EVALUATION OF CONCEPT MAPPING AS A STRATEGY TO ENHANCE
CRITICAL THINKING

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BY
MARGARET GREEN

DR. KAY HODSON CARLTON - ADVISOR

BALL STATE UNIVERSITY
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ABSTRACT

RESEARCH PAPER: Evaluation of Concept Mapping as a Strategy to Enhance Critical Thinking

STUDENT: Margaret Green

DEGREE: Masters of Science

COLLEGE: College of Applied Sciences and Technology

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The demands of caring for more acutely ill patients in health care settings requires nursing graduates to demonstrate critical thinking. The National League for Nursing Accrediting Commission (NLNAC) and the American Association of Colleges of Nursing (AACN) require schools of nursing demonstrate students’ critical thinking competence. This study’s purpose is to evaluate concept mapping as a strategy to promote critical thinking in clinical settings with nursing students. Replicating Abel and Freeze’s (2006) study which partially replicated the study by Daley, Shaw, Balistrieri, Glasenapp, and Piacentine (1999), its conceptual framework is based on Assimilation Theory. The study includes a convenience sample of all senior baccalaureate students (n=75) enrolled in clinical courses at a Midwestern university. Variables are measured with scores from the first and last of 4 concept maps created during the students’ senior year utilizing scoring criteria from Daley et al. (1999). Measurement methods include 2-instructor scoring for validity, awarding points for propositions, hierarchy, cross-links, and examples. Findings will provide information on the effectiveness of concept mapping as a teaching strategy to improve critical thinking over time.
Introduction

Nursing educators are charged with the challenging task of providing teaching-learning strategies that enhance nursing students’ critical thinking, the core component of effective clinical judgment. Graduate nurses are caring for more complex patients in hospital and non-hospital practice settings. The National Advisory Council on Nurse Education and Practice (NACNEP) (2008) reported that both new and experienced nurses need to be attuned to escalating health care needs attributed to increased demand for health care by consumers, cost pressures, consumer demand for quality care, and new technology skills necessary to care for an increasingly diverse population.

The rapidly changing health care environment requires nurses with strong critical thinking and analytical skills as well as the ability to provide professional and compassionate care. These critical thinking and analytical skills are required to acquire and assimilate data in order to make appropriate patient care decisions (NACNEP, 2008, p.6).

These escalating health care needs are compounded by the predicted shortage of nurses. The Health Resources and Services Administration (HRSA) (2006) projected that by 2020 there will be a 33% increase in demand for nurses in Indiana and the shortage
nationwide will reach 1 million. In the 2004 National Sample Survey of Registered Nurses, only 16.4% of RNs nationwide were under the age of 35 and 90% more nurses must be graduated relative to the baseline to meet the projected demand for RN services in the United States in 2020 (Health Resources and Services Administration). The HRSA reported factors contributing to the nursing shortage included licensed nurses working in non-nursing positions, migration to other states, retirement, death, and disability.

The National League for Nursing (2008) reported that greater than 60% of all RN programs in the United States were able to accept fewer than half of all applicants to their programs. Due to the attrition of registered nurses in active practice, schools of nursing are faced with the dual challenges of meeting the demand for the number of nurses and educating nurses who are prepared to meet the increasing demands on the health care system. Further complicating this dilemma is the growing number of nursing faculty vacancies in the United States even as the numbers of full and part-time nursing educators increase (National League for Nursing, 2006).

The nursing profession does not recognize a specific definition of critical thinking. The American Association of Colleges of Nursing (AACN) (2008) defined critical thinking as “all or part of the process of questioning, analysis, synthesis, interpretation, inference, inductive and deductive reasoning, intuition, application, and creativity” (p. 36). Based on their earlier Delphi study for the American Philosophical Association, Facione and Facione (2008) noted that critical thinking is a cognitive and reflective process that is a part of clinical reasoning. Tanner (2006) defined clinical reasoning as the process used by nurses to make a clinical judgment, “an interpretation or conclusion about a patient’s needs, concerns or health problems…” (p. 204). A consensus
definition of critical thinking in nursing was compiled by an expert international panel of nurses from nine countries assembled by Scheffer and Rubenfeld (2000):

    Critical thinking in nursing is an essential component of professional accountability and quality nursing care. Critical thinkers in nursing exhibit these habits of the mind: confidence, contextual perspective, creativity, flexibility, inquisitiveness, intellectual integrity, intuition, open-mindedness, perseverance, and reflection. Critical thinkers in nursing practice the cognitive skills of analyzing, applying standards, discriminating, information seeking, logical reasoning, predicting and transforming knowledge (p. 357).

According to the American Association of Colleges of Nursing (AACN) Essentials of Baccalaureate Education (2008), “the baccalaureate generalist graduate is prepared to…use clinical/critical reasoning to address simple to complex situations” (p. 8).

Measurement of critical thinking skills in nursing has presented a challenge. Tanner (2005) and Scheffer and Rubenfeld (2006) reported that all previous studies of critical thinking in nursing have used critical thinking measures unrelated to nursing practice.

    Scheffer and Rubenfeld (2006) proposed critical thinking as the tool to achieve the Institute of Medicine’s Five Competencies for Health Care and Health Care Education Reforms: patient-centered care, interdisciplinary teamwork, evidence-based practice, quality improvement, and use of informatics. Shell (2001) found that faculty-perceived barriers to teaching critical thinking included student resistance, time constraints, and the need to cover content. Further, nurse educators may not be aware of strategies to teach and evaluate critical thinking (Vacek, 2009). Del Bueno (2005) reported that only 35% of new graduate RNs met the requirements of employers for
critical thinking skills, causing concern that patient needs cannot be safely managed and concluding that nursing curriculum had been more content-focused and less centered on application of knowledge.

To meet the critical thinking requirements of employers, the NLNAC, and the AACN, nursing educators looked for educational strategies proven to develop meaningful learning and evaluate critical thinking. Angel, Duffey, and Belyea (2000) recommended that faculty use evidence-based models to evaluate curricular decisions. Previous research has promoted concept mapping as one teaching-learning strategy and an evaluation tool for critical thinking.

**Background and Significance**

In conducting an extensive literature search of teaching strategies used to increase critical thinking in nursing students and the effectiveness of those strategies, Staib (2003) reported that although critical thinking is a newer concept in nursing, it was first proposed in the 1950s in general education. In 1990, the American Philosophical Association (APA) released a Delphi study of experts from many disciplines establishing a consensus definition of critical thinking. During the following decade, several nursing definitions of critical thinking were published. “Unlike the APA (1990) statement, each nursing definition includes outcomes. It is not enough for nurses to think critically; they must translate thinking into action” (Staib, 2003, p. 499).

Daley, Shaw, Balistrieri, Glasenapp, and Piscentine (1999) noted that as outcomes-oriented nursing education became the focus, it created the need for tools to teach and measure critical thinking in nursing context. Existing tools that measured general critical thinking (e.g. Facione’s [1992] California Critical Thinking Skills Test;
Watson and Glaser’s [1980] Critical Thinking Appraisal), did not “possess a connection to the context of nursing practice” (Daley et al., p. 42). These existing tools failed to prove validity as a measurement of the concept of critical thinking in nursing (Daley et al.).

Abel and Freeze (2006) studied concept mapping “as a clinical teaching-learning activity that reflects critical thinking by promoting identification of non-linear relationships among the components of the nursing process” (p. 356) finding that concept maps complement traditional nursing care plans which are more linear in thinking. Irvine (1995), as cited in Abel and Freeze, considered concept mapping a representation of interpreted ideas in diagrammatic form. Daley et al. (1999) found concept maps to be a metacognitive learning strategy to improve student critical thinking. In the clinical setting, concept maps facilitated students’ drawing complex conceptual relationships about nursing care and served as an outcome measure of critical thinking, linking clinical practice to theoretical material. Schuster (2000) found that replacing traditional columnar nursing care plans with concept mapping enhanced clinical reasoning and critical thinking by visualizing priorities and identifying relationships in patient data. King and Shell (2002) promoted concept mapping as a visualization too for the student to see the patient holistically. Luckowski (2003) utilized concept maps in critical care as a teaching strategy noting that critical thinking can be integrated into curriculums for all nursing levels.

Abel and Freeze (2006) described the hierarchal concept map as used by Irvine (1995) and Daley et al. (1999):
General concepts are placed at the top of the map, and progressively more specific concepts are placed under one another to form a hierarchy. Major concepts are circled or boxed; examples of concepts are not circled nor boxed. Lines show relationships or links, and the direction of the thought process is indicated with arrows. Propositional links between concepts, showing the meaning of the relationship between the two concepts, are represented by connecting lines with words that describe the relationship written along the lines (Abel & Freeze, p. 357).

Abel and Freeze (2006) cited other research that utilized a modified hierarchal map structure, placing the subconcepts peripherally around the center major concept and eliminating the use of propositions on the map (Ignatavicius & Workman [2002]; Baugh & Mellott [1998]; Schuster [2000]; King and Shell [2002]; Castellino & Schuster [2002]). All and Havens (1997) as cited in Abel and Freeze viewed knowledge as “organized hierarchically in a cognitive structure, whereby most new learning involves placing concepts and propositions into existing hierarchies” (Abel & Freeze, p. 357), supporting the use of the hierarchical concept map structure.

Although Ausubel’s Assimilation Theory and concept mapping, its schematic representation, have been used in various educational areas, their use in nursing is relatively new (St. Cyr & All, 2009). Daley et al. (1999) noted that teaching and evaluating critical thinking in nursing students must occur in the context of nursing practice and proposed that concept mapping demonstrated this. Abel & Freeze (2006) proposed that concept mapping reflected critical thinking in nursing because of its “identification of non-linear relationships among the components of the nursing process”
This study proposes to evaluate concept mapping as a strategy to enhance critical thinking in clinical settings with nursing students.

Problem Statement

The demands of caring for more acutely ill patients in health care settings requires nursing graduates to demonstrate critical thinking. The National League for Nursing Accrediting Commission (NLNAC) and the American Association of Colleges of Nursing (AACN) require schools of nursing demonstrate students’ critical thinking competence.

Purpose

The purpose of this study is to evaluate concept mapping as a teaching strategy to enhance critical thinking in nursing students. This is a replication of Abel and Freeze’s (2006) study, which partially replicated the Daley et al. (1999) study.

Research Questions

1. Can baccalaureate nursing students utilize hierarchical concept mapping to create nursing care plans that demonstrate critical thinking by clearly demonstrating priorities and identifying relationships in patient clinical data?

2. Can concept maps measure increases in baccalaureate nursing students’ critical thinking over two senior semesters?

3. How do senior nursing students and associated faculty evaluate concept mapping as a teaching/learning strategy in a clinical setting?
**Conceptual Model**

Ausubel has provided a theoretical framework that supports concept mapping as a strategy to promote critical thinking based on his Assimilation Theory of Learning. In this framework Ausubel proposed that meaningful learning occurs when new knowledge is relevantly linked to pre-existing cognitive structure modifying both in the process of the assimilation (Ausubel, Novak, & Hanesian, 1978). Novak and Gowin (1984) developed concept mapping as an application of Ausubel’s Assimilation Theory of Learning, visually linking concept hierarchies with propositions. These hierarchal cross links establish relationships and synthesis between concepts providing a visual method to share information, correct misperceptions, and facilitate discussion of relationships (Daley et al., 1999).

**Definition of Terms**

**Nursing Process: Conceptual**

“Nursing process consists of assessment, analysis and nursing diagnosis, planning for outcomes and interventions, implementation of interventions, and evaluation of outcomes to provide nursing care” (Abel & Freeze, 2006, p. 358).

**Nursing Process: Operational**

In this study, concept mapping demonstrates linear and nonlinear thinking and “shows the flow of the thought processes involved in implementation of the nursing process” (Abel & Freeze, 2006, p. 359).
Concept Maps: Conceptual

“Concept Maps are graphical depictions of the flow of thought processes, and require analyzing, synthesizing, and evaluating information or knowledge to determine an action or nursing intervention” (Abel & Freeze, 2006, p. 358).

Concept Maps: Operational

In this study, concept maps are the hierarchal “structure with links to form valid propositions” (Abel & Freeze, 2006, p. 357) which is used as a teaching-learning strategy to demonstrate and evaluate critical thinking in nursing education. Map scoring criteria for research analysis purposes will be the same as used by Daley et al., (1999) awarding points for “meaningful, valid and significant” (Abel & Freeze, p. 359) components of the map.

Linear Thinking: Conceptual

According to Abel and Freeze (2006), “Linear thinking involves creation of a hierarchy of concepts that move from general to specific. The hierarchy of concepts is used to build an understanding of relationships, reflects the nursing process, and is based on acquired knowledge from nursing and related sciences, standards of care, policies, and procedures” (p. 358).

Linear Thinking: Operational

Concept maps in this study will use a hierarchal format that place general concepts at the top and more specific concepts below.
**Nonlinear Thinking: Conceptual**

Nonlinear thinking is the “identification of relationships between hierarchies of concepts” (Abel & Freeze, 2006, p. 358).

**Nonlinear Thinking: Operational**

In this study, relationships in the concept maps are shown with connecting lines. The direction between the nursing process components are noted with arrows.

**Critical Thinking: Conceptual**

Abel and Freeze (2006) defined critical thinking as the “deliberate logical reasoning and linear and nonlinear thinking used to analyze, synthesize, and evaluate relationships between components of the nursing process for the purpose of self-regulatory judgments and clinical decision making” (p. 358).

**Critical Thinking: Operational**

For this study, critical thinking is “the numerical score representing linear identification of concepts and the nonlinear relationships among concepts involved in the nursing care of hospitalized clients” (Abel & Freeze, 2006, p. 358). This numerical score is awarded to meaningful, valid, and significant concept map components according to the scoring criteria used by Daley et al. (1999). Propositions, meaningful relationships between two concepts with linking words, receive 1 point. A general to specific hierarchy is awarded 5 points per level. Ten points each are awarded for cross-links connecting hierarchy segments. Specific examples of a concept are awarded 1 point each.

