

CONCEPT MAPPING AS A METHOD TO PROMOTE CRITICAL THINKING OF
NURSING STUDENTS IN THE CLINICAL SETTING

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BY

MARIA HINES

DR. KAY HODSON CARLTON – ADVISOR

BALL STATE UNIVERSITY

MUNCIE, INDIANA

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ABSTRACT

RESEARCH PAPER: Concept Mapping as a Method to Promote Critical Thinking of Nursing Students in the Clinical Setting

STUDENT: Maria Hines

DEGREE: Master of Science

COLLEGE: College of Applied Sciences and Technology

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Because of the complexity of our current health care system, new graduates need to problem solve and critically think. Educational accreditation agencies have required nursing schools to incorporate critical thinking in their objectives and to validate this with outcomes. Educators are faced with the task of how best to prepare nursing students to become problem solvers and critical thinkers for entry into the work force. The purpose of this study is to determine if baccalaureate nursing students who use concept mapping to prepare for clinical experiences will show greater improvement in critical thinking skills than those who did not. This is a replication of Wheeler and Collins' (2003) study. The conceptual framework is Ausubel's Assimilation Theory of Learning. A quasi experimental study with a pre and post design will be conducted at a large university in the Midwest. A convenience sample of 100 junior level nursing students will be randomly assigned to an experimental (N=50) and control group (N=50). Concept mapping will be taught to the experimental group and only traditional care planning to the control group. For one year, students will utilize one of these methods to prepare for clinical and for clinical assignments. The California Critical Thinking Skills Test will measure critical thinking for the pretest and post test. Findings will demonstrate whether concept mapping is more effective in developing critical thinking ability in the clinical setting.

Chapter One

Introduction

Registered nurses represent the largest working group in health care today. In order to meet the demands of a dynamic and complex health care system, more registered nurses will be needed. The United States Department of Labor Statistics has projected that more than one million new and replacement RNs will be needed by 2012 due to the increased demand, and the retirement of an aging workforce (National Advisory Council on Nurse Education and Practice, 2008). With the retirement of expert nurses, inexperienced nurses will have fewer experienced resources available to them.

Despite the need for more RNs, thousands of qualified undergraduate nursing students are not granted admission to nursing programs. In 2007- 2008, there were 190,483 applications to baccalaureate programs in the US. Although admission criteria were met by 122,001 of the applicants, only 80,616 applicants were accepted. This figure represents only a 42.3 % acceptance rate. The greatest reason for this discrepancy cited by 62.5% of respondents was lack of qualified faculty (American Association of Colleges of Nursing, 2009).

Compounding these findings is the reality that just producing more nurses is not enough. Better educated nurses with complex skills and abilities are required to deliver safe and quality patient care in a health care system that continually changes. Nursing

graduates need to be prepared to not only be compassionate caregivers, but highly skilled problem solvers and critical thinkers. In addition, nursing graduates need to be culturally competent to care for a diverse population and technologically savvy to meet the advancing technological health care system (National Advisory Council on Nurse Education and Practice, 2008).

Nursing educators are faced with a dilemma: prepare nursing students who critically think in order to function within a complex and changing health care system with a decreasing number of experienced nurses. Clinical reasoning for nursing graduates is essential to making clinical judgments, the outcome of critical thinking. Clinical reasoning is noted as a basis for nursing practice for the baccalaureate nursing generalist and involves the assimilation of knowledge and skills essential to practice. Critical thinking is defined as “all or part of the process of questioning, analysis, synthesis, interpretation, inference, inductive and deductive reasoning, intuition, application, and creativity” (American Association of Colleges of Nursing, 2009, p.36). Educators need to incorporate teaching strategies in the classroom and the clinical area that effectively promote and enhance critical thinking in nursing students. This, in turn, will ensure better clinical reasoning which will lead to safe clinical judgments. Further study is needed to denote which methods to promote critical thinking are evidence-based and produce the desired outcome.

Background and Significance

Because of the increased demands and complexity of the current health care system, critical thinking has been deemed an essential attribute of nursing graduates in order to provide quality and safe patient care. In addition, the National League for

Nursing Accrediting Commission (National League for Nursing Accrediting Commission, 2008) and the American Association of Colleges of Nursing (American Association of Colleges of Nursing, 2009) require critical thinking as a core competency for nursing students. Even though critical thinking is important in nursing education and to nursing graduates, the definition and measurement of critical thinking remains an issue. A lack of clarity in the literature is evident in the many definitions of critical thinking utilized, multiple ways of measuring critical thinking in nursing students, and the need for more evidence-based research into what teaching methods are most effective to promote critical thinking (Turner, 2005).

Research studies have utilized many different definitions of critical thinking. Some of the most frequently cited definitions are Paul (1992), Watson and Glaser (1980), Beyer (1995), Kataoka-Yahiro and Saylor (1994), Ennis and Millman (1985), and Facione (1990). Most of these studies utilized the Delphi Project on Critical Thinking definition (Turner, 2005). The Delphi Project on Critical Thinking consisted of a panel of 46 experts in critical thinking which reached a consensus on a definition. They defined critical thinking as “a process of purposeful, self-regulatory judgment that uses interpretation, analysis, inference, evaluation, explanation, and reflective reasoning to consider the evidence from all angles before deciding what to believe or do” (Wheeler & Collins, 2003, p.339). The use of multiple definitions in the research on critical thinking has led to a lack of clarity and a decrease in the usefulness of studies since each defines the outcome differently.

The next area fraught with difficulty has been the standardized instruments used to measure critical thinking. Three standardized instruments: The Watson-Glaser Critical

Thinking Appraisal (WGCTA), The Critical Thinking Skills Test (CCTST), and The California Critical Thinking Dispositions Inventory (CCTDI) were most widely used to measure critical thinking dispositions. Findings for the studies employing these tests found inconsistent results (Walsh & Seldomridge, 2006).

Nineteen research studies from 1977-1992 reported using the WGCTA to determine the critical thinking ability of nursing students. The review found “nine studies reported a significant increase in critical thinking abilities, 6 reported no significant change in those abilities, and 4 reported mixed results” (Staib, 2003, p.504). Two studies after 1992 using a pretest-posttest design with the WGCTA also obtained different results. Rossignol, as cited in Walsh and Seldomridge (2006), examined whether different teaching methods would improve WGCTA scores in senior baccalaureate students. Results indicated that higher scores were achieved in only one semester, but with less student participation. This finding conflicted with the idea that participation augments critical thinking. Brown, Alverson, and Pepa, as cited in Walsh and Seldomridge measured critical thinking at the beginning and end of a nursing program for undergraduates and RN to BSN students. Studies which used the WGCTA found an increase in scores at the end of the program for both groups (Walsh & Seldomridge).

Two different longitudinal studies utilizing the CCTST illustrated the same lack of consensus in measuring critical thinking with this tool. As cited in Walsh and Seldomridge (2006), Beckie, Lowry, and Barnett (2001) reported improved CCTST scores in one of three groups; whereas, Spelic, Parsons, Hercinger, Andrews, Parks, and Norris (2001) discovered an increase in CCTST scores in three undergraduate groups.

Studies that utilized both the CCTST and the CCTDI found conflicting results. Profetto-McGrath (2003), as cited by Walsh and Seldomridge (2006), reported an improvement in CCTST scores from year 1-4 in baccalaureate nursing students, but no change in year 3. A strong relationship was shown between the CCTST and the CCTDI, but there was no statistical difference noted between the four groups of nursing students except in the subscale systematicity. Another research study by McCarthy, Schuster, Zehr, and McDougal (1999), as cited by Walsh and Seldomridge, noted a similar improvement in CCTST and CCTDI scores in nursing students from sophomore to senior year. Subscales with noted significant differences were truth-seeking, confidence, analyticity, and inquisitiveness. Highlighting the inconsistencies with these tests, Stone, Davidson, Evans, and Hansen, 2001, as cited by Staib (2003), reported no relationship between the CCTST and CCTDI in baccalaureate senior nursing students and decided “the CCTDI does not measure characteristics needed for nursing-specific critical thinking skills” (Staib, 2003, p.505).

Moving away from the difficulty in defining and measuring critical thinking, researchers focused on teaching strategies in the classroom that facilitated the critical thinking ability of nursing students. Various active teaching and learning strategies, such as computer assisted instruction, case studies, reflective journaling, discourse strategies were researched (Staib, 2003). One of the active teaching and learning methods proposed to promote critical thinking was concept mapping. Concept maps were first developed by Novak in the 1980s while at Cornell University. Novak explained concept maps “as an organizational tool to represent knowledge as well as a metacognitive strategy to promote meaningful learning” (Gul & Boman, 2006, p.201). Another term for concept maps is

mind maps. This technique has been used in many other disciplines, such as science, mathematics and educational psychology. These other disciplines have also utilized concept maps as indicators of critical thinking. In nursing, concept maps present nursing concepts about patient care in a pictorial form. The concept map is a visual representation that aids a student in organizing data and seeing relationships between patient's problems by linking concepts with arrows or lines. Concept mapping is an active learning method that directs students to engage in meaningful learning, which can lead to critical thinking (Wheeler & Collins, 2003).

