pre-eclampsia or eclampsia risk
  b. risk for impaired gas exchange (newborn)
  c. risk for ineffective coping
  d. risk for injury
  e. risk for bleeding
  f. risk for fluid volume deficit
  g. fetal distress

2. Please prioritize your nursing diagnoses/problems in order of importance to patient outcomes. To change the priority of an item, click on it with the mouse and while holding the mouse button down, drag it to a new position in the list.
   fetal distress   1
   pre-eclampsia or eclampsia risk   2
   risk for impaired gas exchange (newborn)   3
   risk for injury   4
   risk for bleeding   5
   risk for fluid volume deficit   6
   risk for ineffective coping   7

3. For the problem pre-eclampsia or eclampsia risk,   What evidence points to this problem?
   146/88 BP, urine sample +2 protein, complaint of headache, lack of variability (less than 15)

4. For the problem pre-eclampsia or eclampsia risk,   Please list appropriate nursing interventions in priority order.
   Administer Magneium Sulfate, Continue to monitor on fetal monitor, Continue to assess urine and blood pressure, Ensure maternal comfort, Place patient on seizure precautions

5. For the problem pre-eclampsia or eclampsia risk,   What is/are your patient goal(s)/desired outcomes?
   Deliver a healthy baby
   Prevent maternal seizure

3. For the problem risk for impaired gas exchange (newborn) ,   What evidence points to this problem?
   Fetal heart 150 bpm, 2-5 bpm variability, heart returns to 140s after peak of contraction

4. For the problem risk for impaired gas exchange (newborn) ,   Please list appropriate nursing interventions in priority order.
   Continue to assess the fetus with the fetal monitor

5. For the problem risk for impaired gas exchange (newborn) ,   What is/are your patient goal(s)/desired outcomes?
   Deliver a healthy baby, Deliver baby via c-section if continues to show signs of fetal distress

3. For the problem risk for ineffective coping ,   What evidence points to this problem?
   physical evidence of pre-eclampsia/risk for eclampsia, fetal distress

4. For the problem risk for ineffective coping ,   Please list appropriate nursing interventions in priority order.

Assess pain and maternal comfort, Adminsiter pain medication PRN or as ordered by provider, Place mother on bedrest, Use therapeutic communication with mother, Be a support for mother and do not leave her side, Remind mother that outcome of labor is a baby so that a c/s vs. an SVD is not of importance-- a healthy baby is

5. For the problem risk for ineffective coping ,   What is/are your patient goal(s)/desired outcomes?
   Patient copes well and verbalizes low pain numbers and that she is comfortable
   Patient verbalizes understanding that no matter what happens, the outcome is what she should focus on

3. For the problem risk for injury,   What evidence points to this problem?
   lack of variability (2-5), high maternal blood pressure, relatively early in labor

4. For the problem risk for injury,   Please list appropriate nursing interventions in priority order.
   Continue to monitor fetus via electronic fetal monitoring, continue to assess heart tones with doppler or fetal monitor regularly, use interventions to prevent mother from eclampsia, prepare for a c/s if condition does not improve

5. For the problem risk for injury,   What is/are your patient goal(s)/desired outcomes?
   Mother remains free from injury
   Baby is delivered without injruy

3. For the problem risk for bleeding ,   What evidence points to this problem?
   Risk for eclampsia/pre-eclampsia--> possibly c/s or delivery (Any delivery has risk of bleeding)

4. For the problem risk for bleeding ,   Please list appropriate nursing interventions in priority order.
   Massage the fundus immediately after delivery, Administer Pitocin if uterus remains boggy after delivery, IF c/s, assess incision site frequently (as ordered), Perform frequent maternal assessments after labor

5. For the problem risk for bleeding ,   What is/are your patient goal(s)/desired outcomes?
   The patient remains free form postpartum hemorrhage
   The patient does not lose more than 500 cc of blood for SVD or 1000 cc for c/s