**Limitations**

Generalizability of this study is limited due to the use of a small sample size in a single Midwestern baccalaureate nursing setting. While the gender diversity in the sample
may reflect the predominance of females in the total nursing student population, age and cultural diversity are limited.

**Assumptions**

The following assumptions were made in this study:

- The definitions of critical thinking in nursing are consistent with the nursing process components.
- The nursing process synthesizes current and previous knowledge “to identify and describe client needs, nursing care, and relevant relationships among components” (Abel & Freeze, 2006, p. 358).
- Concept maps graphically demonstrate linear and nonlinear thought processes used in implementing the nursing process.
- Nursing students and faculty will provide honest answers to evaluation questions.

**Summary**

Nurses are caring for more complex patients in acute and non-acute health care settings. This challenge combined with the projected increased demand for RNs, places a demand on nursing educators to employ teaching-learning strategies that enhance critical thinking. The purpose of this study is to evaluate the use of concept mapping as a strategy to enhance critical thinking in nursing students. This study will be a partial replication of the study by Abel and Freeze (2006) in a baccalaureate program. Ausubel provides a theoretical framework that supports concept mapping as a strategy to promote critical thinking based on his Assimilation Theory of Learning. In this framework Ausubel proposed that meaningful learning occurs when new knowledge is relevantly linked to pre-existing cognitive structure modifying both in the process of the assimilation
Novak and Gowin (1984) developed concept mapping as an application of Ausubel’s Assimilation Theory, visually linking concept hierarchies with propositions. These hierarchical cross links establish relationships and synthesis between concepts providing a visual method to share information, correct misperceptions, and facilitate discussion of relationships (Daley et al., 1999).
Chapter II

Review of Literature

Introduction

The demands of caring for more acutely ill patients in health care settings requires nursing graduates to demonstrate critical thinking, the core component of effective clinical judgment. The National League for Nursing Accrediting Commission (NLNAC) and the American Association of Colleges of Nursing (AACN) require schools of nursing demonstrate students’ critical thinking competence. To fulfill these nursing education needs, it is critical for nurse educators to move nursing students from rote learning and linear thinking to utilization of evidence-based methods that enhance students’ critical thinking over time (Abel & Freeze, 2006). Concept mapping requires the nursing student use analysis, synthesis, and evaluation to develop nursing interventions while linking theory and practice (Abel & Freeze; All & Havens, 1997).

Purpose

The purpose of this study is to evaluate concept mapping as a strategy to promote critical thinking in clinical settings with nursing students. This is a replication of Abel & Freeze’s (2006) study, which partially replicated the Daley et al. (1999) study.
Organization of Literature

The literature review to support this study is divided into four sections, (a) theoretical framework, (b) development of critical thinking skills, (c) concept mapping and critical thinking, and (d) concept mapping and clinical learning. The chapter concludes with a summary.

Theoretical Framework

Ausubel’s Assimilation Theory of Learning (Ausubel et al., 1978) is the conceptual framework for this study which is a partial replication of the studies by Daley et al. (1999) and Abel and Freeze (2006). In this cognitive learning theory, Ausubel et al. proposed three kinds of meaningful learning, (a) representational learning which applies names and meaning to symbols; (b) concept learning which gives cognitive structure to categories of objects, events or phenomena; and (c) superordinate propositional learning which relates new proposition to existing knowledge and subsumes the new knowledge. In assimilation, “new information is linked to relevant, preexisting aspects of cognitive structure and both the newly acquired information and the preexisting structure are modified in the process. …Most meaningful learning is essentially the assimilation of new information” (Ausubel et al., 1978, p. 68). According to Novak (2003), Ausubel made a distinction between rote memorization of facts and meaningful learning that relates new knowledge to previous learning in an organized continuum. Novak believed that Ausubel’s Assimilation Theory promoted a shift from behavioral learning strategies to strategies that are cognitive, utilizing a conceptual approach to subsume knowledge through the linking of old and new knowledge. “Meaningful learning occurs when the
learner deliberately seeks to relate and incorporate new information into relevant knowledge structures she/he possesses” (Novak, p. 124).

Daley et al. (1999) summarized the three processes in which learning occurs according to Ausubel’s Assimilation Theory. First, through inductive and deductive thinking, learners organize learning into hierarchies that facilitate learning and remembering concepts. By arranging concepts, “the learners subsume lower-order concepts under higher-order concepts in a hierarchical fashion” (Daley et al., 1999, p. 43). In the next step, new concepts are broken down into components. Lastly, these differentiated concepts are then examined for connections that link them to other concepts through integrative reconciliation.

Utilizing the concepts of Ausubel’s Assimilation Theory, Novak and Gowin (1984) developed concept mapping, a schematic representation of the theoretical framework. Concept maps consist of a hierarchy of concepts connected through linking words called propositions. Broader concepts are at the top of the hierarchy. Different areas of the hierarchy are labeled and connected with cross links that establish relationships and synthesis between concepts. Events or objects that exemplify the concepts are also added to the map. “Concept maps facilitate students’ understanding of conceptual relationships and the structure of knowledge” (Daley et al., 1999, p. 44). As a teaching strategy, concept maps provide a visual method to share information, correct misperceptions, and facilitate discussion of conceptual relationships (Daley, et al). Novak (2003) proposed that concept mapping strongly supports meaningful learning in both instruction and assessment.
Although Ausubel’s Assimilation Theory and concept mapping, its schematic representation, have been used in various educational areas, their use in nursing is relatively new (St. Cyr & All, 2009). Senita (2008) proposed that “concept mapping is a teaching-learning strategy that can be used to evaluate a nursing student’s ability to critically think in the clinical setting. It has been used in disciplines other than nursing to allow the learner to visually reorganize and arrange information in a manner that promotes learning of concepts that interrelate” (p. 6). Daley et al. (1999) noted that teaching and evaluating critical thinking in nursing students must occur in the context of nursing practice and proposed that concept mapping would accomplish that. Abel and Freeze (2006) proposed that concept mapping reflected critical thinking in nursing because of its “identification of non-linear relationships among the components of the nursing process” (p. 356). This study proposes to evaluate concept mapping as a strategy to enhance critical thinking in clinical settings with nursing students.

Development of Critical Thinking Skills

The need for evidence-based clinical decision making requires nurse educators to evaluate instructional methods to enhance knowledge and improve critical thinking. The purpose of Angel et al.’s (2000) study was to measure learning outcomes in acquisition of knowledge and development of critical thinking based on structured and unstructured methodologies used by undergraduate faculty. The study framework was Perry’s Scheme of Intellectual and Ethical Development.

Angel et al. (2000) used a convenience sample (n=142) of undergraduate junior nursing students at a large mid-Atlantic public research university consisting of 93% female, 86% white, and average age 24 years. Subjects had completed N56: Basic
Theories, Processes, and Skills for Beginning Clinical Practice during fall semester 1996. Using post-nursing school admission Watson Glaser Critical Thinking Appraisal scores, students were placed in high, middle, or low categories and quartiles and random stratified groups were used to assign clinical groups. Clinical groups included 2 students each from the high and low categories and 4 from the middle, balancing gender, ethnicity, and GPA as possible. Students were exposed to the same experiences and information. Students groups were assigned to either use a structured (n=72) or unstructured (n=70) format for health pattern assessment.

A case study with eight open-ended questions, six elicited knowledge and two reflected critical thinking, was designed by the researchers. The knowledge questions were scored based on the correct answers for each question and a sum of the knowledge scores. Scoring for critical thinking questions was measure with Nelson Denney and Watson Glaser Critical Thinking Appraisal based on key phrases in student responses which were assigned a numerical value. The sum of the values divided by the number of phrases provided the total score. Data was collected on the first day and at the conclusion of the course. No reliability or validity was reported (Angel et al., 2000).

The first research question explored the change in critical thinking from pre-course to post-course. Angel et al. (2000) found significant differences in all knowledge and critical thinking measures using paired t-tests. Pre and post-course knowledge scores increased an average of 37.99 points from 7.7 to 45.68 (p≤.001). Critical thinking scores increased 2.56 points from 4.31 to 6.8 (p≤.001). To answer the second research question on the influence of structured versus unstructured format on pre- and post-course measurements of knowledge and critical thinking, a split plot repeated ANOVA was
performed. No significant total score differences were found between the structured and unstructured formats. The students using unstructured format did have a greater increase (8.15 versus 7.44) in data present in a health pattern. The third research question investigated certain demographics and pre-course and post-course measurements. The researcher’s data analysis showed that chronological age and previous degree completion did not influence critical thinking or total scores. Age and previous degree did show a significant change in pathophysiology and health pattern assessment categories with unstructured format students showing the greatest change. Multiple regression was used to determine selected demographic data effects on knowledge and critical thinking scores.

The last research question involved prediction of knowledge level or critical thinking performance in beginning BSN students based on academic variables. The authors found that younger students, females, and previous degree students demonstrated larger changes in knowledge, while critical thinking scores and entrance GPA did not affect scores. Critical thinking was not predicted by any of these variables (Angel et al., 2000).

Angel et al. (2000) found that the interface of learning method and learner characteristics may affect education results more than teaching strategy alone. Older students benefited from an unstructured approach while younger benefited from a more structured approach. The researchers recommended the development of a critical thinking tool more specific to nursing. It was recommended that faculty use evidence-based models to evaluate curricular decisions. Further research was needed to explore relationships between teaching methods, knowledge attainment, and learner individuality.

Nursing has struggled to define critical thinking and little research is available on teaching critical thinking in clinical situations. Because the practice of nursing requires
critical thinking skills, nurse educators must prepare students to meet this challenge. In a qualitative, ethnographic multiple case study of baccalaureate nursing faculty by Twibell, Ryan, and Hermiz (2005), perceptions of strategies to teach critical thinking in clinical settings were explored. The sample for this study was 6 faculty members at a Midwestern public school of nursing with at least five years of clinical nursing experience and one year of clinical teaching experience who currently supervised junior or senior clinical nursing experiences in beginning or intermediate adult health, child bearing/rearing, mental health, community health, and nursing management courses. The faculty age ranged from 40-55, four of who had doctoral degrees with 21 to 36 years of nursing practice experience and 11 to 24 years as clinical instructors and two with MSNs and 17 to 20 years of nursing practice experience with 2 to 4 years as clinical instructors.

During one semester at 2 week intervals shortly after a student clinical experience, each participant was asked to describe student behaviors that reflected critical thinking and instructional intervention used to support or direct student critical thinking. These interviews were conducted by one researcher, audio taped, transcribed, and analyzed. Biases were identified and analyzed by two researchers without collaboration. Dependability and confirmability were evaluated by an audit trail of data collection material. Spradley’s developmental research sequence was used to analyze data along with domain analysis and taxonomic analysis (Twibell et al., 2005).

The analysis revealed 5 domains, (a) putting it all together, (b) strategies to promote critical thinking, (c) role of clinical instructors, (d) beneficial characteristics of instructors, and (e) rewards for critical thinking. The first two domains were discussed in the article. “Putting it all together” was noted as central to critical thinking and meant
synthesizing parts into a whole. This domain included information seeking, reflecting, assigning meaning, problem solving, predicting, planning, and applying to novel contexts. “Strategies to promote critical thinking” reflected the importance of the instructor in students’ learning to think critically. This domain included the use of four techniques, (a) high-ordered cognitive questioning, (b) faculty’s comments on students’ written products, (c) clinical conferences, and (d) student journals with clear guidelines for content. Participants were in agreement that these four strategies were beneficial to old and new faculty members seeking to promote critical thinking (Twibell et al., 2005).

Twibell et al. (2005) found there was agreement among respondents about what constituted critical thinking and that clinical faculty were able to explain markers of critical thinking, “…information gathering, synthesis, reflection, assignment of meaning, problem solving, predicting, planning, and applying knowledge to new contexts” (p. 77). The findings paralleled other studies of the definition and components of critical thinking in nursing. The authors note study respondents used the terms problem solving, decision making, clinical judgment and critical thinking without differentiation. The researchers concluded that nurse educators need to be clear about critical thinking skills in order to teach and evaluate these critical skills in clinical settings. Noting that critical thinking in nursing practice has components unique to nursing, the authors stated,

Nurse educators could benefit from a clarification of the shared and unique conceptual space of cognitive activities, including the nursing process, problem solving, decision making, clinical judgment, and critical thinking. Beyond theorizing, consensus on what types of cognitive skills support effective nursing care would be of even greater value” (p. 77).
The researchers found the best strategy for developing student critical thinking skills was the use of a variety of instructional methods. Twibell et al., (2005) recommended further study with diverse groups to determine (a) faculty barriers to developing critical thinking in clinical settings; (b) faculty perception of the relationship of critical thinking to clinical judgment, nursing process, and decision making; (c) methods to measure critical thinking in clinical settings; and (d) variations in faculty critical thinking expectations across curriculum strata.

*Concept Mapping and Critical Thinking*

The emphasis on outcome-oriented education and National League for Nursing requirements for demonstration of critical thinking in nursing school graduates requires nursing faculty find methods to teach and evaluate critical thinking in nursing. Nursing educators need tools that teach, measure, and evaluate critical thinking in students. Daley et al. (1999) explored the use of concept maps to teach and evaluate critical thinking in nursing students. The study’s conceptual framework was based on Ausubel, Novak, and Hanesian’s Assimilation Theory of Learning and explored concept maps’ use in nursing education as a tool to teach and evaluate critical thinking and measure critical thinking changes across a semester. The study also evaluated faculty and student perceptions of concept maps.

The study population consisted of a convenience sample from six senior-level clinical groups within a baccalaureate nursing program (n=54). Three students from each of 6 groups (n=18) were randomly selected for scoring and analysis of the first and last of the three concept maps created during the semester. An unknown number of faculty and
all of the students were asked to evaluate their concept map experiences. No other demographic data was provided (Daley et al., 1999).

During the semester students created three concept maps including client relationships, pathophysiological and pharmacologic factors, and therapeutic nursing interventions. During clinical post-conference discussions the concept maps were used to link course theory and assigned clinical patients. The concept map scoring formula was gleaned from Novak and Gowin Assimilation Theory. Points were awarded for propositional links (1 point each), hierarchy (5 points for each level), cross links (up to 10 points), and examples (1 point each). Reliability was established by independently scoring each map with a correlation score of .82. Content validity was established by two educational researchers reviewing the theoretical premise of concept maps in relation to the American Philosophical Association (APA) Delphi study of critical thinking. Students and faculty also provided anecdotal evaluation (Daley et al., 1999).