Several research studies have reported the effectiveness of concept mapping as a teaching learning method in nursing. Rooda (1994), as cited by Clayton (2006), explored the use of concept mapping with sophomore students in a research course. This study noted increased academic performance in the experimental group that used concept mapping as opposed to a control group. In addition, the students found the teaching strategy fun and useful (Clayton).

Daley (1996), as cited by Wheeler and Collins (2003), utilized concepts maps to compare the thinking of first year nursing students in an associate degree program to their instructors and determine if students were linking theory with practice. After conducting interviews with faculty and students, Daley created concept maps from the interviews and compared the thought processes of faculty and students. Daley was able to compare the thought processes of first year nursing students and see where they were "getting the big picture" and what concepts necessitated assistance.

Gaines (1996), as cited by Clayton (2006), evaluated the use of concept mapping in a BSN pharmacology course with junior level students. Concept maps were prepared

on drug classifications while students collaborated in groups. Concept maps and student's exam scores showed significant correlation. This increase in exam scores and correlation with concept maps indicated concept maps aided in student's academic success (Clayton, 2006).

Caelli (1998), as cited in Clayton (2006), examined if concept mapping aided in Australian nursing students' understanding of health promotion. The students wrote concept maps related to health outside of class and utilized them for class and discussions. After comparing the first and last concept maps written by the students, the researcher found an 86 % increase in clarity. The majority of students reported that concept mapping was an effective learning tool to understand health (Clayton).

Kathol, Geiger, and Hartig (1998), as cited by Wheeler and Collins (2003), discovered an advantage to utilizing concept maps was preparation for clinical experiences. Students were able to analyze, synthesize, evaluate, and apply new concepts and knowledge by constructing the concept maps. Faculty reported greater ease in identifying learning difficulties, and students enjoyed the learning process (Wheeler & Collins).

Another Australian study explored the use of concept mapping to teach science to baccalaureate nursing students. Wilkes, Cooper, Lewin, and Batts (1999) found concept mapping promoted students to be more independent learners and gain more confidence in science. In addition, concept mapping aided the students in more personalized and meaningful learning which linked science and nursing in their practice.

Castellino and Schuster (2002) examined the use of concept mapping, as opposed to traditional care plans, as a strategy to promote critical thinking and problem solving

with post-RN degree nurses who returned to nursing school to further their education. The students used concept maps for 17 weeks in a clinical advanced concepts course in Pakistan. The students and faculty completed a questionnaire evaluating the use of concept mapping at the end of the semester. The students and faculty reported satisfaction with concept mapping for many reasons. Concept mapping fostered organization and critical thinking because it required the students to view the patient holistically and to construct relationships between patient problems, not just copy information from a care planning book. Faculty reported an advantage of using concept maps was the strategy allowed the students to identify learning difficulties and provided immediate feedback (Castellino & Schuster, 2002).

In order to quantify the effectiveness of concept maps as a strategy that promoted critical thinking in the clinical setting, Wheeler and Collins (2003) conducted a quasi-experimental, pretest-posttest design with a control group study with junior level baccalaureate nursing students. The researchers compared concept mapping and traditional care plans as preparation tools for clinical learning. BSN students increased their critical thinking scores on the California Critical Thinking Skills Test (CCTST) after one semester, but the study did not show a statistically significant difference between concept mapping and traditional care planning. The researchers suggested the utilization of a different tool and one that may be more sensitive in measuring critical thinking in nursing (Wheeler & Collins).

The difficulties regarding the research for critical thinking and concept maps are evident. Nursing studies in this area are needed to contribute to the evidence-based research for nursing education. Replication of studies is also needed to develop a sound

research base. As Dr. Marilyn Oermann, Professor and Chair of Adult and Geriatric Health in the School of Nursing at The University of North Carolina stated:

Research on concept maps illustrates the problem. Most studies on concept maps in nursing education explore their use in promoting critical thinking or problem solving, but define these outcomes differently and unfortunately, do not measure them with the same tools. It would be more useful for the development of the evidence base if researchers extended and replicated studies to learn more about the effectiveness of concept mapping with different student groups, in addition to learning when and how to use concept maps (National Council of State Boards of Nursing, 2009, p.1).

This study is significant as a partial replication of the Wheeler and Collins (2003) study. The findings will add to the research base about concept mapping and its effectiveness to improve the critical thinking skills of nursing students.

Statement of Problem

The present health care system is growing more complex and challenging. Better educated nurses with complex skills and abilities are required to deliver safe and quality patient care in a health care system that continually changes (National Advisory Council on Nurse Education and Practice, 2008). Nursing educators are faced with a dilemma: prepare nursing students for professional practice who critically think in order to function within a complex health care system with a decreasing number of experienced nurses. Educators need to incorporate teaching strategies in the classroom and the clinical area that effectively promote and enhance critical thinking in nursing students. Concept mapping is one of these strategies.

Purpose of the Study

The purpose of this study is to determine if baccalaureate nursing students who use concept mapping to prepare for clinical experiences will show greater improvement in critical thinking skills than those who did not.

Research Question

Are there differences in critical thinking skills in two groups of baccalaureate nursing students, one which used concept mapping and one which used traditional care plans?

Theoretical Framework

Ausubel's Assimilation Theory of Learning is the theoretical underpinning of this study. Ausubel stated that meaningful learning takes place when a person relates new learning to prior knowledge. This new information is not just added to the old information, but reacts with the old information to produce a new, more detailed cognitive structure. In contrast to rote learning which is just memorizing material, meaningful learning aids in longer retention of knowledge because relationships and links are established between concepts (Ausubel, 1968).

This framework is appropriate for this study because concept mapping is an active teaching and learning strategy that seeks to find relationships between patient problems. It promotes meaningful learning. Meaningful learning is necessary for a person to critically think and problem solve.

Definition of Terms

Critical Thinking: Conceptual.

Critical thinking will be defined as “purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, inference, as well as the explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment was based” (Facione, 1990, p.4).

Operational: Critical Thinking.

Nursing students’ critical thinking skills in this study will be measured by the California Critical Thinking Skills Test (CCTST). The CCTST used is based on the five critical thinking cognitive skills identified in this definition. In addition, the CCTST includes items that reflect this definition.

Conceptual: Concept Map

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).

Operational: Concept Map

In nursing, concept maps are a pictorial tool to organize and plan nursing care while showing relationships between problems (Schuster, 2008). In this study, concept maps will be scored according to Novak and Gowin’s (1984) concept map scoring criteria for grading purposes in the course, but scores will not be utilized.

Conceptual: Baccalaureate Nursing Students

Students that are enrolled in a four year college or university nursing program which includes freshmen, sophomores, juniors, and seniors.

Operational: Baccalaureate Nursing Students

For the purpose of this study, baccalaureate nursing students will only include junior level nursing students enrolled in a four year college or university.

Conceptual: Traditional Care Plans

Traditional care plans are five-column linear worksheets that utilize the nursing process to plan and guide nursing care for a client. The nursing process includes assessment, nursing diagnosis, planning, implementation, and evaluation.

Operational: Traditional Care Plans

In this study, traditional care plans will be defined as the care plans utilized by the nursing department at Indiana-Purdue University, Fort Wayne campus (Indiana-Purdue University, 2010b)

Limitations

Generalization is limited because the study will only be conducted at one Midwestern university. In addition, this one setting will limit gender and cultural diversity among the participants. Generalizability to other types of nursing programs will be limited by the use of only baccalaureate nursing students.

Assumptions

This research study makes two assumptions. Critical thinking can be measured by the California Critical Thinking Skills Test. Concept mapping is a teaching strategy that is beneficial to nursing students and effective for all learning styles.

Summary

Changing demographics and economic factors mandate that nurses in greater numbers must enter the workplace with superior and fully developed critical thinking

skills. The National League for Nursing Accrediting Commission and the American Association of Colleges of Nursing require critical thinking as an outcome measurement of nursing education. The challenge for nursing educators will be to find ways to enhance critical thinking skills in the classroom and clinical experiences. Concept mapping is an active teaching strategy that has been reported to enhance critical thinking abilities in nursing students.