3. For the problem risk for fluid volume deficit ,   What evidence points to this problem?
   See bleeding-- c/s and.or SVD pose risk for fluid volume deficit r/t labor

4. For the problem risk for fluid volume deficit ,   Please list appropriate nursing interventions in priority order.
   If woman has epidural, bolus with fluids beforehand, ensure adequate output of at least

30 cc/hr, prevent bleeding in postpartum period

5. For the problem risk for fluid volume deficit   What is/are your patient goal(s)/desired outcomes?
   Patient remains free from fluid volume deficit as evidenced by blood loss <500 for SVD or <1000 for c/s, a firm uterus, and at least 30 cc/hr of UO

3. For the problem fetal distress,   What evidence points to this problem?
   Lack of variability

4. For the problem fetal distress,   Please list appropriate nursing interventions in priority order.
   Continue to monitor mother and baby, Continue to assess fetal heart tones of baby, recommend c/s if fetal distress continues

5. For the problem fetal distress   What is/are your patient goal(s)/desired outcomes?
   Neonate is delivered successfully and remains free from labor complications

6. Please list any legal and/or ethical implications of the scenario.
   Implications: if we allow the labor to progress naturally, there is a high chance that the mother will have a seizure or that fetal distress will become worse. There is risk that if we do not deliver this baby, it could pass away or experience complications. There is a great need to act quickly here.

7. What are the pieces of missing data that you need to care for this patient?
   No information on prenatal care, nothing more about heartburn.

8. Please list all topics to be included in the discharge plan for this client.
   Need to go to postpartum visits to discern if pre-eclampsia, chronic hypertension (as many women are not diagnosed due to lack of medical care until they come to the hospital in labor), or gestational hypertension. Nutrition. Breastfeeding. When to call the doctor for mother and baby in postpartum period. S/sx of postpartum blues and/or depression and when to call MD or CNM about this. How to ensure infant is getting enough to eat. Vaccinations.

   Would you like to take Part 2 , which takes about 45 minutes, now or later?   If you click now, you will be directed to Part 2. If you click later, you will receive the link to Part 2 as an email.   To get your incentive and participate in the iPad Mini drawing, you must also complete Part 2 within 10 days, so see you soon!
   Later

Part 2 Recipient Data:

Time Finished:--------

IP:--------

ResponseID:--------

Response Summary:
Please enter your name and email address. Be sure to use the same email address as the one you entered in Part 1.

    First Name --------
    Last Name --------
    Email   --------
    Date --------

PROFESSED AND ENGAGED INTEREST MEASURE
Professed Interest

  1. Providing labor support 7

  2. Educating parents about birth options 9

  3. Supporting families at the moment of birth 8.8

  4. Assessing the fetus and newborn 8.9

  5. Participating in development of guidelines for labor care 4.9

  6. Assisting in the provision of pharmacologic pain relief 6.7

  7. Promoting continuity of care from community to hospital 7.7

  8. Providing breastfeeding education 8.4

  9. Helping parents feel empowered during pregnancy 9.6

  10. Providing discharge instructions to first-time parents 8.8

Engaged Interest

  1. Volunteered for community activities related to maternal-newborn health 0

  2. Participated in journal club or hospital committees 0

  3. Volunteered as a labor support person 0

  4. Attended conference, seminar, or workshop related to maternity nursing 0

  5. Completed continuing education beyond organizational requirements 0

  6. Provided childbirth or parenting education for a friend or community institution 0.8

  7. Read a book or watched a DVD related to pregnancy, birth, breastfeeding, newborns,

or maternity nursing   0.8

  8. Participated in the writing or reviewing of an article for a maternity nursing journal or newsletter   0

  9. Consulted with a member of another discipline in a maternity nursing project   1.4

  10. Examined posters at an obstetrical nursing conference.   0

TEST OF RELATIONAL REASONING

[Multiple choice responses]

At the conclusion of the analysis of this study, would you like to be emailed a copy of the results?

  Yes

  Q_TotalDuration   --------

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