Using data analysis the authors found the difference of mean group scores from the students’ first concept map (mean= 40.3889) to the last map score (mean = 135.5556) was 98.1667 with a $t$ value of -5.69 ($p=.001$). This analysis demonstrated an increase in conceptual and critical thinking over the course of the semester. Student anecdotal reviews of concept map use were mixed. Students expressed improved understanding of the interaction of patient conditions, but difficulty in changing learning strategies in their senior year. Faculty felt concept mapping demonstrated student gains and helped visualize students’ thinking processes. Concept maps demonstrated student preparation and needs allowing faculty to address student misperceptions (Daley et al., 1999).
Daley et al. (1999) found that concept maps were a strategy for drawing relationships among patient care concepts making them a tool to teach and evaluate critical thinking. The increase in concept map scores over the course of the semester demonstrated significant improvement in student critical thinking abilities. The authors recommended that faculty consider the most beneficial time within the curriculum to introduce concept mapping techniques. The researchers also recommended further research with larger samples, correlation with other critical thinking measures, and establishing construct validity of concept mapping to measure critical thinking to determine convergence and discriminability.

As nursing educators seek meaningful ways to move students from linear thinking to making meaningful links between past learning and new information, concept mapping is one method being used to develop and assess these critical thinking functions. Abel and Freeze’s (2006) study examined concept mapping as a tool to promote critical thinking by identifying and cross-linking non-linear relationships in the nursing process. The authors explored the ability of ADN students to use concept mapping to demonstrate critical thinking and nursing process in hospital clinical experiences, the use of concept maps’ affects on measured changes in critical thinking over time, and the evaluation of concept maps as a learning strategy by students and faculty.

The conceptual framework was not identified, but this study is a partial replication of Daley et al. (1999) which utilized Assimilation Theory. Abel and Freeze (2006) initiated the study in the second semester of an ASN program lasting five semesters, emphasizing the nursing process and client’s physiological and psychosocial needs.
The population consisted of a convenience sample of 28 of 30 graduating nursing students from one class in a 5-semester ASN program. Two students entered the program third semester and were not included. The sample consisted of 25 women and 3 men, 24 Caucasian, 2 African American, 1 Hispanic, and 1 Asian student with a mean age of 28 years (Abel & Freeze, 2006).

Student concept maps were created in the second and fourth semesters during students’ clinical rotation on a women and children’s unit. During the fifth semester students created one map from their ICU clinical rotation and another from a rehabilitation unit clinical placement. The second semester map and one of the two fifth semester maps were analyzed using Daley et al.’s (1999) concept map scoring criteria based on the American Philosophical Association (APA) definition of critical thinking. The scoring criteria awarded 1 point for each proposition or example of a specific instance of a concept, 5 points for each hierarchal level, and 10 points for each cross-link. A 2002 pilot study also conducted by Abel and Freeze established interrater reliability of the two instructors and scoring criteria. The total score indicated the student’s critical thinking ability within the nursing process. Independent scoring of 51 maps indicated 85% agreement by two instructors. Rescoring two randomly selected maps produced 97% and 94% scorer agreement indicating reliability. Written student and faculty evaluations during the fifth semester provided anecdotal data (Abel & Freeze, 2006).

Concept map total scores based on propositions, cross-links, examples, and hierarchy for the second semester map were 241 and fifth semester were 373. These reflected the nursing process. Cross-link scores were 140 and 260, respectively. The authors evaluated ability to identify and communicate client needs, nursing care, and
relevant relationships through total concept map scores. Total mean scores rose each semester from the first map (mean =73) to the semester 5 map (average mean=249). Mean cross-link scores indicating ability to process current and past knowledge and identify relationships rose from second semester (mean=89) and fifth semester (average mean=143) with statistically significant difference in scores demonstrated by \( t \) test \( t \) value of -3.76 and critical \( t \) value with 27 df of 2.05 (\( p=0.05 \)). The authors found this result confirms concept maps measure changes in critical thinking over time. No significant difference was found in the type of clinical unit where the concept map was developed.

Anecdotally, faculty noted concept mapping directed student focus to holistic patient perspectives, focusing on physiological, psychological, and nursing needs. Concept maps were easier to read, score, and recognize student insight. Knowledge deficits were identifiable to facilitate faculty intervention. Critical thinking was evident. Student evaluations reflected the challenge of moving from linear to nonlinear thinking. Of students who completed the questionnaire, 79% (\( n=22 \)) reported increased nursing care knowledge. Eighteen students (\( n=64\% \)) felt concept mapping should be used in addition to traditional care plans and 68% (\( n=19 \)) suggested introducing the maps in the first or second semester (Abel & Freeze, 2006).

Abel and Freeze (2006) found that concept mapping was an effective teaching strategy to promote critical and nonlinear thinking and the nursing process in an ASN program and to measure students’ critical thinking changes over time. Faculty and students evaluated concept maps as a positive clinical learning activity. The authors felt concept mapping of complex ICU patients was potentially too advanced since ASN students are prepared as generalists. The researchers believed concept mapping should be
introduced early in the nursing program curriculum before students become too focused on traditional care plans. It was concluded that further research was needed to determine which methods and formats to use in applying concept mapping in clinical nursing education.

Nursing faculty face challenges in preparing nursing graduates to care for patients with increasingly acute needs. They seek methods to identify and objectively evaluate critical thinking. Concept mapping is a method to link old and new learning and help students conceptualize patient problems. Hicks-Moore and Pastirik’s (2006) pilot study using descriptive exploratory design with qualitative and quantitative methods explored the use of concept mapping to teach critical thinking and determine critical thinking levels in second year baccalaureate nursing students’ clinical concept maps. The authors’ primary research question was to determine the level and extent of critical thinking in the concept maps of second year nursing students. The authors also sought to determine the effectiveness of Facione and Facione’s Holistic Critical Thinking Scoring Rubric (HCTSR) as a tool to evaluate critical thinking in clinical concept maps, and the second year baccalaureate nursing students’ and clinical instructors’ evaluations of concept mapping to promote critical thinking in clinical education. No conceptual framework was noted in the study. Key concepts in the study included concept mapping, critical thinking, and nursing education.

The study population consisted of second year nursing students in a five week hospital-based clinical setting at the end of winter semester who volunteered to submit their final concept maps to be scored (n=18). Clinical placements included family medicine, restorative care, and obstetrics/gynecology. As a course requirement, students
developed concept map care plans. Concept maps had been introduced to students the previous semester and all students were given information on Schuster’s Concept Mapping Framework which clearly delineated the method to create concept maps. Examples of the HCTSR used to score the clinical concept maps were also given to the students. Eight of the 18 nursing students who submitted concept maps also participated in the student focus group. Three out of six clinical instructors participated in the faculty focus group. No demographic data was available for the student or faculty focus group members (Hicks-Moore & Pastirik, 2006).

Content analysis was used to analyze student and faculty responses to researchers’ open-ended questions during focus groups. The audio taped focus group discussions each lasted approximately one hour. Questioning focused on student experiences developing and using concept maps in clinical settings and faculty perceptions of the strengths and limitations of concept mapping and the HCTSR. Audiotape transcriptions of the discussions and researcher notes of group interaction during student and faculty discussions were analyzed by the two researchers for code words and themes (Hicks-Moore & Pastirik, 2006).

Faculty and researchers scored students’ clinical concept maps using Facione and Facione’s Holistic Critical Thinking Scoring Rubric based on six competencies, (a) interpretation, (b) analysis, (c) evaluation, (d) inference, (e) explanation, and (f) self-regulation. The HCTSR used a Likert 4-point scale to determine critical thinking level with 1 being the lowest critical thinking score and 4 demonstrating the highest levels of critical thinking. No reliability or validity was given for the HCTSR, but the rubric was derived from the California Critical Thinking Disposition Inventory (r=.66, p<.001) and
the California Critical Thinking Skills Test which has a reliability coefficient of .71. Concept maps were scored by the clinical instructors after receiving instructions in a researcher-led information session on concept map scoring using the HCTSR. The student concept maps scored by the instructor were submitted without instructor scores to the two researchers for scoring. Comparison of the instructor and researcher scores demonstrated an intraclass correlation coefficient of .81 demonstrating agreement in level of critical thinking in the concept maps between the coders. Scoring discrepancies were settled using the score awarded by the instructor (Hicks-Moore & Pastirik, 2006).

The findings for the first research question showed HCTSR scores for student concept maps ranged from 2 to 4 with average mean 2.83. Most map scores were 3 or more, indicating that critical thinking was demonstrated most of the time in the concept maps. The second research question pertaining to the effectiveness of the HCTSR to measure critical thinking in concept maps was answered through the analysis of the instructor focus group. Instructors reported the rubric had merit. The generic nature of the HCTSR made it challenging for educators to identify levels of critical thinking in the student concept maps because the rubric criteria did not fit the course. The researchers reported instructors’ perception that scoring the concept maps without the opportunity to speak with students made it difficult to identify the level of student reasoning (Hicks-Moore & Pastirik, 2006).

Findings for the third and fourth research questions came from content analysis of student and instructor responses to the focus group questions. Two central themes, critical thinking and clinical preparedness, emerged from the analysis. Researchers reported student comments from the focus group included complaints of the extended time the
early maps took to develop before their confidence increased to allow more creative and independent thinking about nursing care. Students commented that using concept maps aided them to look at the patients holistically, rationalize care decisions, and prioritize patient care. Clinical instructors noted that critical thinking developed with clinical experience when coupled with teaching strategies like concept mapping. The instructors found that concept maps allowed them to evaluate overall student knowledge including strengths and weaknesses, student’s ability to make clinical judgments, and student’s clinical preparedness. Overall, students and instructors agreed that clinical concept mapping was an effective teaching and learning strategy that heightened student and faculty awareness of critical thinking competencies (Hicks-Moore & Pastirik, 2006).

The authors reported HCTSR was a reliable framework for evaluating critical thinking in second year nursing students, but there were limitations. The generic language made the HCTSR difficult to apply to concept mapping process as used in this study, and the rubric did not include dialogue with the student which would have provided insight into student thinking during the creation of the maps. The researchers recommended further modification and testing of the HCTSR to improve reliability and validity for measuring critical thinking in nursing students. Hicks-Moore and Pastirik (2006) concluded that concept maps fostered critical thinking in nursing students through promotion of holistic patient views. Further study was needed to determine changes in critical thinking over time and to explore concept maps as a strategy to identify and evaluate critical thinking.

Selecting effective methods to teach critical thinking and assure safe and effective client care for students with differing learning styles is a challenge for nursing faculty.
Kostovich, Poradzisz, Wood, and O’Brien (2007) described the relationship between the learning style preference of nursing students and their aptitude for concept maps. The framework was based on Ausubel’s Assimilation Theory and also utilized Kolb’s Learning Style Preference Model.

The population was a convenience sample of all second semester junior or first semester senior students enrolled in a medical surgical nursing course at a private Catholic university in a large city in the Midwest (n=120). No demographic data for the study participants was available (Kostovich et al., 2007).

A Learning Style Survey (LSS), based on Kolb’s Learning Style Inventory, was completed by each student in the study. The LSS ranked statements on a scale of 4 to 1 according to the degree the statement reflects the characteristics of the respondent providing 3 sets of scores. The first score identified the student’s preferred learning style (concrete experiences, active experimentation, abstract conceptualization, or reflective observation). The subscale scores yield a grasping score, the propensity for apprehending new knowledge, and the transforming score, the integration of knowledge into existing cognitive structures. By plotting those two scores on a grid, the preferred learning style was determined. No validity or reliability for the LSS was available in the literature. Internal reliability of the LSS sub scores was low and correlation of subscale scores and retest scores were moderately strong and statistically significant (p<0.05) for concrete experience, active experimentation, and abstract conceptualization scales. Validity was supported by negative correlations between abstract versus concrete subscales and active versus reflective subscales. A second open-ended question instrument was developed to determine preferences for creating concept maps. Concept map grading was based on a
rubric adapted from Novak and Gowin with points awarded for hierarchy, propositions, cross-links and thoroughness. The specific scoring was not contained in this article. One faculty member graded all concept maps to improve reliability (Kostovich et al., 2007).

Learning Style Survey subscale scores showed 29% (n=35) of students preferred concrete learning, 26% (n=31) preferred reflective learning, 23% (n=28) preferred abstract learning, and 22% (n=26) preferred active learning. Correlation between mean concept map grade (89.98, SD=9.15) and mean final course grade (82.68, SD=7.04) were weak (r=0.37, p<0.01). On the survey, the abstract learning preference group showed a preference for concept maps (n=11) versus case studies (n=6) and concrete learners showed a slight preference for concept maps (n=9) versus case studies (n=8). Active learners had no preference of one method over the other, and those who preferred reflective learning chose case studies (n=7) over concept maps (n=4). No relationship between survey comments and learning preference was found (Kostovich et al., 2007).

The study found complex learning strategies such as concept mapping can be effective for all kinds of learning styles. No relationship was noted between learning style preference and aptitude for creating concept maps. Kostovich et al. (2007) noted that the small sample size limited generalization of the findings and development of new measurement instruments for learning style is needed to achieve reliability and validity. The researchers recommended examination of learning style preference and critical thinking development over the course of nursing curriculum to enhance critical thinking skill development.

Hospitals have limited resources to train new graduate nurses. These novice nurses often lack the critical thinking skills needed for safe nursing practice and require
educational support to develop the skills. In a descriptive pre- and post-test design study by Wilgis and McConnell (2008), the use of concept mapping as a teaching strategy to improve critical thinking skills in novice graduate nurses during hospital orientation was examined. Benner’s Novice to Expert Theory was the framework for the study emphasizing critical thinking development in novice hospital nurses.