The purpose of this study is to determine if baccalaureate nursing students who use concept mapping to prepare for clinical experiences will show greater improvement in critical thinking skills than those who did not. This study will be a partial replication of Wheeler and Collins (2003) study. Ausubel's Assimilation Theory of Learning will be the framework to guide the study.

Chapter II

Review of Literature

Introduction

The present health care system is growing more complex and challenging. Some factors contributing to this complexity are increased demands for service from better educated clients, higher patient acuity, and increased cost saving measures adopted by agencies because of a struggling economic climate. In addition, multifaceted needs of a culturally diverse population, an increased use of technology and new medications play a role in this demanding environment. Better educated nurses with complex skills and abilities are required to deliver safe and quality patient care in a health care system that continually changes (National Advisory Council on Nurse Education and Practice, 2008).

Nursing graduates need to be prepared to not only be compassionate caregivers, but need to be highly skilled problem solvers and critical thinkers. Nursing graduates also need to be culturally competent to care for a diverse population and technologically savvy to meet the advancing technological health care system. The National League for Nursing Accrediting Commission (National League for Nursing Accrediting Commission, 2008) and the American Association of Colleges of Nursing (American Association of Colleges of Nursing, 2009) have required nursing schools to incorporate critical thinking in their objectives and to validate this with outcomes. Educators are

faced with the task of how best to prepare nursing students to become problem solvers and critical thinkers for entry into the work force.

This quasi experimental study with a pre and post design is a replication of Wheeler and Collins' (2003) study. The same research variables will be used with a different population. The research design will be tighter because the same students will use concept mapping to prepare for clinical for an entire year. The Wheeler and Collins' (2003) study only studied the students over a semester and only three students utilized concept mapping for the entire semester.

Purpose

The purpose of this study is to determine if baccalaureate nursing students who use concept mapping to prepare for clinical experiences will show greater improvement in critical thinking skills than those who did not.

Organization of Literature

The review of literature examined faculty perception of critical thinking strategies and the evaluation of critical thinking using structured or unstructured methods of assessments. Concept mapping as a teaching/learning strategy to promote critical thinking skills in the classroom using scenarios and in relation to student learning preferences was explored. In addition, concept mapping as a teaching/learning strategy to enhance critical thinking skills in the clinical setting utilizing different measurement tools was also examined. The literature was divided into four sections: (a) theoretical framework: Ausubel's Assimilation Theory of Learning, (b) critical thinking development, (c) critical thinking and concept maps, and (d) concept mapping and clinical learning.

Theoretical Framework

Ausubel's Assimilation Theory of Learning was the guiding theoretical framework for this study. Ausubel's theory is centered on cognitive learning or the acquisition and use of knowledge. Ausubel defined concepts as "objects, events, situations, or properties that possess common criteria attributes and are designated by some sign or symbol" (Ausubel, Novak, & Hanesian, 1978, p.56). According to this framework, concept acquisition has two processes: concept formation and concept assimilation. Concept formation is developed during the preschool years; whereas, concept assimilation is developed later as children and adults. In the development of the theoretical framework, Ausubel's primary focus was concept assimilation rather than concept formation.

Ausubel's central idea for concept assimilation was meaningful learning. Ausubel believed that meaningful learning was produced when new information was incorporated by an individual and assimilated with old information. This new information was not just added to the old information, but reacted with the old information to produce a new, more detailed cognitive structure (Ausubel, 1968). As Ausubel stated, "If I had to reduce all educational psychology to just one principle it would be this: The most important single factor influencing learning is what the student already knows. Ascertain this and teach him accordingly" (Ausubel et al., 1978, p. 163).

According to Ausubel's theoretical framework, three criteria need to be met for meaningful learning to take place. The learner needs to approach the material with an engaging mindset. Secondly, the material must make sense or be logical to the student.

Finally, the learner needs comparable ideas for the new material to relate with (Ausubel et al., 1978).

Ausubel contrasted meaningful learning with rote learning. Rote learning is any learning that does not fit the criteria for meaningful learning and does not promote the learner to make relationships between concepts. Meaningful learning aids in longer retention of knowledge; whereas, rote learning results in forgotten learning because relationships and links are not established between concepts (Ausubel, 1968). In addition, Ausubel proposed that once learning was assimilated, it was hierarchically organized in cognitive structure from the most to least inclusive concepts (Ausubel et al., 1978).

Since the learner must choose to put forth the effort to use the process of meaningful learning, the educator can support this process by utilizing tools that promote active learning. Ausubel et al. (1986) related concept mapping as one of these tools to promote meaningful learning. Novak and Gowin (1984), as cited in Schuster (2008), defined concept maps as “schematic devices for representing a set of concept meanings embedded in a framework of propositions...as hierarchical graphical organizers that serve to demonstrate the understanding of relationships among concepts” (p.2). The hierarchical structure and the development of cross links are two aspects of concept maps that promote critical thinking. Concept mapping is an active strategy that engages the learner to search for relationships between their previous knowledge and new knowledge.

The purpose of this study is to determine if baccalaureate nursing students who use concept mapping to prepare for clinical experiences will show greater improvement in critical thinking skills than those who did not. Ausubel’s Assimilation Theory of Learning is important because it defines meaningful learning and rote learning. Concept

mapping is a method that promotes meaningful learning which is needed for problem-solving and critical thinking.

Critical Thinking Development

In this fast paced, complex ever changing society, nurses are needed in health care who can problem solve and think critically in clinical settings. Nursing educators are confronted with the need to prepare students who can meet these challenges and think critically upon graduation. Therefore, nurse educators need to understand the thinking methods of expert nurses and develop and teach these methods to student nurses. As the researchers reviewed the literature, they found little consensus on the definition of critical thinking or validated strategies for teaching it. Most studies used a quantitative design and did not explore in-depth descriptions by educators. In a qualitative study, Twibell, Ryan, and Hermiz (2005) investigated “the perceptions of nursing faculty members as they teach critical thinking skills to baccalaureate student nurses in clinical settings” (p.72). The conceptual framework for this study was not identified.

The study was conducted at a public Midwestern university and utilized a convenience sample of six nursing instructors. All the faculty members were women ranging in age from 40 to 55 years. Four of the subjects had doctoral degrees and two had master’s degrees. Their years in nursing practice ranged from 17 to 36 years and their years as a clinical instructor ranged from 2 to 24 years (Twibell et al., 2005).

This qualitative study’s design was an ethnographic, multiple case study approach. Data was collected three times in a semester by a series of interviews after clinical laboratory experiences with students, each two weeks apart. These interviews were

recorded, copied, and analyzed for themes and relationships. The following questions were asked:

1. Think about a student who performed well in clinical experiences this week. Describe the student's behaviors that evidenced progress toward satisfactory critical thinking. Describe the student's words that evidenced progress in critical thinking skills.
2. What did you say or do to support this student's critical thinking? Describe your actions or words that may have directed the student's critical thinking. What characteristics of your instruction were intended to stimulate or support the development of critical thinking? (Twibell et al, 2005, p.73)

Strategies of credibility, fittingness, auditability, and confirmability were performed and guaranteed accuracy and precision. Data was analyzed using the first 8 steps of Spradley's developmental research development sequence. Several steps were merged together. Spradley's method utilized domain and taxonomic analysis.

Findings indicated that five domains became apparent. These were summarized by the themes: putting it all together, strategies to promote critical thinking, role of clinical instructors, beneficial characteristics of instructors, and rewards for critical thinking (Twibell et al., 2005, p.73). Only the first two domains were emphasized because they were the most comprehensive and mentioned by most of the research subjects. "Putting it all together" was the central theme for critical thinking and incorporated the seven subcategories of information seeking, reflecting on experiences, assigning meaning, problem solving, predicting, planning, and application to novel contexts.

The second domain, “strategies to promote critical thinking”, identified the instructor as key to enhancing critical thinking. The participants stated four methods to use: questioning, written assignments, clinical conferences, and journaling. Sample questions divided under phases of the nursing process were given as examples of what instructors could use to promote critical thinking. How to handle student’s reactions to questioning was also addressed. A common theme that emerged in all methods was the role of the instructor in how they structured assignments and asked questions in order to stimulate higher thinking processes (Twibell et al., 2005).

Twibell et al. (2005) concluded that clinical faculty explained markers of critical thinking and agreed about what constitutes it. These findings agreed with other studies about the definition of critical thinking and its vital components in nursing. The authors found that the seven subcategories of “putting it all together” are the skills that represented a critical thinker.

The researchers concluded that since critical thinking was considered a valued process in nursing, educators needed to be clear about what skills represent critical thinking in order to evaluate students and teach it. Participants agreed that questioning promoted critical thinking as well as comments on written work and journaling, but a variety of methods should be incorporated (Twibell et al., 2005).

The study was limited because all the respondents were women who taught in one nursing school. Since this study was conducted in a baccalaureate nursing program, any generalization to associate or graduate degree programs was limited. The authors recommended replication with larger and more diverse samples in terms of demographics and the type of nursing program. One topic the researchers proposed for future study was

faculty perceptions of how problem solving, decision making, clinical judgment, nursing process, and critical thinking are conceptually interrelated. Additional areas of focus proposed for future studies included challenges that faculty may face while attempting to utilize methods to develop critical thinking in clinical settings, variations in instructors' expectations for students at different curricular levels, and potential methodology for valid and reliable measurement of critical thinking in the clinical setting. The researchers concluded the study provided a framework for understanding critical thinking and strategies for teaching it, and demonstrates the efficacy and importance of these strategies in educating nurses to think critically in the clinical setting (Twibell et al., 2005).

In order to examine what teaching methods affect critical thinking, Angel, Duffey, and Belyea (2000) conducted a quasi experimental, longitudinal study researching whether structured or unstructured approaches in a clinical course increased critical thinking of students. Although educators agreed the knowledge and critical thinking ability of nursing students must be improved, the researchers found little data to support what teaching methodologies were most effective. The framework utilized in the research study was Perry's scheme of intellectual and ethical development.

Angel et al. (2000) conducted their research at a large mid-Atlantic public research university. The convenience sample consisted of 142 undergraduate junior nursing students who completed an introductory clinical course. Ninety-three percent were female and eighty-eight were white with an average age of twenty-four. Students were placed in clinical groups by their score on the Watson Glaser Critical Thinking Appraisal, gender, ethnicity, and entrance GPA to achieve variation. Each clinical group was designated to use a structured format for health pattern assessment or an unstructured

pattern. The structured format was organized and thought to foster learning in introductory students; whereas, the unstructured format necessitated more thinking on the part of the student and mirrored the unpredictability of clinical settings. Seventy-two students utilized the structured format and seventy utilized the unstructured one.

The authors examined four research questions. First, they explored whether a nursing student's measured level of knowledge and critical thinking were different before the course and after the course. A pretest-posttest design, which consisted of "...an open-ended questionnaire using a case study approach, was developed to measure growth in substantive knowledge and to elicit characteristics of critical-thinking ability" (Angel et al., 2000, p.224). Data was collected on the first day and at the end of the course by the researchers. A significant increase ($p < 0.001$) in both the level of knowledge and total critical thinking scores was supported by the data on the paired t test.

The second question studied whether a structured or unstructured method for health pattern assessment had an effect on level of knowledge and critical thinking ability in the first clinical semester of BSN students. A split plot ANOVA was performed and no significant difference was found between total scores of structured and unstructured groups. The type of format used for health pattern assessment did not alter total knowledge or critical thinking ability (Angel et al., 2000).

The third question investigated whether completing a degree or chronological age affected level of knowledge or critical thinking ability. Using age and previous degree as variants in the split analysis, no difference was discovered in knowledge or critical thinking ability. After controlling for age and previous degree, important differences were noted. The most significant difference was the interaction between age, previous

degree, and learning strategy. On many of the specific items as opposed to the total score, older students in the unstructured group exhibited significant variation. Older students benefited from an unstructured strategy (Angel et al., 2000).

The last research question focused on whether certain academic markers could be used to forecast growth in level of knowledge and critical thinking ability in baccalaureate nursing students. The academic markers used were the Nelson Denney Reading Score, Watson Glaser Critical Thinking Appraisal, entrance grade point average, previous degree, age, and gender. After performing a multiple regression analysis, predictors of change in total knowledge were age, gender, and previous degree. Angel et al. (2000) found young female students with degrees increased in knowledge more than any other over the semester. No variables were found to be able to forecast critical thinking ability.

Angel et al. (2000) emphasized that it may not be the learning strategy alone that affected educational results, but it may be the interface of the learning method and the learner. Older students profited by an unstructured approach; whereas, younger students benefited by a more structured approach. The only significant increase in critical thinking was not due to the teaching methodology, but through familiarity with the tool. The authors recommended further studies need to be done to explore the relationship between teaching methodologies, attainment of knowledge, and learner individuality. Recommendations also included the need to formulate a tool tailored to measure critical thinking in nursing.

Critical Thinking and Concept Maps

Critical thinking is an essential characteristic of nurses in today's health care field. Nursing educators agree that critical thinking needs to be taught and developed in nursing school. Since a variety of teaching methods regarding critical thinking are employed, educators need to know what strategies are most effective. Kostovich, Poradzisz, Wood, and O'Brien (2007) proposed that identifying learning styles of students would be beneficial in understanding what strategies would promote critical thinking development in nursing students. This study's purpose was to explore if a connection existed between nursing students' preferred learning style and their ability to create concept maps. No previous research had been completed in this area. Ausubel's Assimilation Theory of Learning and Kolb's Learning Style Preference Model were the frameworks for this study.

This correlational descriptive study was conducted at a Midwestern private Catholic university. A convenience sample of 120 students enrolled in a medical/surgical nursing course participated. The students were either second semester juniors or first semester seniors and had no previous concept mapping knowledge. Although the demographics of the undergraduate program of the school of nursing were stated and demographic data was collected, no specific demographics were provided concerning the sample population. No information was given in regards to exclusion from the study (Kostovich et al., 2007)

Participants completed two instruments: the Learning Style Survey (LSS) and a questionnaire, developed by the researchers, consisting of nine open-ended questions about their opinions on concept mapping and their demographics. These were completed

by the students about three quarters of the way through the semester after the assignments of case studies and concept maps were finished. The LSS, based on Kolb's Learning Style Inventory, ranked 9 statements on a scale of 4 to 1 according to the degree that this statement reflected the attributes of the participants. This instrument ultimately identified the preferred learning style of the student: concrete, active, abstract, or reflective. No literature supports the validity and reliability of the LSS. This study found internal consistency reliability for the subscales low using Cronbach's alpha coefficients. Test-retest reliability was determined to be moderately strong since 8 of 13 students scored 62% on the retest and statistical significant ($p < 0.05$) for three of the subscales. Validity was confirmed with negative correlations between opposite subscales, such as concrete and active and abstract and reflective. The concept maps were graded using a rubric modified from Novak and Gowin (1984). To improve inter-rater reliability, one faculty member graded all the concept maps. To deal with subjectivity, a structured approach to grading was adopted. Concept maps were sorted, graded from best to least favorable, and the best ones were used as a standard for the others (Kostovich et al., 2007).

Findings showed the following learning preference of the participants: 29% (N=35) concrete, 26% (N=31) reflective, 23% (N=28) abstract and 22% (N=26) active. Only 79 students had concept map grades and final course grades. The mean final grade and mean concept map grade exhibited a weak correlation ($r = 0.37$, $p < .01$). Students classified in the active group had higher mean scores, but these scores were not statistically significant ($p = 0.435$). No relationship was noted between learning style preference and aptitude for concept mapping. Students were about equally divided between who preferred concept maps and who preferred case studies. The only trend found was twice as many students in

the abstract group preferred concept mapping. Two major categories emerged from the qualitative data: impact on learning and process of doing. The responses on the survey were not correlated with learning preference. Small sample size, limited population, and questionable reliability and validity of the LSS make generalization of findings limited (Kostovich et al., 2007).

Kostovich et al. (2007) concluded that concept mapping was effective with all learning styles. The researchers recommended development of a new tool or the use of multiple tools in future studies to measure learning style preference in order to increase validity.

Nursing educators are in agreement that critical thinking skills must be taught, developed, and nurtured. The challenge facing nursing education is what teaching strategies promote and enhance critical thinking dispositions and skills in nursing students. Concept mapping has been proposed as one of these strategies, but research is incomplete in this area (Samawi, 2006).

Samawi (2006) assessed the effectiveness of concept mapping on junior and senior baccalaureate nursing students' critical thinking skills and dispositions and evaluated if this changed over time. This study was a partial replication of the Wheeler and Collins (2003) study and used the same research variables with the addition of the California Critical Thinking Disposition Inventory. Ausubel's Assimilation Theory of Learning and Novak and Gowin's work based on Ausubel's concepts of meaningful learning was the framework for this research.

This quasi-experimental, non-equivalent control group, pretest-posttest design study was conducted at various universities in Illinois, Pennsylvania, and Idaho. A

convenience nonrandom sample of seventy-seven junior and senior level baccalaureate students participated in the study. Participants were mainly female and Caucasian or African-American. Thirty-two students were in the experimental group and these were all in Illinois. Forty-five students were in the control group and twenty-nine were at an Illinois site and the rest were in Pennsylvania and Idaho (Samawi, 2006).