The study population consisted of a convenience sample of graduate nurses (n=14) beginning a 2-day hospital orientation program in northeast Florida. The participants ranged in age from 23 to 50 years with a mean age of 33 years. Thirteen participants were female and one was male. One was a baccalaureate nursing program graduate who was also the only participant with previous concept mapping experience. All 14 novice nurses had taken a National Council Licensure Examination (NCLEX) review course, 21% had taken and passed the licensure test, and 79% had not yet taken the NCLEX. The majority (64%) had no nursing experience and 36% had previous experience as a patient care technician. Fifty percent had previously been a caretaker for someone (Wilgis & McConnell, 2008).

Participants developed a pre-concept map based on a case study. They utilized a visual format on a flip chart after listening to lectures on methods of concept map construction and instruction on disease processes, the nursing process, and physical assessment. A post-concept map based on a second case study was developed by the novice nurses on the second orientation day after lectures on nursing roles, care technician roles, admitting and emergency procedures, dealing with difficult situations, cultural considerations in patient care, and care planning organizational tips. Pre- and post-concept maps were graded using an instrument based on Schuster’s Concept Map
Grading Tool. The instrument included essential elements for assessing critical thinking and patient care planning in nursing and was based on the American Nurses Association Standards of Nursing Care Practice which included collecting health data, developing a nursing diagnosis through analysis of data, expected patient outcomes, developing a patient care plan, nursing interventions implementation, and evaluating patient outcomes. Points were awarded in 11 areas, (a) identifies physiological problems (6 points); (b) identifies psychological problems (1 point); (c) identifies education needs (3 points); (d) correctly links problems to each other (1 point); (e) correctly identifies main health problem (1 point); (f) writes key assessment findings near problem (1 point); (g) identifies abnormal assessment findings near problem (1 point); (h) indicates medications (1 point); (i) indicates treatments/interventions (4 points); (j) correctly labels diagnosis (1 point); and (k) overall map (5 points): logical (1 point), complexity (1 point), appropriate hierarchical order (3 points). There was a possible total concept map score of 25 points. The same faculty member taught the course and scored the maps. According to Schuster, scoring is reliable (r=0.70 or higher) if the same faculty member teaches and scores the concept maps. Anecdotal information was collected using a written Concept Mapping Evaluation form to categorize and summarize comments from the graduate nurses (Wilgis & McConnell, 2008).

Total concept map scores rose 33 points from pre-map (n=197) to post-map (n=230). The post-concept map mean score (16.43) was higher than the pre-concept map mean score (14.07) with paired sample t-test (t=-2.797, df=13, p=.008) showing significant improvement. The increase in post-test composite scores for linkages (n=6) and intervention (n=19) demonstrated improved ability to identify the main health
problem and appropriate interventions on the post-concept maps. Overall map quality score increased 17 points from pre-test (n=36) to post-test (n=53) indicating increased complexity and logic and appropriate hierarchies. Most of the graduate nurses (n=10) scored higher on the post-map, two had the same score as on the pre-concept map, and two scored lower (Wilgis & McConnell, 2008).

On the Concept Mapping Evaluation forms, 10 out of 14 participants found that using the concept map helped link knowledge, prioritize and organize patient care, and improved critical thinking. Two of the graduate nurses were unsure of their feelings about concept maps and two would not recommend concept mapping because of the time involved (Wilgis & McConnell, 2008).

The study found that concept mapping was a useful teaching and evaluation strategy for novice graduate nurses. The use of concept mapping accelerated graduate nurses’ “ability to synthesize and prioritize information, formulate appropriate care plans, and make judicious decisions about critical clinical situations, thus meeting orientation program objectives and improving critical thinking skills” (Wilgis & McConnell, 2008, p. 124). The small sample size, use of a convenience sample, and test design affected generalizability of the results. The researchers recommended further study to determine if increased scores were due to increased critical thinking or improved technique in constructing the concept maps.

Concept Mapping and Clinical Learning

The needs of patients in both acute and long-term health care and cost cutting measure in health care institutions require nurses to be able to make effective clinical judgments. These judgments require complex reasoning and skilled nursing practices.
Both the National League of Nursing (NLN) and the American Association of Colleges of Nursing (AACN) have noted that the core competency for making these effective clinical judgments is critical thinking. The purpose of the Wheeler and Collins (2003) study was to determine if concept maps used to prepare for clinical experiences proved more effective than traditional care plans in developing critical thinking in baccalaureate nursing students. The framework was based on Ausubel’s Assimilation Theory of Learning.

In reviewing the literature, Wheeler and Collins (2003) found no data on the effectiveness of concept mapping to prepare nursing students to apply critical thinking skills to clinical problems. This study was developed after faculty noted students who had used concept maps to prepare for clinical experiences in a previous course managed complex patient care issues in a different way. The researchers explored the improvement of critical thinking scores in first semester junior nursing students who used concept mapping versus traditional care planning to prepare for clinical experience.

Wheeler and Collins (2003) used a convenience sample (n=76) consisting of a control group (n=32) and experimental group (n=44) of sophomore baccalaureate students enrolled in an introductory nursing course at a southeastern university in the Spring of 1998 who had been accepted into the upper-division program. These students had been accepted into the junior level courses for the next semester. Participation was voluntary and all students participated. The control group consisted of students in two of the three pediatric nursing courses, the students in the maternity nursing course, and the students assigned to the psychiatric nursing course. The experimental group included students enrolled in all sections of the adult health course and the one pediatric nursing
course not included in the control group. Although two-thirds of the sample was less than 22 yeas of age and only 5% male, the two groups did not differ significantly in age or sex.

A demographic questionnaire was given asking sex, age, level of education, and previous experience with concept mapping. Critical thinking skills were measured by the California Critical Thinking Skills Test (CCTST). Two conceptually equal versions of the CCTST were used. Each test was previously studied for reliability and validity. Each version measures the five critical thinking skills (analysis, evaluation, inference, deductive reasoning, and inductive reasoning) and was internally consistent. Face validity and construct validity were established previously by other users of the test. The Kuder-Richardson-20 test was used to compute internal consistencies of both test versions and found them acceptable (Form A=.70, Form B=.71). The CCTST is accepted as an appropriate measure of critical thinking by the NLNAC and validity is supported by the test items’ reflection of the consensus definition of critical thinking by the American Philosophical Association (APA) Delphi study. One version of the test was given as a pretest during the sophomore year of a baccalaureate program. Another version was given as a posttest after students had clinical with or without concept mapping and at the end of fall semester junior year (Wheeler & Collins, 2003).

The pre-test scores between the control and experimental group were not significantly different. After analysis of covariance on the mean difference between pre- and post-tests on the overall CCTST and the subscale, an important F value was obtained, but no noteworthy differences between the experimental and control group were revealed. In analysis of subscale results (analysis, evaluation, inference, deductive reasoning, and
inductive reasoning), there was only a noteworthy difference in the means of the experimental group on the analysis subscale. Deductive and inductive reasoning demonstrated no significant variation between pre- and post-test for either group. A negative mean difference was obtained on the inference subscale for both groups with the control group exhibiting a greater difference. In the pre/post-test CCTST scores, findings showed an overall mean difference for the experimental group of 1.04 with standard error of 0.44 (p=.02) and an analysis mean difference of 0.55 with standard error of 0.19 (p=.005). The evaluation mean difference for the experimental group was 0.62 with standard error of 0.31 (p=.05) and for the control group, 0.89 with standard error 0.36 (p=.01). The inference mean difference for the control group was -0.81 with standard error of 0.29 (p=.007) (Wheeler & Collins, 2003).

The percentile rankings for the entire sample increased from the 62nd percentile to the 66th percentile. The experimental group demonstrated a lower percentile ranking than the entire sample at pre-test, but a higher score at the post-test. This group showed a higher percentage of change than the control group. The percentile rankings for the subscale exhibited the same example of change (Wheeler & Collins, 2003).

Wheeler and Collins (2003) found that concept mapping stimulated discovery learning. Anecdotally, students reported more in-depth learning while using concept mapping. Faculty reported the students who learned concept mapping the previous semester had better problem solving skills in later clinical courses than other students. Better objective methods are needed to measure the effects of concept mapping on critical thinking and analyze outcomes over time and across populations. The authors
suggested the California Critical Thinking Disposition Inventory (CCDTI) might better reflect critical thinking skills in nursing students.

Nursing students must learn to link theory and practice in planning patient care. The use of learning strategies that promote critical thinking facilitate nursing students’ ability to link old and new knowledge. The pilot study by Adema-Hannes and Parzen (2005) evaluated nursing students’ perceptions of the effectiveness and feasibility of using concept mapping in clinical situations. The authors also examined faculty perceptions of the value of using concept maps in the clinical setting. The conceptual framework was not reported. The clinical course used for this study was based on Roy’s Adaptation Nursing Model and the concept map development was derived from Schuster’s studies on the use of concept maps in the clinical setting.

The population for this qualitative study was four groups of nursing students (n=32) in the third year of a baccalaureate program. All 32 students participated in a two hour interactive group tutorial and read a journal article on the use of concept mapping based on the work of Schuster, including receiving a concept map template. Students utilized this template to collect patient data on the unit the day before clinical and were expected to spend two hours preparing for the next morning clinical by constructing a map using this data. Each group used concept maps to plan care each week for 1-2 patients for two 12-week pediatric medical/surgical clinical rotations. The maps were refined by students during the clinical experience based on discussions with tutors and new patient data such as labs, medicines, and patient response. The map refinements demonstrated the students’ increased understanding and knowledge of the patient. The
authors did not provide demographic data for the faculty group (Adema-Hannes & Parzen, 2005).

Students responded to short answer questions from the researchers at the end of the clinical rotation. The questions sought student perceptions of the utilization of concept maps, the effect of concept mapping on clinical reasoning, and the ability to link lab values, medicines, and patient issues using concept maps. The authors did not report if questions and responses were written or oral. Some of the student responses to the use of concept maps in the clinical setting were listed and some summarized in the study (Adema-Hannes & Parzen, 2005).

The authors found that 100% of the students (n=32) rated concept mapping as having improved the ability to link lab values, medications, pathophysiology and patient issues. Improved clinical reasoning was also reported by 100% of the students. Other student responses reported concept maps improved organization, demonstrated student thinking and knowledge, and incorporated research into patient care. Adema-Hannes and Parzen (2005) reported suggestions offered by the nursing students including the need to introduce concept mapping earlier in the curriculum and to incorporate nursing theory into the concept maps. The researchers did not indicate the method of collecting data from faculty, but reported that faculty found concept maps were useful in assessing student knowledge, preparation for clinical, and assessing the student’s ability to link concepts. Faculty specifically commented that concept mapping was interactive and less tedious that traditional paperwork. The faculty noted that students’ initial difficulty with the mapping technique improved as the semester progressed.
The authors found that concept mapping was a visual tool that helped students understand the interrelationships of clinical concepts and client data, organize thoughts, plan patient care, prioritize, and think critically. The authors concluded that concept mapping could be considered as a strategy for awarding grade value in nursing clinical settings and further research should be conducted to establish reliability and validity (Adema-Hannes & Parzen, 2005).

Nurse educators must find ways to develop judgment in nursing students that is not teacher-centered rote learning. In their review of the literature, Hsu and Hsieh (2005) found that “meaningful learning occurs when learners engage in active cognitive processing, including information collection, organization, and integrations” (p. 143). In a study by Hsu and Hsieh concept mapping was evaluated as a learning strategy in nursing education, and the efficacy of concept mapping as an instructional tool across the semester was examined. No conceptual framework was reported by the authors for this study, but the nursing course in which the research was conducted was based on the concepts of Roy’s Adaptation Model of Nursing with a focus on physical function, self-concept, role function, and interdependence. Other concepts used in the study included concept mapping and nursing education.

The study population was all 43 Taiwanese nursing students taking Nursing 1 in the first semester of a two-year nursing program in Fall 2002. Students were assigned to seven groups of 6 or 7 students each to created group concept maps based on scenarios presented by the nursing instructors. During the first two weeks of the course, students were taught how to create scenario-based concept maps utilizing Schuster’s Concept Mapping steps. These steps include reading and analyzing the scenario, identifying
concepts, listing possible solutions to major problems, linking related concepts, making
propositions, discussing and revising the map, and presenting the complete concept map.
(Hsu & Hsieh, 2005).

Six concept maps were developed by each of the seven groups of nursing students
during the semester. Five maps were based on scenarios dealing with physical functions,
activity and rest, fluids and electrolytes, neuroendocrines, sensoryperception, and
sexuality. One map scenario dealt with role functions. After listening to the scenario
presentation each group developed a first draft of the concept map. The group then had
two weeks to make revisions to the map. The total possible map score was 30 points.
Points derived from Novak and Gowin’s concept mapping rubric were awarded in
specific categories, concept links (2 points), hierarchies (5 points), cross links (10 points),
and examples (1 point). The authors did not report who scored the concept maps nor any
reliability or validity for the scoring method. A Proposition Inventory Evaluation Tool
was used by researchers to qualitatively evaluate the concept maps. No further
information was provided on this instrument by the authors (Hsu & Hsieh, 2005).

Data analysis was conducted on the groups’ map scores. The first map scores
were low (total average mean=8, SD 5.16). Qualitative review revealed these maps were
very linear with no cross linkage between nursing diagnoses. The first maps contained
simple concepts and no interventions were included in the map. Researchers graded the
first maps as poor, demonstrating that students had only partial understanding of
relationships between nursing diagnoses. By the third map, drawn in the sixth week of the
semester, the groups demonstrated improvement in concept map scores (total average
mean=19.93, SD 4.57). This improvement continued on the fourth, fifth, and sixth maps
with total average mean scores of 18.14 to 18.64, SD=2.11 to 4.70. Qualitatively the third through sixth concept maps were noted to be hierarchal and highly integrated. Starting with the groups’ third and fourth maps, integrated concept webs were apparent demonstrating cause and effect relationships, analysis of nursing diagnoses, and identification of nursing interventions. The researchers reported that the concept maps developed from linear designs in the first maps to integrated webs in the final maps. Students were able to demonstrate prioritization of problems and interventions (Hsu & Hsieh, 2005).