Concept mapping was introduced to both groups as part of a nursing theory class. No description was given of the extent of the teaching in class about the concept maps. Experimental group students were expected to complete two maps over the course of a semester. This study did not discuss what the control group did or any assignments they needed to complete. Implied from the study is the control group did not prepare concept maps as part of this course. The topics for the maps were either assigned by the faculty or chosen by the student and had to reflect content covered in class (Samawi, 2006).

Maps were scored utilizing Novak and Gowin's method and scoring criteria (Samawi, 2006). The faculty teaching the class scored the maps, but no information was given about the training of the scorers or the inter-rater reliability. Critical thinking skills were measured using the California Critical Thinking Skills Test (CCTST) and dispositions by the California Critical Thinking Disposition Inventory (CCTDI). Both tools are well developed and well known. This study did not report any reliability or validity of the tools. Both tests were given to the experimental and control groups before the introduction of concept mapping and at the end of the semester after experimentation.

Results indicated no significant difference between the experimental and control groups' means on pre and posttest critical thinking skills after t test ($t = -1.26$, $df = 75$, $p = .213$) or in critical thinking disposition after t test ($t = 67$, $df = 75$, $p = .507$). Therefore, the

researchers concluded use of concept mapping did not promote critical thinking in nursing students in this study. A comparison of post CCTST and second concept map scores after pretest scores were removed yielded no significant relationship ($r=.001$, $p=.994$). No significant relationship was noted either between CCTDI and second concept map scores after removing pretest scores ($r=.39$, $p=.832$). The researchers found an improvement in scores between the first and second map (CM 1=mean 107.06, CM 2=mean 119.56). These findings showed that concepts maps increased in complexity over time. Researchers questioned the use of the CCTST as an instrument to accurately measure the effect of concept mapping on critical thinking. This is consistent with other studies that suggested a different tool may be needed to measure the critical thinking ability of nursing students (Samawi, 2006).

This study added to the research about concept mapping as a teaching method to promote critical thinking. Although no relationship was found between concept mapping and critical thinking skills and dispositions, the study reported an increase in complexity of concept maps. This finding “suggested that concept mapping triggered critical thinking which guided the student to engage in meaningful learning” (Samawi, 2006, p.1).

Hsu and Hsieh (2005) noted that Asian students in foreign countries tended to be passive learners and relied on rote learning. The researchers proposed that concept mapping was a teaching method that incorporated active learning and promoted critical thinking. The subsequent research study investigated the effectiveness of the active teaching strategy of concept mapping used with case scenarios by nursing students enrolled in a two year nursing program. Ausubel’s Assimilation Theory of Learning and the Constructivist Theory were the frameworks for the research.

The authors were from Taiwan and there was a discussion of Asian students; however, there was no mention of the actual geographic location of the study. Forty-three nursing students from the Nursing I course participated in the research. No other specific demographic data, such as age, gender or educational preparation, was given. The forty-three students were divided into seven concept mapping groups with six or seven participants in each group. The students, in the first week of class, were taught in detail by the instructor how to construct the concept maps. Specific steps from Schuster's Concept Map Framework about how to create concept maps based on scenarios was presented to the students. The study did not elaborate on any other method utilized in the introductory class besides verbal presentation. In groups, students completed six maps based on six scenarios and concepts from Roy's Adaptation Model dealing with physical functions (activity and rest, fluids and electrolytes, neuroendocrine, sensory perception, and sexuality) and role functions. The article did not address who wrote the scenarios, but gave three examples of the six case scenarios. The groups prepared a first draft and then prepared multiple revisions in a 2 week period after the teacher lectured on the topic (Hsu & Hsieh, 2005).

The researchers scored the maps utilizing a modified system based on Novak and Gowin's (1984) concept map scoring criteria. The maps were each analyzed in four categories: concept links (2 points each), cross-links (10 points each), hierarchies (5 points each), and examples (1 point each). The highest score for a map was 30. All the drafts of the concept maps for each group were scored. How many people or who scored the maps was not addressed. A qualitative evaluation tool named a "proposition inventory" was utilized in order "to account for variation in the quality of concept maps"

(Hsu & Hsieh, 2005, p.146). There was no description of this tool and/or the reliability or validity of either tool.

Results revealed low scores by all teams on first draft maps, but higher scores on third and fourth draft maps. Improved problem solving and critical thinking happened after two drafts. Mean scores were calculated and reported for all the drafts for each group on each of the six concept maps. Every group exhibited improved mean scores from the first map to the last map. Total mean score for all groups increased from 8 on the first concept map to 18.64 on the sixth concept map. Students worked in groups which required more active participation (Hsu & Hsieh, 2005).

The authors believed that the students gained a more holistic view of the patient and their problems through the use of concept maps. In addition, the students learned how to organize complex data and explore deeper relationships. The researchers concluded that concept mapping based on scenarios is an effective tool which promoted critical thinking and engaged students in active learning (Hsu & Hsieh, 2005).

In order to address the intense level of anxiety noted in Taiwan nursing students regarding adequacy of their long term learning, problem-based learning methods were proposed to help students develop problem solving skills. Hsu (2004) examined whether concept maps using scenarios as a problem-based learning method enhanced learning outcomes. The frameworks that guided the research were the Constructivist Theory and Problem-Based Learning Theory.

This experimental study was conducted at Chang Gung Institute for Technology of Taiwan. Two classes out of six first year Nursing I classes were chosen by chance. One class was randomly assigned to the control group (N=49) and the other to the

experimental group (N=43). The total sample population consisted of 92 students and two teachers. The demographics of the groups included 19-20 year old female students with similar educational preparation and entrance qualifications. Each group was taught by different methods for the semester: the control group received traditional teaching and the experimental group were taught using concept mapping in problem-based learning (PBL) scenarios. All the students at the end of the course watched the same video and needed to develop a concept map for the people in the video incorporating four concepts (physical function, self-concept, role-function, and interdependence) from Roy's Adaptation Model (Hsu, 2004).

Maps were scored using Novak and Gowin's (1984) scoring criteria with points given for propositions (concept links), hierarchies, cross-links, and examples. The highest map score was 30. Mean total map scores were reported and t tests were computed. The two teachers scored the maps, but no information was provided about their training or if the researcher conducted a small pilot study to assess inter-rater reliability. Pearson correlation determined a significant correlation in propositions, hierarchies and cross-link scores between the two evaluators ($p < 0.01$). No correlation was obtained with the subscale of examples. The researchers reported the cause was the strictness of one rater in the example category. A student needed a perfect map to get any score other than zero from this evaluator. No validity of the tool was reported (Hsu, 2004).

Findings showed low total map scores for the control and experimental group. Twenty-six students in the experimental group and forty-six in the control group scored less than 10. Zero scores were received by eighteen in the control group and four in the experimental. A statistically significant higher score ($p < 0.0001$) was noted for

propositions and hierarchies in the experimental group, but not for cross-links or examples. The total map score showed a significantly higher score in the experimental group ($p < 0.002$) which confirmed that the experimental group had better concept mapping skills. Students were able to incorporate Roy's four concepts into the maps which demonstrated that concept mapping can "facilitate the development of metacognitive skills, including textbook comprehension, organization for information, and preparation for examinations" (Hsu, 2004, p.513). Time was a negative factor in the development of the concept maps as students reported the maps being time consuming and having less time to study.

Hsu (2004) concluded concept mapping with scenarios as a problem-based learning method aided in the evaluation of nursing students' thinking processes. Generalization of the findings was limited because of the small sample size. Future longitudinal studies were recommended to ascertain what level of thinking process was needed to construct concept maps.

Community care settings tend to be less structured and more diverse than traditional institutional settings. This diversity requires a different skill set and knowledge in nursing in order to effectively plan and evaluate care. Although concept mapping has been studied as a teaching and learning tool in acute care settings, Hinck, Webb, Seims-Gidden, Helton, Hope, Utley, Savinske, Fahey, and Yarbrough (2006) found no research studies had examined concept maps as a beneficial strategy in community care settings. Their study evaluated whether concept mapping was an effective method to implement the nursing process in a community-based mental health course. Ausubel Assimilation Theory of Learning was the framework for the research (Hinck et al.).

This quasi-experimental pre- and posttest design study was conducted at a Midwest metropolitan university. The sample population consisted of twenty-three junior level baccalaureate students who were in a sixteen week community-based clinical experiences of a mental health course. No other demographics about the population were given by the researchers (Hinck et al., 2006).

Before the semester began, eleven course and clinical faculty were trained by an expert in a half day seminar about the purposes and use of concept maps. The faculty then developed the teaching plan for the students which included preparation of the students, course requirements, and evaluation of the concept maps. Faculty also attended the workshop with the students by a national expert in concept mapping in the community. In this workshop, faculty learned and practiced concept mapping (Hinck et al., 2006).

The training of the students for this study consisted of a one day training course, at the beginning of the semester, by a national expert on concept mapping in the community setting. The students, in previous semesters, had two other clinical courses, but were only taught to do traditional care plans in those courses. In the training course, students learned and practiced concept mapping. Then, in class, faculty members led group practice activities on concept mapping utilizing case studies. Instructions were very specific and students in groups created concept maps with different color pencils to highlight different relationships (Hinck et al., 2006).

Students wrote their concept maps during the first clinical day since contact with the client before this was not available. Maps were improved after discussion with faculty and peers in pre-and post conferences. Concept maps were due a few days after clinical,

so this enabled the students to further improve the maps. Students wrote concept maps over the course of the semester. The first and the seventh maps were scored by the researchers and evaluated for patterns and relationships. A questionnaire regarding student satisfaction and self-assessment of their learning was administered (Hinck et al., 2006).

The concept map grading criteria tool was developed by the nursing clinical faculty. Points were awarded in the following nine areas: main health concern, two nursing diagnoses, prioritization of diagnosis, supporting data, short and long-term goals, interventions, teaching, evaluation of care, and cross-links. The highest total points for each map were 20. The researchers established reliability by randomly choosing concept maps, scoring them individually, and then comparing scores. Agreement with all maps on all items was established with a mean of 0.84 for all items. The areas of identification of goals, identification of cross-links and evaluation of care had a lower agreement between raters. Final data analysis was only performed on one investigator's scores. The student questionnaire of 21 questions was written by the researchers based on the Student Assessment of Learning Gains Instrument. Twenty five point Likert scale questions ascertained the degree of learning. One open-ended question asked for student comments regarding learning with concept maps. Prior to implementation, the questionnaire was examined by three doctorate-prepared investigators who were independent from the study (Hinck et al., 2006).

The mean score of the first and seventh concept map were compared by a paired t test. The paired t test yielded a $t = -3.01$, $df = 22$, $p = .006$ which showed the concept maps increased significantly in thoroughness with little variation. The student's twenty self-

evaluation and satisfaction questions were assessed by means and standard deviation. Students stated high satisfaction with concept mapping and the process. High areas of satisfaction included having in-class practice to learn the process, improvement in their critical thinking ability, preparation for the real world, enhanced care planning ability in the community setting, and general improvement of overall learning. Open ended comments were generally positive and students felt that concept mapping was beneficial to them. Negative comments centered on the time consuming nature of the task (Hinck et al., 2006).

The researchers concluded that concept mapping enhanced learning and critical thinking ability in the community-based setting. Instructors reported concept mapping provided a holistic picture of the clients and revealed clearly the complexities of the client's problems. The researchers believed the increase in complexity of the maps signified an enhancement in conceptual and critical thinking which could correlate with clinical practice. They suggested that further research with a direct measurement of critical thinking be conducted. In addition, the researchers noted the difficulty and subjectivity in the grading process of concept maps and recommended standardizing the acceptable level of detail and wording in the maps (Hinck et al., 2006).

Concept Mapping and Clinical Learning

One of the landmark studies to explore whether concept mapping as a teaching method increased critical thinking was done by Daley, Shaw, Balistreri, Glasenapp, and Placentine (1999). Since the National League for Nursing required critical thinking as an outcome of nursing education, educators have explored strategies to teach critical thinking since traditional methods have not been too effective. Concept mapping as a

teaching strategy was evaluated in the clinical area because of the non linear type thinking required to complete the concept maps. The conceptual framework used in the research study was Ausubel, Novak, and Hanesian's Assimilation Theory of Learning. According to the researchers, this theory promoted meaningful learning by focusing on the organization and inter-relationships of content or concepts rather than information memorization. By using inductive and deductive reasoning, learners remember concepts and utilize higher cognitive processes (Daley et al.).

This descriptive study was conducted with a convenience sample of six senior clinical groups with 54 students in a BSN program. Three students from each of the 6 clinical groups (N=18) were randomly selected for scoring and analysis of the concept maps. Daley et al. (1999) do not report the size of the institution or any other demographic data on the students. The number of faculty for anecdotal evaluation was not reported either.

Daley et al. (1999) required each student to construct three concept maps over the course of one semester. Three students from each of the six clinical groups were randomly chosen to have their maps scored. Only the first and last maps were used in the scoring. The scoring criteria for the maps were based on Ausubel, Novak, and Hanesian's Assimilation Theory of Learning, awarding points for propositions, organizational hierarchy, and cross links or relationships/connections on the concept maps. Two independent evaluators scored the maps of each student and established reliability with a correlation of .82. Content validity by two educators was established in relation to the APA Delphi Study definition of critical thinking. Faculty and students also completed a written evaluation about concept mapping as a learning strategy.

The first research question explored the use of concept maps to teach and evaluate critical thinking. Findings showed a difference in group mean score from first to last concept map was 98.16. The t value between the first and last map was -5.69 ($p=.001$) which demonstrated an important statistical difference. According to the researchers, this finding indicated a greater ability in student's conceptual and critical thinking. This also answered the second research question regarding if concept maps could measure critical thinking over the semester. The third research question inquired about how students and faculty would evaluate concept mapping. Students reported feeling lost in the process and concept mapping was very time consuming. Many felt the concept would be more effective as a learning strategy if introduced earlier in their program, not in the last semester. Faculty conveyed that students gained knowledge and helped differentiate learning between the quiet and verbal students. Faculty also indicated preparation for clinical could be seen on the concept map even if the student had not talked much. In contrast, students who were talkative might be perceived as understanding their patient and the concepts, but seeing a visual representation helped balance this and correct any misperceptions by the faculty.

The authors concluded that concept maps did improve critical thinking in clinical nursing students over the semester and served as an effective educational and evaluation method. Concept mapping helped students make complex relationships. Further study and replication with larger, cross-institutional populations was recommended. The authors suggested evaluating concept mapping as a method to teach critical thinking with other critical thinking methods. Also, construct validity of concept maps needed to be determined. Daley et al. (1999) stated "This construct validity could be assessed using the

multitrait-multimethod matrix. This procedure would help determine if convergence and discriminability existed between concept maps and critical-thinking ability” (p.47). The researchers concluded educators need to explore the most effective time to introduce concept mapping in the curriculum.

In order to study concept mapping in the clinical setting, Wheeler and Collins (2003) designed a study to examine whether concept maps or traditional care plans better prepared nursing students for clinical. Previous to this study, no data showed concept mapping as an effective clinical tool that promoted critical thinking. This study was developed after faculty noted students who had used concept maps to prepare for clinical in a previous course managed patient care issues in a different way. The framework of this study was Ausubel’s Assimilation Theory of Learning.

This quasi-experimental study with a pre-test, post-test design with a control group was conducted at a southeastern university in the United States. A convenience sample of seventy-six junior baccalaureate students was utilized. Subjects volunteered for the study and all eligible students participated with no exclusions. Students were randomly assigned to an experimental group (N=44) or a control group (N=32). The control group was made up of 2 males and 30 female students assigned to two of the three pediatric nursing courses, maternity nursing, and psychiatric nursing course. The experimental group included 2 males and 42 female students enrolled in all sections of the adult health course and the one pediatric nursing course not included in the control group. Men made up only 5% of the sample. The age ranges were from twenty to forty-four years of age. The mean age for both groups was about 23 years and 63% of the sample was less than 22 years old. Eleven students in all were seeking a second degree and no other

demographic data, such as race was collected. The experimental group was taught concept mapping to prepare for their clinical for one semester; whereas, the control group only used traditional care planning to prepare for clinical. This study tried to achieve some randomization by using a convenience sample and randomly assigning students to one of four courses: adult health, pediatric nursing, maternity or psychiatric nursing and its clinical rotation for seven and half weeks and then to one of the other courses for the next seven and half weeks. Not all the courses utilized concept mapping: adult health did in all sections, but only one third of the students in pediatrics used concept mapping. Therefore, it was possible to only be in a clinical course for seven and half weeks that used concept maps and still counted in the experimental group. Wheeler and Collins (2003) pointed out that only three nursing students utilized concept mapping for the entire semester.