In answer to the first research question, Hsu and Hsieh (2005) found that group concept mapping was a useful learning strategy for developing critical thinking by demonstrating conceptual relationships and patterns in scenarios, making concept mapping a good strategy in nursing education. Concept maps allow nursing educators to probe students’ misconceptions and provide students with a holistic view of the patient. The researchers also reported that instructor guidance and instructional time are needed to promote students’ higher order thinking skills using concept maps. In answer to the second research question, Hsu and Hsieh concluded that concept map scores rose across the semester demonstrating increased student learning and ability to incorporate nursing concepts into patient care planning.

Due to the diverse and unstructured nature of community-based nursing education, unique nursing knowledge and skills are required. Nursing students must possess a broad perspective of the client with consideration for the nursing care concepts of illness prevention, health promotion, and empowerment. Community-based nursing education requires independent decision making skills including self-direction and
critical thinking. From a review of the literature, Hinck, Webb, Sims-Giddens, Helton, Hope, et al. (2006) found no studies using concept maps to demonstrate the unique health dynamics of nursing in community settings. The purpose of their subsequent study was to determine the effectiveness of using concept map care plans for student learning throughout the semester in a community-based nursing course and to explore students’ satisfaction and evaluation of learning using concept mapping. No research framework was presented for this quasi-experimental study with pre- and post-test, but concepts included concept mapping and community-based education.

The study population was all enrolled junior level nursing students at a Midwest university (n=23) in the spring of 2004 who had previously taken two clinical courses using traditional care plans and were enrolled in a 16 week mental health community-based course. Participation was voluntary. No other demographic data was provided by the authors (Hinck et al., 2006).

In the study, faculty created a rubric based on the inclusion of eight required concept map elements and the appropriateness of the plan. There was a 20-point maximum total score for the map with points assigned for including each of the required eight elements. These required elements were client’s main health concern (1 point), two nursing diagnoses (2 points) that were prioritized for the client (2 points), subjective and objective data to support nursing diagnoses (2 points), long and short term goals present for each nursing diagnosis (4 points), nursing interventions relate to the nursing diagnosis (2 points), evaluation of goals and recommendations for changes in goals (4 points), teaching relevant to nursing diagnosis (2 points), and cross links are present (1 point). Two out of eight concept maps developed during the semester were chosen by the
students to be graded by faculty. Three randomly chosen maps were graded by two investigators using the rubric. Reliability was established through a formula dividing the number of scoring agreements by the number of possible agreements. A discussion of the scoring led to agreement and then three more maps were randomly chosen, scored by investigators, and discussed. Agreement on scores of these initial six maps ranged from .44 to .70. The two investigators then independently scored the remaining 40 concept maps with item agreement ranging from .41 to 1.0 with a mean for all items of .84. One investigator’s scores were used for the data analysis (Hinck et al., 2006).

A 21-item written questionnaire based on the Student Assessment of Learning Gains Instrument was administered to students during class time at the end of the semester. The questionnaire, reviewed for clarity, content appropriateness, format, and style by three doctorate prepared investigators not involved in data collection or analysis for the study, contained 20 Likert scale items to determine the amount of learning with a score of 5 being a great amount of learning and 1 being no learning. One open-ended question asked students to share anything more about concept mapping (Hinck et al., 2006).

Data analysis was conducted with SPSS 12.0 software using a paired t-test comparison of the first map scores (M=17, range 8-20) and seventh map scores (M=19, range 16-20) which demonstrated no decreased scores. A significant increase in the comprehensiveness of student concept mapping was noted over the course (t=-3.01, df=22, p=.006) with less score variation found for the second map. This increase in student concept map scores demonstrated improvement in students’ ability to see patterns
and relationships in patient care and answered the first research question by showing concept mapping was an effective strategy for student learning (Hinck et al., 2006).

The second research question related to student satisfaction and evaluation of learning with the use of concept mapping. Only selected student questionnaire results were reported by the authors. Students’ most favorable method to learn concept mapping was in-class practice as shown in responses to questionnaire Item 3 (M=3.78, SD 0.74) and Item 4 (M=3.74, SD=0.81). The least favorable method to learn mapping was reading about it as indicated in results from Item 5 (M=2.65, SD=1.34). Students appreciated feedback according to the results of Item 9 (M=3.96, SD=0.93) and student questionnaire Item 12 and Item 14 results demonstrated concept maps improved thinking ability (M=3.08, SD1.09) and understanding of complex community situations (M=3.17, SD=0.98). Perceived enhancement of overall learning from Item 20 was favorable (M=3.26, SD1.06) and students believed that concept maps aided in creating community clinical care plans as noted in questionnaire Items 16-19 (M range= 3.22-3.56, SD range=0.84-1.09). The authors reported 21 of 23 students expressed satisfaction with using concept mapping as a learning strategy. Student (n=4) responses to the open-ended question were divided, with two students feeling positively toward the use of concept maps and two expressing preference traditional care plans (Hinck et al., 2006).

The authors reported an improvement in students’ ability to see patterns and relationships in patient care as demonstrated by the increase in student concept map scores over the semester. Most students were satisfied with concept mapping as a learning strategy. More study is needed to assess changes in concept map scores over longer time periods and to find new strategies to measure the effectiveness of concept
mapping. The researchers concluded that the results supported the use of concept mapping as a learning strategy to apply new knowledge to complex patients in the community clinical setting (Hinck et al., 2006).

Developing teaching strategies to enhance and measure critical thinking in nursing students is an essential aspect of nursing education. Samawi’s (2006) study explored concept mapping’s effectiveness as a teaching strategy for critical thinking in junior and senior nursing students. The author also evaluated the development of concept mapping skills over time in this group of students. The framework was based on Ausubel’s Theory of Meaningful Learning and Novak and Gowin’s work on application of meaningful learning using concept mapping.

The population for this quasi-experimental pre-test, post-test study with a nonequivalent control group was a non-random convenience sample (n=77) of junior and senior level baccalaureate nursing students divided into an experimental group from Illinois (n=32) and control group (n=45) from Illinois, Pennsylvania, and Idaho. The majority of the sample was Caucasian or African-American and female (Samawi, 2006).

Samawi (2006) collected data from two concept maps, one from week 7 and the other from week 11 during one semester, developed by the experimental group and scored by faculty using Novak and Gowin’s Concept Mapping scoring rubric. No details of the rubric were given, but the possible total map score is unlimited. The California Critical Thinking Skills Test (CCTST) and the California Critical Thinking Dispositions Inventory (CCTDI) were used to measure critical thinking skills and dispositions. No validity or reliability was reported.
The findings between control and experimental groups’ pre- and post-test critical thinking on subscale and total scores from the CCTST showed no significant difference. The second research question results using the CCTDI also showed no difference between the control and experimental groups in critical thinking dispositions subscale and total scores. Samawi (2006) reported the results of the third research question, using partial correlation to account for the influence of the CCTST pre-test, showed the relationship between CCTST post-test scores and second concept map was not significant. After extracting the influence of CCTDI pre-test scores to answer the fourth research question, the author found the relationship of CCTDI post-test scores and the concept mapping scores was not significant. In the fifth research question, comparing concept map mean scores did show improvement from the first to the second map. The first concept map scores ranged from 61-138 (mean=107.06) and the second map scores from 72-143 (mean=119.56, t=−5.32, p<.001). The author found that the greater complexity of the second maps compared to the first concept maps demonstrated an increase in critical thinking.

Samawi (2006) found that the improvement in the concept mapping scores indicated an increase in the nursing students’ critical thinking, but CCTST was not an effective measure of concept mapping’s effects on critical thinking in nursing students. Ausubel’s Meaningful Learning Theory was supported by the difference in complexity between the first and second concept maps. The author concluded that the study lacked generalizability due to the small sample size and further development of quantitative and qualitative research methods was needed to study concept mapping’s effectiveness as a strategy to teach critical thinking.
Summary

The demands of caring for more acutely ill patients in health care settings requires nursing graduates to demonstrate critical thinking, the core component of effective clinical judgment. The National League for Nursing (NLN), the National League for Nursing Accrediting Commission (NLNAC), and the American Association of Colleges of Nursing (AACN) require schools of nursing demonstrate students’ critical thinking competence. The purpose of this study is to evaluate concept mapping as a strategy to promote critical thinking in clinical settings with nursing students. It replicates Abel and Freeze’s (2006) study which partially replicated the study by Daley et al. (1999). Ausubel has provided a theoretical framework that supports concept mapping as a strategy to promote critical thinking based on his Assimilation Theory of Learning. In this framework Ausubel proposed that meaningful learning occurs when new knowledge is relevantly linked to pre-existing cognitive structure modifying both in the process of the assimilation (Ausubel et al., 1978). Novak and Gowin (1984) developed concept mapping as an application of Ausubel’s Assimilation Theory, visually linking concept hierarchies with propositions. These hierarchical cross links establish relationships and synthesis between concepts providing a visual method to share information, correct misperceptions, and facilitate discussion of relationships (Daley et al., 1999). The literature review revealed that concept mapping was a strategy to teach and evaluate critical thinking and that further study is needed to determine how best to teach and measure critical thinking, expand research to determine generalizability of findings to other demographics and learning styles, determine the effects of concept mapping on critical thinking over time, and assure reliability and validity of measurements and findings.
This literature review was divided into three sections. The first section contained studies pertaining to the development of critical thinking skills, exploring teaching methodologies and faculty perceptions of critical thinking teaching strategies in nursing education. The second section reviewed studies that utilized concept mapping to develop critical thinking in nursing students. In the third section, the reviewed studies related to the use of concept mapping to measure students’ critical thinking in clinical situations.

*Development of Critical Thinking Skills*

In the researchers’ study of baccalaureate nursing faculty, Twibell et al. (2005) explored perceptions of strategies to teach critical thinking skills in clinical settings. Critical thinking in nursing practice has components that are unique to nursing and the best strategy for developing student critical thinking skills was the use of a variety of instructional methods. Further study with diverse groups was recommended to determine (a) faculty barriers to developing critical thinking in clinical settings; (b) faculty perception of the relationship of critical thinking to clinical judgment, nursing process, and decision making; (c) methods to measure critical thinking in clinical settings; and (d) variations in faculty critical thinking expectations across curriculum strata (Twibell et al.).

Angel et al. (2000) measured learning outcomes in acquisition of knowledge and development of critical thinking based on structured and unstructured methodologies used by undergraduate faculty. The interface of learning method and learner characteristics may affect education results more than teaching strategy alone, with older students benefiting from an unstructured approach while younger students benefited from a more structured approach. The researchers recommended the development of a critical
thinking tool more specific to nursing and that faculty use evidence-based models to evaluate curricular decisions. Further research was needed to explore relationships between teaching methods, knowledge attainment, and learner individuality (Angel et al.).

**Concept Mapping and Critical Thinking**

A population of senior baccalaureate nursing students was the sample for a study by Daley et al. (1999) that explored concept mapping’s use in nursing education as a tool to teach and evaluate critical thinking and to measure critical thinking changes across a semester and evaluated faculty and student perceptions of concept mapping. Concept maps were a strategy for drawing relationships among patient care concepts making them a tool to teach and evaluate critical thinking. The increase in map scores over the course of the semester demonstrated significant improvement in student critical thinking abilities. Faculty felt concept mapping demonstrated students’ knowledge gains, preparation, and needs. Students expressed improved understanding of the interaction of patient conditions. The authors recommended faculty consider the most beneficial time within the curriculum to introduce concept mapping, further research with larger samples, correlation with other critical thinking measures, and establishing construct validity of concept mapping to measure critical thinking (Daley et al.).

In a partial replication of Daley et al.’s (1999) study, Abel and Freeze (2006) explored the ability of ADN students to use concept mapping to demonstrate critical thinking and nursing process in hospital clinical experiences, the use of concept maps’ affects on measured changes in critical thinking over time, and the evaluation of concept maps as a learning strategy by students and faculty. Concept mapping was an effective
teaching strategy to promote critical and nonlinear thinking and the nursing process and to measure students’ critical thinking changes over time in an ADN program. Faculty and students evaluated concept maps as a positive clinical learning activity. Concept mapping should be introduced early in the program before nursing students become too focused on traditional care plans. Further research was needed to determine which methods and formats to use in applying concept mapping in clinical nursing education (Abel & Freeze).

Hicks-Moore and Pastirik’s (2006) pilot study explored the use of concept mapping to teach critical thinking and determine critical thinking levels in second year baccalaureate nursing students’ concept maps. The authors also examined the effectiveness of Facione and Facione’s Holistic Critical Thinking Scoring Rubric (HCTSR) as a tool to evaluate critical thinking in clinical concept maps and explored the students’ and clinical instructors’ evaluations of concept mapping in clinical education. Concept maps fostered critical thinking in nursing students through promotion of holistic patient views. Overall, students and instructors agreed that clinical concept mapping was an effective teaching and learning strategy that heightened student and faculty awareness of critical thinking competencies. The HCTSR was reported to be a reliable framework for evaluating critical thinking in second year nursing students with limitations due to difficulty applying the rubric to the concept mapping process used in this study and the absence of a student-faculty dialogue to provide insight into student thinking. Further study was needed to determine changes in critical thinking over time and to explore concept maps as a strategy to identify and evaluate critical thinking (Hicks-Moore & Pastirik).
Kostovich et al. (2007) explored the relationships between the nursing students’ learning style preference and their aptitude for concept maps. Complex learning strategies such as concept mapping can be effective for all kinds of learning styles, but no relationship was noted between learning style preference and aptitude for creating concept maps. Small sample size limited generalizability of the findings and development of new measurement instruments for learning style was needed. Examination of learning style preference and critical thinking development over the course of nursing curriculum was needed to enhance critical thinking skill development (Kostovich et al.).

In a study of the use of concept mapping as a teaching strategy to improve critical thinking skills in novice graduate nurses during hospital orientation, Wilgis and McConnell (2008) found that concept mapping was a useful teaching and evaluation tool for novice graduate nurses. The use of concept mapping improved synthesis and prioritization of information and decision making in critical clinical situations. Small sample size, use of a convenience sample, and test design affected generalizability of the results. Further study was recommended to determine if increased scores were due to increased critical thinking or improved technique in constructing the concept maps (Wilgis & McConnell, 2008).