The methods of measurement for this study consisted of a demographic questionnaire constructed by the researchers and the California Critical Thinking Skills Test (CCTST) which measured critical thinking skills. The demographic questionnaire was given to participants and asked for sex, age, level of education, and their previous experience with concept mapping. The CCTST yielded overall score and 5 subscales: analysis, evaluation, inference, deductive reasoning, and inductive reasoning. The instrument's authors provided norms for beginning junior level college students with a mean age of 22 and no prior coursework using critical thinking. Two conceptually equal versions of the CCTST were used that were previously studied for reliability and validity. Each version measured the five critical thinking skills and was internally consistent by an acceptable Kuder Richardson-20 test. Face validity was also determined previously by

other users of the test. Construct validity was substantiated because the test questions “reflect the consensus definition of critical thinking by the American Philosophical Association’s Delphi study” (Wheeler & Collins, 2003, p.342) and was established through pre and posttest experiments which showed improvements in students who took a critical thinking course and no improvement in students who did not. The National League of Nursing Accreditation Committee has accepted this test as an outcome measure of critical thinking. One version of the test was given as a pretest during the sophomore year and then another version, as a posttest, at the end of the fall semester junior year after clinical with or without concept map use.

The research question proposed by Wheeler and Collins (2003) examined whether first semester junior baccalaureate nursing students who used concept mapping to prepare for clinical experiences demonstrated greater improvements in critical thinking scores and ability than those who used traditional care plans. On the whole, the pretest scores between the control and experimental group were not significantly different. After analysis of covariance on the mean differences between pre and posttests on the overall CCTST and the subscales, an important F value was obtained, but no noteworthy differences between the experimental and control group were revealed. Post hoc tests (Fisher Least Significant Difference Test) did not add any significant differences between the groups. The findings indicated that student’s critical thinking increased in one semester because of the improvement noted on the pre and posttests. Since no statistical difference was noted between the experimental and the control group, the findings suggested the increase in critical thinking skills was not due to the method of preparation for clinical. Concept mapping and traditional care planning both prepared students and

helped develop critical thinking skills in the clinical area. The authors commented that, perhaps, this was due to the fact that only three people in the study did concept mapping for the entire semester. The three students that did concept mapping all semester more than doubled the overall score of the experimental group. In the analysis of subscale results, there was only a significant difference in the means of the experimental group on the analysis subscale. Deductive and inductive reasoning demonstrated no significant variation between pre and posttest for either group. A negative mean difference was obtained on the inference scale for both groups with the control group exhibiting a greater difference. The explanation for the control group having a significant loss of inference skills was, perhaps, “some aspect of traditional nursing education inhibits the student’s ability to make inferences and that concept mapping helps moderate that effect” (Wheeler & Collins, 2003, p.344).

The authors recommended replicating this study with a tighter design and larger population in order to generalize across populations. The sensitivity of the CCTST was also questioned since the authors failed to prove their hypothesis even though faculty and students anecdotally reported that concept mapping improved the critical thinking ability and problem solving capabilities of the students. The California Critical Thinking Disposition Inventory was suggested as an alternative test to see if it accurately reflected the critical thinking ability of nursing students. Further investigation was needed to see if the findings of the decrease in inference skills of the control group could be repeated. Finally, Wheeler and Collins (2003) recommended a longitudinal study to see the length of time needed to learn concept mapping and its long term effects. Educators also needed to comprehend better how concept maps help students learn and when is the optimal time

to introduce the strategy into the curriculum. Although there were limitations in this study, the authors believed concept mapping was an effective strategy for increasing critical thinking skills.

As nursing education shifts from the traditional “sage on the stage” rote learning to a focus on connections among non-linear relationships, the teaching style and strategies of educators must also undergo transformation. Concept mapping as a tool to encourage higher cognitive thinking has been utilized. Abel and Freeze (2006) conducted a descriptive study to assess whether concepts maps in the clinical setting were a true expression of critical thinking. Critical thinking would be evident if students “identified nonlinear relationships among the components of the nursing process” (p.356). The research questions were as followed:

Can ADN students demonstrate critical thinking and use of the nursing process in a concept map to describe the care of hospitalized clients, can concept maps measure purported changes in critical-thinking ability over time and how do ADN students and faculty evaluate the use of concept maps as a clinical learning activity? (p.358).

These authors partially replicated Daley et al. (1999) study on concept mapping and critical thinking. Areas that diverged from the Daley study were the emphasis on the nursing process including physiological and psychosocial needs, the population studied, and the length of time the study was conducted. Daley et al. studied baccalaureate nursing students in their last semester and this project was conducted for one year with ASN students. The framework of this study was not stated, but was assumed to be assimilation theory because this was the framework for Daley’s study.

Abel and Freeze (2006) conducted this study in an ASN program with a convenience sample of 28 graduating nursing students. Two students were excluded from the project because they were admitted into the program in the third semester and could not do all the concept maps. The sample consisted of twenty-five women and three men with a mean age of 28. Race included twenty-four Caucasians, two African Americans, one Hispanic, and one Asian.

For one year, students wrote four concept maps during their clinical experience in a community hospital setting. One map was done in the second and fourth semester. The last two concept maps were completed in the fifth semester on a patient in the Intensive Care Unit and a patient from the rehabilitation unit of the hospital. The two instructors who scored the maps were the only clinical teachers for these students during that year. Second semester students were taught how to write a concept map and given an instructor example and guidelines for evaluation. These guidelines were explained before all clinical rotations. An anecdotal evaluation by both instructors and students was accomplished at the end of the clinical year. Concept maps were given a numerical score by the instructors in accordance with the criteria used by Daley et al. (1999), but only the first one and average of the last two were used for data analysis. The criteria for scoring included an assessment of propositions, hierarchy, and cross links. The total score was the indication of a student's critical thinking ability within the nursing process. Content validity of the scoring criteria was established in Daley's (et al., 1999) study and involved comparing the nursing process with four critical thinking definitions to demonstrate congruency. An initial pilot study established interrelater reliability with a 94-97%

agreement between the raters. A paired t test was performed and evaluated the first map against the average of the last two maps (Abel & Freeze, 2006).

Findings showed an increase in mean total concept map scores and mean cross-link scores from the first map to the fourth map. Abel and Freeze (2006) stated as the maps became more detailed, this indicated an increase and synthesis in student's knowledge and more in depth understanding of the relationships between aspects of patient's care and conditions. A significant difference between the mean total score of the first map and the average of the last two was found with a paired t test of -4.75 and a critical t value with 27df of 1.70 ($p=0.05$). Also a significant statistical difference was discovered between the mean cross-link scores from the first map to the last with a paired t test of -3.76 and a critical t value with 27df of 2.05 ($p=0.05$). The paired t test done on the maps of the rehabilitation unit and the Intensive Care Unit has a t value of 1.983 with a critical t value of 2.051 ($p=0.05$). No significant difference was noted between the maps on these two units, but the total scores were greater on the rehabilitation unit maps than the Intensive Care Unit.

Anecdotal evaluation by the students reflected that concept mapping increased their critical thinking and their learning. It helped them see the "big picture of nursing care on one page" (Abel & Freeze, 2006, p.363). Sixty-four percent felt concept mapping should be utilized with traditional care plans. Sixty-eight percent of the students believed the concept should be introduced as early as possible in the nursing program.

Abel and Freeze (2006) concluded that concept mapping is an effective teaching strategy to promote critical thinking and nonlinear thinking in an ASN program. They recommended an early introduction of the concept, so students do not become too

focused on traditional care planning. Another recommendation was to evaluate carefully which clinical setting to employ concept mapping in, especially in an ASN program, because students were prepared more as generalists. The researchers hypothesized that students may have more trouble with complex patients found in the ICU setting than with patients located on medical/surgical units. The authors recommended further research was needed to investigate successful methods to apply concept mapping in clinical nursing education which could lead to concept mapping being considered as a primary teaching method in the clinical area.

In reviewing the literature regarding concept mapping, Hicks-Moore and Pastirik (2006) noticed “gaps” and inconsistent data in verifying concept mapping as an effective tool to promote critical thinking skills. Using this review as an incentive, the authors examined whether concept maps of second year baccalaureate nursing students would show proof of critical thinking. Faculty and students’ perceptions about concept mapping were also investigated. No specific framework for this study was identified.

This descriptive, exploratory study was conducted in a baccalaureate program with second year students enrolled in a five week clinical practicum course. No other information regarding the setting or the demographics of the students was given (Hicks-Moore & Pastirik, 2006).

Students utilized concept mapping in this clinical course. Students were taught concept mapping in the previous semester using Shuster’s concept mapping framework on case study scenarios. In this clinical course, the instructor scored all the concept maps with the Holistic Critical Thinking Scoring Rubric and gave feedback on the maps. No specific number of concept maps to be completed was stated in the study, but students

needed to submit their final concept map and attended a focus group at the end of the course. Although forty-two students attended the course, only eighteen submitted their final concept map and only eight of them attended the focus group (Hicks-Moore & Pastirik, 2006).