**Concept Mapping and Clinical Learning**

In exploring the difference in development of critical thinking skills using concept maps versus traditional care plans, Wheeler and Collins (2003) found that concept mapping stimulated discovery learning. Students reported more in-depth learning, and faculty reported the students who had previously used concept mapping had better problem solving skills in later clinical courses than other students. Better objective
methods were needed to measure the effects of concept mapping on critical thinking and analyze outcomes over time and across populations. The California Critical Thinking Disposition Inventory (CCDTI) might better reflect critical thinking skills in nursing students (Wheeler & Collins).

The pilot study by Adema-Hannes and Parzen (2005) evaluated nursing students’ perceptions of the effectiveness of using concept mapping in clinical situations and faculty perceptions of the value of using concept maps. Concept mapping was found to be a visual tool that helped students understand the interrelationships of clinical concepts and client data, organize thoughts, plan patient care, and think critically. Concept mapping could be considered as a strategy for awarding grade value in nursing clinical settings. Further research should be conducted to establish reliability and validity (Adema-Hannes & Parzen).

The effectiveness of using of concept map care plans in a community-based nursing course and the resulting student perceptions were studied by Hinck et al. (2006). Students demonstrated improved ability to see patterns and relationships in patient care. Most students were satisfied with concept mapping as a learning strategy. Concept mapping was supported as a learning strategy to apply new knowledge to complex patients in the community clinical setting. More study was needed to assess changes in concept map scores over longer time periods and to find new strategies to measure the effectiveness of concept mapping (Hinck et al).

Hsu and Hsieh (2005) evaluated concept mapping as a nursing education strategy and the efficacy of concept mapping as an instructional tool across the semester. Group concept mapping was a useful learning strategy for developing critical thinking by
demonstrating conceptual relationships and patterns in scenarios, making concept mapping a good strategy in nursing education. Students demonstrated increased ability to incorporate nursing concepts into patient care planning. Concept mapping allows nursing educators to probe students’ misconceptions and provide students with a holistic view of the patient (Hsu & Hsieh).

Samawi (2006) explored concept mapping as a critical thinking teaching strategy and the development of students’ concept mapping skills over time. Improvement in concept mapping scores indicated an increase in the nursing students’ critical thinking skills over time. The study lacked generalizability due to small sample size. Further development of quantitative and qualitative research methods was needed to study concept mapping’s effectiveness as a strategy to teach critical thinking (Samawi).
Chapter III

Methodology

Introduction

The demands of caring for more acutely ill patients in health care require nursing graduates to demonstrate critical thinking, the core component of effective clinical judgment. The National League for Nursing Accrediting Commission (NLNAC) and the Commission on Collegiate Nursing Education (CCNE) require programs of nursing demonstrate students’ critical thinking competence. Effective evidence-based practice has found concept mapping to be a teaching-learning strategy that reflects critical thinking in nursing education (Abel & Freeze, 2006). This study is a partial replication of the study conducted by Abel & Freeze to evaluate concept mapping as a strategy to promote critical thinking in clinical settings with senior baccalaureate nursing students. This chapter presents the research questions, population, setting, sample, methodology, and procedures utilized for this study.

Research Questions

1. Can baccalaureate nursing students utilize concept mapping to create nursing care plans that demonstrate critical thinking?

2. Can concept maps measure changes in nursing students’ critical thinking over two senior semesters?
3. How do senior nursing students and associated faculty evaluate concept mapping as a teaching/learning strategy in a clinical setting?

Population, Sample, and Setting

The population for this study will include an anticipated convenience sample of all first semester senior baccalaureate nursing students (n=75) currently enrolled in clinical nursing courses as a Midwestern public university. Demographics are expected to reflect those of the school of nursing, predominantly Caucasian, female, and 20 to 32 years of age. The faculty sample will include all clinical and didactic instructors assigned to senior clinical nursing courses.

Protection of Human Subjects

The Ball State University Institutional Review Board and the review board of the participating school of nursing will review and approve this study prior to its initiation. Ethical standards for research will be maintained, as will confidentiality of participants. Data collection will be anonymous. Participation is voluntary and there will be no consequences for refusal. There are no identified risks to study participation and there will be equal benefits to all students who participate.

Procedures

After receiving Institutional Review Board approvals, the participating school of nursing faculty will be contacted and the study will be explained by the researchers. The two researchers will conduct a pilot study to establish interrater reliability and scoring criteria. Faculty members will receive instruction on creating and scoring concept maps. Senior nursing students will receive a full day of instruction on developing concept maps at the beginning of the first senior semester. This instruction will include creating maps in
groups and individually. Students will give written consent if willing to participate in the study. No extra assignments are involved and participation is voluntary. Students may choose at any time to withdraw from participation.

Students will create eight concept maps as part of their clinical experience over the course of the two semesters. After being graded by clinical instructors, the names and scores will be removed from the maps and a random number assigned for each student before the maps are given to the researchers for scoring.

Instrumentation, Reliability, and Validity

Each concept map will be scored using the scoring rubric developed by Daley et al. (1999). This was the same procedure used in the Abel and Freeze (2006) study, which was a partial replication of the Daley et al. study. Content validity for this rubric was established by two educational researchers reviewing concept maps in relation to the American Philosophical Association Delphi study of critical thinking (Daley et al.). The two researchers will conduct a pilot study to establish interrater reliability and scoring criteria. Nursing students’ and faculty anecdotal evaluation will be achieved through a written questionnaire including short answer responses (Abel & Freeze).

Design

This study will utilize descriptive design. No variables are to be manipulated and changes in critical thinking will be measured in the same group of subjects over a period of two semesters (Burns & Grove, 2005). Surveys will also be used to acquire demographic and anecdotal data through self-report. The study will be conducted over two semesters comparing concept map scores across the time period. The maps will be scored by two researchers. Prior to making the first map, nursing students will receive
instruction on the techniques for developing concept maps and faculty will learn how to develop and assess maps.

*Intended Method for Data Analysis*

Data analysis will be conducted using descriptive statistics. Paired *t*-scores will be performed to determine statistically significant differences in concept map mean scores from the beginning to the end of the study indicating changes in critical thinking. In addition, cross-link mean scores, which represent the identification of relationships and synthesis of current and past knowledge, will be examined across the two semesters. Statistical significance level, the probability of a Type I error if the null is true, will be set at 0.05 (Burns & Grove, 2005). Anecdotal survey responses will be examined by the researchers for themes.

*Summary*

Methodology and procedures for this study are described in this chapter. The study partially replicates Abel & Freeze’s (2006) study and will evaluate concept mapping as a strategy to promote and evaluate critical thinking in nursing students. A descriptive study design with additional anecdotal data collection will be used. An anticipated sample of 75 first semester senior nursing students will be used to collect data from their development of eight concept maps over two semesters. Students will receive instruction on concept map development and faculty will be trained to develop and assess concept maps. Concept map total mean scores and cross link mean scores will be analyzed yielding descriptive statistics with a significance level of <0.05, and anecdotal responses to the written surveys will be analyzed for themes. This study will enhance the pool of evidence-based strategies for teaching critical thinking in nursing.
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<td>Angel, Duffey, &amp; Belyea (2000)</td>
<td>The need for evidence-based clinical decision making required nurse educators to evaluate instructional methods to enhance knowledge and improve critical thinking.</td>
<td>Measured learning outcomes in acquisition of knowledge and development of critical thinking based on structured and unstructured methodologies used by undergraduate faculty.</td>
<td>Convenience sample (n=142) of undergraduate junior nursing students at a large mid-Atlantic public research university consisting of 93% female, 86% white, and average age 24 years. Subjects had completed N56: Basic Theories, Processes, and Skills for Beginning Clinical Practice during fall semester 1996. Using post-nursing school admission Watson Glaser Critical Thinking Appraisal scores students were placed in high, middle, or low categories and quartiles and random stratified groups were used to assign clinical groups. Clinical groups included 2 Perry’s Scheme of Intellectual and Ethical Development</td>
<td>Longitudinal quasi-experimental design</td>
<td>A case study with eight open-ended questions, six elicited knowledge and two reflected critical thinking, was designed by the researchers. The knowledge questions were scored based on the correct answers for each question and a sum of the knowledge scores. Scoring for critical thinking questions was measured with Nelson Denney and Watson Glaser Critical Thinking Appraisal based on key phrases in student responses which were assigned a numerical value. The sum of the values divided by the number of phrases provided the total score. Data was collected on the first day and at the conclusion of the course. No reliability or validity was reported.</td>
<td>The first research question explored the change in critical thinking from pre-course to post-course: significant differences were found in all knowledge and critical thinking measures using paired t-tests. Pre and post-course knowledge scores increased an average of 37.99 points from 7.7 to 45.68 (p≤.001). Critical thinking scores increased 2.56 points from 4.31 to 6.8 (p≤.001). Second question on the influence of structured versus unstructured format on pre- and post-course measurements of knowledge and critical thinking; a split plot repeated ANOVA was performed. No significant total score differences were found between the structured and unstructured learning methods and learner characteristics may affect education results more than teaching strategy alone. Older students benefited from an unstructured approach while younger benefited from a more structured approach. Recommended the development of a critical thinking tool more specific to nursing. Recommended faculty use evidence-based models to evaluate curricular decisions. Further research was needed to explore relationships between teaching methods, knowledge attainment, and learner individuality.</td>
<td>Interface of learning method and learner characteristics may affect education results more than teaching strategy alone. Older students benefited from an unstructured approach while younger benefited from a more structured approach. Recommended the development of a critical thinking tool more specific to nursing. Recommended faculty use evidence-based models to evaluate curricular decisions. Further research was needed to explore relationships between teaching methods, knowledge attainment, and learner individuality.</td>
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<td>students each from the high and low categories and 4 from the middle, balancing gender, ethnicity, and GPA as possible. Students were exposed to the same experiences and information. Students groups were assigned to either use a structured (n=72) or unstructured (n=70) format for health pattern assessment.</td>
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<td>The students using unstructured format did have a greater increase (8.15 versus 7.44) in data present in a health pattern. The third research question investigated certain demographics and pre-course and post-course measurements: data analysis showed that chronological age and previous degree completion did not influence critical thinking or total scores. Age and previous degree did show a significant change in pathophysiology and health pattern assessment categories with unstructured format students showing the greatest change. Multiple regression determined selected demographic data effects on knowledge and critical thinking scores. The last research question involved prediction of</td>
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<td>Twibell, Ryan, &amp; Hermiz (2005)</td>
<td>Nursing has struggled to define critical thinking and little research is available on teaching critical thinking in clinical situations. Because the practice of nursing requires critical thinking skills, nurse educators must prepare students to meet this challenge.</td>
<td>Explored perceptions of strategies to teach critical thinking in clinical settings.</td>
<td>Convenience sample of 6 faculty members at a Midwestern public school of nursing with at least five years of clinical nursing experience and one year of clinical teaching experience who currently supervised junior or senior clinical nursing experiences in beginning or intermediate adult</td>
<td>No framework cited</td>
<td>Qualitative, ethnographic multiple case study</td>
<td>During one semester at two week intervals shortly after a student clinical experience, each participant was asked to describe student behaviors that reflected critical thinking and instructional intervention used to support or direct student critical thinking. Interviews were conducted by one researcher, audio taped, transcribed, and analyzed. Biases were identified and analyzed by two researchers without collaboration.</td>
<td>Analysis revealed 5 domains, (a) putting it all together, (b) strategies to promote critical thinking, (c) role of clinical instructors, (d) beneficial characteristics of instructors, and (e) rewards for critical thinking. The first two domains were discussed in the article. “Putting it all together” was noted as central to critical thinking and meant synthesizing parts into a whole. This knowledge level or critical thinking performance in beginning BSN students based on academic variables: Younger students, females, and previous degree students demonstrated larger changes in knowledge, while critical thinking scores and entrance GPA did not affect scores. Critical thinking was not predicted by any of these variables.</td>
<td>Found agreement among respondents about what constituted critical thinking. Clinical faculty were able to explain markers of critical thinking. “… information gathering, synthesis, reflection, assignment of meaning, problem solving, predicting, planning, and applying knowledge to new contexts” (p. 77).</td>
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|        | health, child bearing/rearing, mental health, community health, and nursing management courses. The faculty age ranged from 40-55, four of who had doctoral degrees with 21 to 36 years of nursing practice experience and 11 to 24 years as clinical instructors and two with MSNs and 17 to 20 years of nursing practice experience with 2 to 4 years as clinical instructors. | Dependability and confirmability were evaluated by an audit trail of data collection material. Spradley's developmental research sequence was used to analyze data along with domain analysis and taxonomic analysis. | domain included information seeking, reflecting, assigning meaning, predicting, planning, and applying to novel contexts. "Strategies to promote critical thinking" reflected the importance of the instructor in students’ learning to think critically. This domain included the use of four techniques, high-ordered cognitive questioning, faculty comments on students’ written products, clinical conferences, and student journals with clear guidelines for content. Participants were in agreement that these four strategies were beneficial to old and new faculty members seeking to promote critical thinking. | Findings paralleled other studies of the definition and components of critical thinking in nursing. Respondents used the terms problem solving, decision making, clinical judgment, and critical thinking without differentiation. Nurse educators needed to be clear about critical thinking skills in order to teach and evaluate these critical skills in clinical settings. "Nurse educators could benefit from a clarification of the shared and unique conceptual space of cognitive activities, including the nursing process, problem solving, decision making, clinical judgment, and critical thinking. Beyond theorizing, consensus on what types of cognitive skills support...
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<td>effective nursing care would be of even greater value” (p. 77). The best strategy for developing student critical thinking skills was the use of a variety of instructional methods. Recommended further study with diverse groups to determine (a) faculty barriers to developing critical thinking in clinical settings, (b) faculty perception of the relationship of critical thinking to clinical judgment, nursing process, and decision making, (c) methods to measure critical thinking in clinical settings, and (d) variations in faculty critical thinking expectations across curriculum strata.</td>
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<td>Daley, Shaw, Balistrieri, &amp; Piacentine (1999)</td>
<td>The emphasis on outcome-oriented education and National League for Nursing requirements for demonstration of critical thinking in nursing school graduates requires nursing faculty find methods to teach and evaluate critical thinking in nursing. Nursing educators need tools that teach, measure, and evaluate critical thinking in students.</td>
<td>Explored the use of concept maps to teach and evaluate critical thinking in nursing students.</td>
<td>A convenience sample from six senior-level clinical groups within a baccalaureate nursing program (n=54). Three students from each of 6 groups (n=18) were randomly selected for scoring and analysis of the first and last of the three concept maps created during the semester. An unknown number of faculty and all of the students were asked to evaluate their concept map experiences. No other demographic data was provided.</td>
<td>The study’s conceptual framework was based on Ausubel, Novak, and Hanesian Assimilation Theory of Learning and explored concept maps’ use in nursing education as a tool to teach and evaluate critical thinking and measure critical thinking changes across a semester and to evaluate faculty and student perceptions of concept maps.</td>
<td>Descriptive study</td>
<td>Map scoring: During the semester students created three concept maps including client relationships, pathophysiological and pharmacologic factors, and therapeutc nursing interventions. During clinical post-conference discussions the concept maps were used to link course theory and assigned clinical patients. The concept map scoring formula was gleaned from Novak and Gowin Assimilation Theory. Points were awarded for propositional links (1 point each), hierarchy (5 points for each level), cross links (up to 10 points), and examples (1 point each). Reliability was established by independently scoring each map with a correlation score of .82. Content validity was established by two educational researchers reviewing the theoretical premise of concept maps in relation to the American Philosophical</td>
<td>The difference of mean group scores from the students’ first concept map (mean= 40.3889) to the last map score (mean = 135.5556) was 95.1667 with a t value of -5.69 (p=.001), demonstrating an increase in conceptual and critical thinking over the course of the semester. Student anecdotal reviews of concept map use were mixed. Students expressed improved understanding of the interaction of patient conditions, but difficulty in changing learning strategies in their senior year. Faculty felt concept mapping demonstrated student gains and helped visualize students’ thinking processes.</td>
<td>Concept maps demonstrated student preparation and needs allowing faculty to address student misperceptions. The increase in concept map scores over the course of the semester demonstrated significant improvement in student critical thinking abilities. Recommended that faculty consider the most beneficial time within the curriculum to introduce concept mapping techniques. Also recommended further research with larger samples, correlation with other critical thinking measures, and establishing construct validity of concept mapping to measure critical thinking.</td>
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<td>Abel &amp; Freeze (2006)</td>
<td>Nursing educators are seeking meaningful ways to move students from linear thinking to meaningful links between past learning and new information. Concept mapping is one method being used to develop and assess critical thinking.</td>
<td>Examined concept mapping as a tool to promote critical thinking by identifying and cross-linking non-linear relationships in the nursing process. Explored the ability of ADN students to use concept mapping to demonstrate critical thinking and nursing process in hospital clinical experiences, the use of concept maps' affects on measured changes in critical thinking over time, and the evaluation of student concept maps</td>
<td>Convenience sample of 28 of 30 graduating nursing students from one class in a 5-semester ASN program. Two students entered the program third semester and were not included. The sample consisted of 25 women and 3 men, 24 Caucasian, 2 African American, 1 Hispanic, and 1 Asian student with a mean age of 28 years.</td>
<td>The conceptual framework was not identified, but this study is a partial replication of Daley, Shaw, Balistrieri, Glasenapp, and Piacentine study (1999) which utilized Assimilation Theory. Concepts include concept mapping and critical thinking.</td>
<td>Descriptive design study. It was a partial replication of Daley et al. (1999) study. This study differed by emphasizing the nursing process and included clients’ physiological and psychosocial needs. Daley did a last semester study in a BSN program whereas this study covered a year and was conducted in an ASN program.</td>
<td>Student concept maps were created in the second and fourth semesters during students’ clinical rotation on a women and children’s unit. During the fifth semester students created one map from their ICU clinical rotation and another from a rehabilitation unit clinical placement. The second semester map and one of the two fifth semester maps were analyzed using Daley et al.’s (1999) concept map scoring criteria based on the American Philosophical Association (APA) definition of critical thinking. The scoring criteria awarded 1 point for each proposition or example of a specific instance of a concept, 5 points for each hierarchical level, and 10 Concept map total scores based on propositions, cross-links, examples, and hierarchy for the second semester map were 241 and fifth semester were 373, reflecting the nursing process. Cross-link scores were 140 and 260, respectively. The authors evaluated ability to identify and communicate client needs, nursing care, and relevant relationships through total concept map scores. Total mean scores rose each semester from the first map (mean =73) to the semester 5 map (average mean=249). Mean cross-link scores indicating ability to process current and past knowledge and thinking to determine convergence and discriminability.</td>
<td>Concept maps measured changes in critical thinking over time in an ASN program. Early introduction of concept mapping needs to take place before the students become too focused on traditional nursing care plans. The clinical setting for concept mapping in an ASN program needs to be explored as ASN students are prepared more as generalists and may have more trouble with concept mapping with complex patients in the ICU setting. Further research is needed to</td>
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<td>of concept maps as a learning strategy by students and faculty.</td>
<td>points for each cross-link. A 2002 pilot study also conducted by Abel and Freeze established interrater reliability of the two instructors and scoring criteria. The total score indicated the student’s critical thinking ability within the nursing process. Independent scoring of 51 maps indicated 85% agreement by two instructors. Rescoring two randomly selected maps produced 97% and 94% scorer agreement indicating reliability. Written student and faculty evaluations during the fifth semester provided anecdotal data.</td>
<td>identify relationships rose from second semester (mean=89) and fifth semester (average mean=143) with statistically significant difference in scores demonstrated by t test t value of -3.76 and critical t value with 27 df of 2.05 (p=0.05). No significant difference was found in the type of clinical unit where the concept map was developed. Anecdotally, faculty noted concept mapping directed student focus to holistic patient perspectives, focusing on physiological, psychological, and nursing needs. Concept maps were easier to read, score, and recognize student insight. Knowledge deficits were identifiable to facilitate faculty intervention. Critical thinking was evident. Student evaluations reflected the</td>
<td>investigate successful methods to apply concept mapping in clinical nursing education; could lead to concept mapping being considered as a primary teaching method.</td>
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<td>Hicks-Moore, &amp; Pastrik (2006)</td>
<td>Nursing faculty are challenged to prepare nursing graduates to care for patients with increasing needs. Educators need methods to identify and objectively evaluate critical thinking (CT). Concept mapping (CM) is a method to link old and new learning and help students.</td>
<td>Pilot study to explore the use of concept mapping to teach critical thinking and determine critical thinking levels in 2nd year baccalaureate nursing students' clinical concept maps. 1. What level and extent of critical thinking is in the concept maps of nursing.</td>
<td>2nd year nursing students in a 5 week hospital-based clinical setting at the end of winter semester who volunteered to submit final CM to be scored (n=18) and participate in focus group (n=8). Clinical placements included family medicine, restorative care, and OB/GYN. 3 out of 6 clinical</td>
<td>Framework not delineated. Concepts included concept mapping and critical thinking.</td>
<td>Descriptive exploratory design with qualitative and quantitative methods</td>
<td>Content analysis was used to analyze responses from student and faculty focus group findings from audiotape and notes to determine themes from responses to open ended questions on experiences developing and using CM in clinical settings for students and strengths and limitations of CM and HCTSR for faculty. Holistic CT Scoring Rubric by Facione and Facione was used to measure CT based on HCTSR for concept map scores ranged from 2-4 with mean average 2.83. Most scores were 3 or more meaning that CT was demonstrated most of the time in CM. Focus group responses reviewed by 2 researchers to identify words and themes. 1st theme: CT: students were able to link multiple patient concepts and look at patient holistically.</td>
<td>Concept mapping and dialogue with students offered greater insight on student reasoning than concept mapping and HCTSR alone.</td>
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<td>Kostovich, Poradzisz, Wood, &amp; O'Brien (2007)</td>
<td>Selecting effective methods to teach critical thinking and assure safe and effective client care for students with differing learning styles is a challenge for nursing faculty.</td>
<td>Described the relationship between the learning style preference of nursing students and their aptitude for concept maps.</td>
<td>A convenience sample of all second semester junior or first semester senior students enrolled in a medical surgical nursing course at a private Catholic university in a large city in the Midwest (n=120).</td>
<td>Based on Ausubel's Assimilation Theory and Kolb's Learning Style Preference Model</td>
<td>Correlational descriptive study to describe the relationship between learning style preference and concept mapping aptitude in nursing students.</td>
<td>A Learning Style Survey (LSS), based on Kolb's Learning Style Inventory, was completed by each student in the study. The LSS ranked statements on a scale of 4 to 1 according to the degree the statement reflected the characteristics of the respondents providing 3 Learning Style Survey subscale scores showed 29% (n=35) of students preferred concrete learning, 26% (n=31) preferred reflective learning, 23% (n=28) preferred abstract learning, and 22% (n=26) preferred active learning. Correlation between mean concept map</td>
<td>Complex learning strategies such as concept mapping can be effective for all kinds of learning styles. No relationship was noted between learning style preference and aptitude for creating concept maps. The small</td>
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No demographic data for the study participants was available.

Sets of scores. The first score identified the student’s preferred learning style (concrete experiences, active experimentation, abstract conceptualization, or reflective observation). The subscale scores yielded a grasping score, the propensity for apprehending new knowledge, and the transforming score, the integration of knowledge into existing cognitive structures. By plotting those two scores on a grid, the preferred learning style was determined. No validity or reliability for the LSS was available in the literature. Internal reliability of the LSS sub scores was low and correlation of subscale scores and retest scores were moderately strong and statistically significant (p<0.05) for concrete experience, active experimentation, and abstract conceptualization scales. Validity was supported by negative correlations between grade (89.98, SD=9.15) and mean final course grade (82.68, SD=7.04) were weak (r=0.37, p<0.01). On the survey, the abstract learning preference group showed a preference for concept maps (n=11) versus case studies (n=6) and concrete learners showed a slight preference for concept maps (n=9) versus case studies (n=8). Active learners had no preference of one method over the other, and those who preferred reflective learning chose case studies (n=7) over concept maps (n=4). No relationship between survey comments and learning preference was found.

Sample size limited generalization of the findings and development of new measurement instruments for learning style was needed to achieve reliability and validity. Recommended examination of learning style preference and critical thinking development over the course of nursing curriculum to enhance critical thinking skill development.
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<td>Wilgis, &amp; McConnell (2008)</td>
<td>Hospitals have limited resources to train new graduate nurses. These novice nurses often lack the critical thinking skills needed for safe nursing practice and require educational support to develop the skills.</td>
<td>Examined use of concept mapping as a strategy to improve critical thinking skills in novice graduate nurses during hospital orientation.</td>
<td>Convenience sample of graduate nurses (n=14) beginning a northeast Florida hospital 2 day orientation program. The age range was 23 to 50 years with mean age of 33 years. Thirteen participants were female, 1 was male. One was a</td>
<td>Benner’s Novice to Expert Theory was the framework for the study emphasizing critical thinking development in novice hospital nurses.</td>
<td>Utilized pre- and post-test design.</td>
<td>A pre-concept map was developed based on a case study utilizing a visual format on a flip chart after lectures on methods and construction of concept maps and instruction on disease processes, nursing process, and physical assessment. A post-test concept map was developed by the novice nurses on the second day after</td>
<td>Total concept map scores rose 33 points from pre-test (n=197) to post-test (n=230). The post-concept map mean score (16.43) was higher than the pre-concept map mean score (14.07) with paired sample t test (t=-2.797, df=13, p=.008) showing significant improvement. The increase in post-test</td>
<td>Concept mapping was a useful teaching and evaluation strategy for novice nurses. Use of concept mapping accelerated graduate nurses’ “ability to synthesize and prioritize information, formulate appropriate care</td>
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<td>baccalaureate nursing program graduate who was also the only participant with previous concept mapping experience. All 14 had taken an NCLEX review course, 21% had taken and passed the licensure test and 79% had not yet taken the NCLEX. The majority 64% had no nursing experience and 36% had previous experience as a patient care technician. Fifty percent had been a caregiver for someone. On the first day of orientation, participants were given lectures on concept mapping methods and construction, specific disease processes, the nursing process, and physical assessment.</td>
<td>lectures on nursing roles, care technician roles, admitting and emergency procedures, dealing with difficult situations, cultural considerations in patient care, and care planning organizational tips. Pre- and post-concept maps were graded using an instrument based on Schuster's Concept Map Grading Tool. The instrument included essential elements for assessing critical thinking and patient care planning in nursing and was based on the American Nurses Association Standards of Nursing Care Practice, collection of health data, developing a nursing diagnosis through analysis of data, expected patient outcomes, development of a patient care plan, nursing interventions implementation, and evaluation of patient outcomes. Points were awarded in 11 areas, (a) identifies physiological problems (6 points), (b) identifies composite scores for linkages (n=6) and intervention (n=19) demonstrated improved ability to identify the main health problem and appropriate interventions on the post-concept maps. Overall map quality score increased 17 points from pre-test (n=36) to post-test (n=53) indicating increased complexity and logic and appropriate hierarchies. Most of the graduate nurses (n=10) scored higher on the post-map, 2 had the same score as on the pre-concept map, and 2 scored lower. On the Concept Mapping Evaluation forms, 10 out of 14 participants found that using the concept map helped link knowledge, prioritize and organize patient care, and improved critical thinking. Two of the graduate nurses were unsure of their feelings about plans, and make judicious decisions about critical clinical situations, thus meeting orientation program objectives and improving critical thinking skills” (p. 124). Small sample size, use of convenience sample, and test design affected generalizability. Further study needed to determine if increased scores were due to increased critical thinking or improvement in construction techniques of concept maps.</td>
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<td>psychological problems (1 point), (c) identifies education needs (3 points), (d) correctly links problems to each other (1 point), (e) correctly identifies main health problem (1 point), (f) writes key assessment findings near problem (1 point), (g) identifies abnormal assessment findings near problem (1 point), (h) indicates medications (1 point), (i) indicates treatments/interventions (4 points), (j) correctly labels diagnosis (1 point), (k) overall map (5 points): logical (1 point), complexity (1 point), appropriate hierarchical order (3 points). There was a possible total score of 25 points. The same faculty taught the course and scored the maps. Scoring is reliable (r=0.70 or higher) if the same faculty teaches and scores according to Schuster. A written Concept Mapping Evaluation form was used to categorize and</td>
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<td>concept maps and two would not recommend concept mapping because of the time involved.</td>
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<td>Wheeler, &amp; Collins (2003)</td>
<td>The needs of patients in both acute and long-term health care and cost cutting measures in health care institutions require nurses to be able to make effective clinical judgments. These judgments require complex reasoning and skilled nursing practices. Both the National League of Nursing (NLN) and the American Association of Colleges of Nursing (AACN) have noted that the core competency for making these effective clinical judgments is critical thinking.</td>
<td>Determine if concept maps used to prepare for clinical experiences proved more effective than traditional care plans in developing critical thinking in baccalaureate nursing students.</td>
<td>A convenience sample (n=76) consisting of a control group (n=32) and experimental group (n=44) of sophomore baccalaureate students enrolled in an introductory nursing course at a southeastern university in the Spring of 1998 who had been accepted into the upper-division program. These students had been accepted into the junior level courses for the next semester. Participation was voluntary and all students participated. The control group consisted of students in two of the three pediatric nursing courses.</td>
<td>The framework was based on Ausubel’s Assimilation Theory of Learning.</td>
<td>Quasi-experimental pre- and post-test design with a control group</td>
<td>Demographic questionnaire was given asking sex, age, level of education, and previous experience with concept mapping. Critical thinking skills were measured by the California Critical Thinking Skills Test (CCTST). Two conceptually equal versions of the CCTST were used. Each test was previously studied for reliability and validity. Each version measured the five critical thinking skills (analysis, evaluation, inference, deductive reasoning, and inductive reasoning) and was internally consistent. Face validity and construct validity were established previously by other users of the test. The Kuder-Richardson-20 test was used to compute internal consistencies of both test versions and found</td>
<td>The pre-test scores between the control and experimental group were not significantly different. After analysis of covariance on the mean difference between pre- and post-tests on the overall CCTST and the subscale, an important F value was obtained, but no noteworthy differences between the experimental and control group were revealed. Subscale results (analysis, evaluation, inference, deductive reasoning, and inductive reasoning) showed there was only a noteworthy difference in the means of the experimental group on the analysis subscale. Deductive and inductive reasoning demonstrated no significant variation</td>
<td>Concept mapping stimulated discovery learning. Anecdotally, students reported more in-depth learning while using concept mapping. Faculty reported the students who learned concept mapping the previous semester had better problem solving skills in later clinical courses than other students. Better objective methods were needed to measure the effects of concept mapping on critical thinking and analyze outcomes over time and across populations. The authors suggested the California Critical Thinking Disposition Inventory (CCDTI)</td>
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<td>the students in the maternity nursing course, and the students assigned to the psychiatric nursing course. The experimental group included students enrolled in all sections of the adult health course and the one pediatric nursing course not included in the control group. Although two-thirds of the sample was less than 22 years of age and only 5% male, the two groups did not differ significantly in age or sex.</td>
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<td>them acceptable (Form A=.70, Form B=.71). The CCTST is accepted as an appropriate measure of critical thinking by the NLNAC and validity is supported by the test items' reflection of the consensus definition of critical thinking by the American Philosophical Association (APA) Delphi study. One version of the test was given as a pretest during the sophomore year of a baccalaureate program. Another version was given as a posttest after students had clinical with or without concept mapping and at the end of fall semester junior year.</td>
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<td>between pre- and post-test for either group. A negative mean difference was obtained on the inference subscale for both groups with the control group exhibiting a greater difference. In the pre/post-test CCTST scores, findings showed an overall mean difference for the experimental group of 1.04 with standard error of 0.44 (p=.02) and an analysis mean difference of 0.55 with standard error of 0.19 (p=.005). The evaluation mean difference for the experimental group was 0.62 with standard error of 0.31 (p=.05) and for the control group. 0.89 with standard error 0.36 (p=.01). The inference mean difference for the control group was -0.81 with standard error of 0.29 (p=.007). The percentile rankings for the entire</td>
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<td>Adema-Hannes, &amp; Parzen (2005)</td>
<td>Students must learn to link theory and practice in planning patient care.</td>
<td>Pilot study evaluated students’ perceptions of the effectiveness and feasibility of using concept mapping in clinical situations.</td>
<td>4 groups of nursing students (n=32) in their third year used concept maps to plan care for 1-2 patients on a weekly basis for two 12-week pediatric medical/surgical unit clinical rotations.</td>
<td>No framework noted.</td>
<td>Qualitative</td>
<td>Short answer questions answered by students at the end of the clinical rotation addressing students’ perceptions of the utilization of concept maps, their effects on clinical reasoning, and the ability to link lab values, medicines, pathophysiology and patient issues. Completed by students at the end of the clinical rotation.</td>
<td>Faculty: useful in assessing student knowledge, preparation, links between concepts. Students: 100% rated increased ability to link labs, meds, pathophysiology, and patient issues as improved. 0% no change. 0% deteriorated. 100% rated improved clinical reasoning versus no change or deteriorated. Offered suggestions: Introduce concept mapping earlier. Incorporate nursing theory.</td>
<td>Concept mapping was a visual tool that helped students understand the relationship of clinical concepts and client data. Helped organize thoughts, plan patient care, prioritize, and think critically. Consider concept mapping as a strategy for awarding grade value in clinical settings.</td>
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<td>Hsu, &amp; Hsieh (2005)</td>
<td>Nurse educators must find ways to develop judgment in nursing students that is not teacher-centered role learning. In their review of the literature, Hsu and Hsieh (2006) found that “meaningful learning occurs when learners engage in active cognitive processing, including information collection, organization, and integrations” (p. 143).</td>
<td>Evaluated concept mapping (CM) as a learning strategy in nursing education and examined concept mapping’s efficacy as an instructional tool across the semester.</td>
<td>All 43 Taiwanese nursing students taking Nursing 1 in the first semester of a two year nursing program in Fall 2002. Students were assigned to seven groups of 6 or 7 students, to create group concept maps based on scenarios. During the first two weeks of the course, students were taught how to create scenario-based concept maps utilizing Schuster’s Concept Mapping steps.</td>
<td>Framework not delineated. The Nursing 1 course was based on the concepts of Roy’s Adaptation Model of Nursing with a focus on physical function, self-concept, role function, and interdependence. CM scoring was based on Novak and Gowin’s Concept Map Scoring rubric.</td>
<td>Not reported. Six concept maps were developed by each of the seven groups of nursing students during the semester. Five were based on scenarios dealing with physical functions (AR-activity and rest, FEs-fluids and electrolytes, NEs-neuroendocrines, SP-sensoryperception, and SEX-sexuality) and one map dealt with role functions (RF). Each group developed a first draft then had two weeks to make revisions. Data analysis categories and point value for each: concept links (2 points), hierarchies (5 points), cross links (10 points), and examples (1 point). The total possible map score was 30 points. A Proposition Inventory Evaluation Tool was used by researchers to qualitatively evaluate concept maps. No further information was provided on this instrument.</td>
<td>The first map scores were low (total average mean=8, SD 5.16). Maps were very linear with no cross linkage between nursing diagnoses. These maps contained simple concepts and no interventions were contained in the map. Qualitatively, the maps were graded as poor, demonstrating students had only partial understanding of relationships between nursing diagnoses. On the third map, drawn in the sixth week of the semester, the groups demonstrated improvement (Total average mean=19.93, SD 4.57). This improvement was seen on the fourth, fifth, and sixth maps with total average mean scores of 18.14 to 18.64, SD=2.11 to 4.70. Qualitatively, the third through sixth concept maps were hierarchal and highly integrated. Starting concept map scores rose across the semester demonstrating increased student learning and ability to incorporate nursing concepts into patient care planning.</td>
<td>Group concept mapping was a useful learning strategy for developing critical thinking by demonstrating conceptual relationships and patterns in scenarios. Concept mapping allowed the instructor to probe students’ misconceptions. Concept maps provided holistic view of patient. Instructor guidance and instructional time were needed to promote students’ higher order thinking skills. Concept map scores rose across the semester demonstrating increased student learning and ability to incorporate nursing concepts into patient care planning.</td>
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<td>Hinck, Webb, Sims-Giddens, Helton, Hope, Utley, Savinske, Fahey, &amp; Yarbrough (2006)</td>
<td>Due to the diverse and unstructured nature of community-based nursing education, unique nursing knowledge and skills are required. Nursing students must possess a broad prospective of the client and care concepts of illness prevention, health promotion, and empowerment.</td>
<td>Determine the effectiveness of concept mapping for student learning and explore student satisfaction and evaluation of learning using concept mapping.</td>
<td>All enrolled junior level nursing students at a Midwest university (n=23) in the spring of 2004 who had previously taken two clinical courses using traditional care plans and were enrolled in a 16 week mental health course. Participation was voluntary.</td>
<td>No framework presented. Concepts include concept mapping and community-based nursing education.</td>
<td>Quasi-experimental design with pre- and post-test</td>
<td>2 of 8 concept maps created after training on concept mapping for faculty and students were graded based on tool developed by nursing clinical faculty. Grade was based on inclusion of 6 required elements and planned appropriateness for the client to a maximum of 20 points/map. Elements and maximum point award: client's main health concern (1 point), two nursing diagnoses (2 points) prioritized for the client (2 points), subjective and objective</td>
<td>Data analysis was conducted with SPSS 12.0 software using paired t-test comparison of first and 7th concept maps. First map scores: M=17, range 8-20. 7th map: M=19, range 16-20 with no decreased scores. Significant increase in concept map comprehensiveness noted over the course (t=-3.01, df=22, p=.006) with less variation in score for the second map. Only selected questionnaire results</td>
<td>Student concept map scores increased over the semester demonstrating improvement in student ability to see patterns and relationships in patient care. More study was needed to assess score changes over time and to find strategies to measure effectiveness of concept mapping. Results supported use of concept mapping as a</td>
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<td>Community-based nursing education requires independent decision making skills including self-direction and critical thinking. The literature had no examples of studies using concept maps to demonstrate the unique health dynamics of nursing in community settings.</td>
<td>data to support nursing diagnosis (2 points), long and short term goals for each nursing diagnosis (4 points), nursing interventions relate to the nursing diagnosis (2 points), evaluation of goals and recommendations (4 points), teaching relevant to nursing diagnosis (2 points), cross-links are present (1 point). Teachers scored maps then two investigators re-scored maps. Reliability established through formula and discussion. Agreement on initial six maps used for reliability: .44-.70. On following 40 concept maps, agreement on individual item scores ranged from .41 to 1.0 (mean of all item scores .84). Lower agreement areas: identification of goals and evaluation of care. Only one investigator’s score was used in data analysis. Also, 21 item written student questionnaire reviewed by three doctorate</td>
<td>were reported. Students’ most favorable method to learn concept mapping was in-class practice on Item 3 (M=3.79, SD 0.74) and 4 (M=3.74, SD=0.81) and least favorable method was reading in Item 5 (M=2.65, SD=1.34). Students appreciated feedback according to results of Item 9 (M=3.96, SD=0.93). Students scores demonstrated concept maps improved thinking ability (M=3.08, SD1.09) and understanding of complex community situations ((M=3.17, SD=0.98). Enhancement of overall learning was favorable (M=3.26, SD1.06) and students believed that concept maps aided in creating community clinical care plans as noted in 3 questionnaire items (M range= 3.22-3.56, SD range=0.84-1.09). Student (n=4)</td>
<td>learning strategy to apply new knowledge to complex patients in the community clinical setting. Small sample size precluded generalization of results. Grading concept maps was a challenge due to issues of reliability and consistency of scoring. 21 out of 23 students were satisfied with concept maps as a learning strategy.</td>
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<td>Samawi (2006)</td>
<td>Nurse educators recognized the importance of teaching strategies to enhance and methods to measure critical thinking in nursing students.</td>
<td>Explore concept mapping’s effectiveness as a teaching strategy for critical thinking and evaluated the development of concept mapping skills over time in junior and senior level baccalaureate nursing students.</td>
<td>Non-random convenience sample (n=77) of junior and senior level baccalaureate nursing students divided into experimental group from Illinois (n=32) and control group (n=45) from Illinois, Pennsylvania, Idaho. The majority were</td>
<td>Ausubel’s Theory of Meaningful Learning and Novak and Gowin’s work on Application of Meaningful Learning using Concept Mapping</td>
<td>Quasi-experimental pre-test, post-test with a nonequivalent control group.</td>
<td>2 concept maps, one from week 7 and one from week 11 were developed by the experimental group and scored by faculty using Novak and Gowin Concept Map Scoring. Specifics of the scoring rubric were not given but the possible score is unlimited. California Critical Thinking Disposition Inventory (CCTDI) and California Critical Thinking Skills Test (CCTST) were</td>
<td>prepared investigators not involved in data collection/analysis, was administered during last class of semester. Questionnaire was based on Student Assessment of Learning Gains Instrument and contained 20 Likert scale items to determine amount of learning with 5 being great amount and 1 being no learning. One open-ended question asked students to share any other information about concept mapping. responses to the open-ended question were divided with 2 students feeling positively toward the use of concept maps and 2 expressing preference traditional care plans.</td>
<td>The study lacked generalizability due to small sample size. CCTST was not an effective measure of concept maps’ effects on critical thinking as improvement in concept map scores indicated increased critical thinking. Quantitative and qualitative research methods.</td>
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<td>used to measure critical thinking skills and dispositions. No validity or reliability was noted.</td>
<td>from 1st concept map score ranged from 61-138 (mean=107.06) to 2nd map range of 72-143 (mean=119.56) t=-5.32, p.&lt;0.01. Complexity of the 2nd map was greater than the 1st demonstrating increase in critical thinking.</td>
<td>were needed to study concept mapping’s effectiveness as a strategy to teach critical thinking.</td>
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References