The tool utilized in this study was the Holistic Critical Thinking Scoring Rubric (HCTSR). Using a 1 to 4 scale, the HCTSR measured critical thinking based on six competencies. These competencies were interpretation, analysis, evaluation, inference, explanation, and self-regulation. A score of 1 was indicative of a low level of critical thinking with a 4 indicating a high level of critical thinking. The HCTSR had no reliability measurements, but was developed from the California Critical Thinking Skills Test (CCTST) and the California Critical Thinking Dispositions Inventory (CCTDI). Since both of these tests had a high reliability, the authors believed the HCTSR was reliable. The clinical instructors of the students scored the concept maps with the HCTSR after attending training with the researchers. Inter-rater reliability was established by having the two researchers score the maps after the clinical instructors without knowing the scores and comparing results. Students in their focus groups relayed their experiences with concept maps in the clinical area and the functionality of the maps. Faculty in their groups discussed strengths and weaknesses of concept maps as well as the HCTSR. The researchers taped and transcribed these groups (Hicks-Moore & Pastirik, 2006).

Findings showed the students' scores on the concept maps between 2-4 on the HCTSR with a mean of 2.83, standard deviation of 0.71, and a mode of 3. The score of three on the concept map represented critical thinking "most of the time". This finding supported the first objective of the study which was to identify the extent and level of

critical thinking in the concept maps of second year bachelor of nursing students. The second objective concerning the usefulness of the HCTSR as a significant indicator of critical thinking in concept maps was evaluated through discussion in the focus groups. The findings verified the HCTSR as a reliable tool. However, some instructors found the HCTSR difficult to use for nursing because of its generic terms. Since the HCTSR did not have specific concept map criteria, the instructors found dialogue was needed to understand student's decision making and critical thinking ability. Faculty and students reported an increased understanding of what critical thinking meant by using the HCTSR (Hicks-Moore & Pastirik, 2006).

The third and the fourth study objectives focused on the assessment by students and clinical instructors about the use of concept mapping to enhance critical thinking in clinical nursing education. Content analysis of the responses revealed two themes: critical thinking and clinical preparedness. For the first theme, students reported that concept mapping helped them prioritize and see the "whole picture". Instructors stated the concept maps aided them in understanding their students' level of thinking and allowed them to identify strengths and weakness. The concept map also improved the students' ability to question, reason, and think outside the box. In regards to the second theme, clinical preparedness, students described the task of concept mapping at first overwhelming, but then felt more prepared because of the multiple sources used besides the client's record. Clinical instructors reported the students were able to organize and prioritize data better which made them more prepared for clinical (Hicks-Moore & Pastirik, 2006)

Hicks-Moore and Pastirik (2006) concluded that concept mapping was an effective teaching and learning strategy in the clinical area. Concept mapping provided a holistic view of the client, promoted organization and prioritization from the students, and was beneficial in verifying nursing students' preparation level for clinical. Learning with concept maps was enhanced with repetition and practice. In addition, their research suggested that the HCTSR was a reliable tool for assessing critical thinking ability of nursing students. The researcher recommended modifications to the HCTSR to better reflect the nursing process since the nursing process was the basis of concept mapping. It was also recommended that further testing with a greater number and different levels of students would enhance the tool's reliability and validity.

In an attempt to bridge the gap between theory and clinical practice for nursing students, Pickens (2007) examined if a relationship existed between the use of concept mapping and critical thinking in the clinical area for first year nursing students. In addition, the author explored whether a student's perception of concept mapping affected their critical thinking scores. Ausubel's Assimilation Theory of Learning guided the study.

This quantitative and qualitative designed study was conducted at a community college in the Midwest. A convenience sample was chosen from students enrolled in a basic adult medical nursing clinical course and who had not previously taken the course or used concept mapping. Twenty students met the selection criteria, but the sample size was only eleven students because of dropouts due to failure of the companion theory course. All the participants were female, nine Caucasian and two European with English as their second language. Ages ranged for 19 to 41 year with a mean age of 28.8 years

old. GPA and number of credit hours taken were also collected on the participants. The participants were conveniently assigned to a control group or an experimental group, five in the control and six in the experimental group (Pickens, 2007).

Experimental group participants were only taught an hour class on orientation day by the principal investigator on concept mapping. Requirements for the maps were explained including assessment (medical diagnosis, laboratory results, previous medical history, and physical assessment) and nursing problem analysis. The focus of the concept maps was to show relationships, so the researcher did not require a certain format. Concept maps were also acceptable if hand written or computer generated. Students were only given a handout and description of concept maps, but were not shown any samples of concept maps. The reasoning behind this was to allow students to develop their perceptions of the concepts (Pickens, 2007).

During orientation day, the control group was provided instruction from the research assistant on their requirements. Traditional six column linear care plans following the nursing process were explained. In addition, the clinical focus assignment was reviewed. The clinical focus, a five-page linear outline, was to be a weekly tool done on each patient and included medical diagnosis, signs and symptoms, nursing interventions, medications, and lab and diagnostic studies (Pickens, 2007).

The Health Education System Incorporated (HESI) pretest was given prior to the study to both groups on clinical orientation day. During the semester, the control group completed a clinical focus on each patient and two care plans; whereas, the experimental group completed weekly concept maps. At the end of the semester, the participants took

the HESI posttest. Six of the participants (3 control and 3 experimental) completed a one hour taped interview which were analyzed for common themes (Pickens, 2007).

The 50-item pretest and posttest were both designed by HESI according to the course syllabus by a team of nurse educators. Both custom tests were identical and questions were randomized. The reliability of the test was calculated at 0.69 by the Kuder-Richardson formula 20. This was below traditionally accepted levels, but the researcher attributed this to "likely an outcome of KR-20's attenuation due to small sample size" (Pickens, 2007, p.41). Content validity was established by reviewing the syllabi for the course and by the researcher and nurse educators from HESI reviewing the tests. The inter-rater reliability was established by the researcher and the researcher's assistant by grading three maps and comparing scores. The researcher and the research assistant were also the instructors for the clinical course. HESI scored the tests and reported raw scores and probability in the following categories: nursing process, client needs, and specialty area.

Concept maps were scored with a tool designed by the researcher based on Shuster's (2002) tool that used the nursing process. Twenty-six items were evaluated on each map and scored with an incomplete (0), partially complete (1/2), and complete (1). The highest possible score was a 26. The nursing care plan was also graded with a 27 item tool that uses the nursing process. Each item was scored as yes or no that the care plan met the criteria. A score of 80% was needed to be satisfactory. The clinical focus was graded as complete or incomplete. The interview was conducted only by the researcher and audio taped to ensure no deviation (Pickens, 2007).

Findings were guided by 5 research questions. The first research question examined if there was a relationship between GPA, age, gender and credit hours on critical thinking scores. Analysis of covariance showed no significant relationship between pretest scores and age, GPA, and credit hours ($p=.884$). Therefore no variable had an impact on pretest scores (Pickens, 2007).

The second question explored whether the use of concept mapping in the clinical area had an impact on critical thinking scores. A statistically significant increase in posttest scores of both groups was obtained by a paired t-test (control- $p= .028$, experimental- $p= .006$) with a greater increase in mean change scores for the experimental group after an independent t-test ($p=.018$). In order to address the other covariates and small sample size, an analysis of covariance was done. Mean change scores were noted to be significant while controlling covariants ($p=.022$). Findings revealed that concept mapping had significant impact on posttest scores in contrast to the control group (Pickens, 2007).

The last three research questions concerning the student's perception of the clinical rotation, concept mapping and critical thinking, and their perception of critical thinking were addressed in the interview. Qualitative data was analyzed with Nvivo7 software for common themes, patterns, and ideas. Six themes emerged: "the participant's feelings of anxiety regarding hospital clinical, development of the concept map or clinical focus, relevance to the client, knowledge attained, satisfaction or dissatisfaction, and utilization of either the concept map or clinical focus" (Pickens, 2007, p.51). Both groups felt anxiety in the clinical area, but student who used concept maps felt more organized and more directed with their care. Students reported that concept mapping

helped them put it all together. The concept map became their “model for thinking” and “their guide for inquiry” (p.77). Participants attributed the need for higher level thinking in order to develop concept maps. Critical thinking was also needed to research and discover relationships for the concept maps.

The researcher concluded that concept mapping in the clinical setting promoted critical thinking. Age, GPA, and number of credit hours had no effect on the pre and posttest scores. Anecdotally, students reported greater satisfaction with concept mapping and improvement in organization and critical thinking. A limited generalization of findings was noted because of small sample size. Recommendations made by the researcher were to replicate the study with larger and more diverse samples (Pickens, 2007).

Nursing educators continue to explore strategies to make learning meaningful, relate theory to practice, and enhance critical thinking abilities in the clinical setting. Concept mapping has been proposed as one tool to assist in the development of these goals in the clinical learning setting. Yet a gap exists in the nursing literature on the effectiveness of concept mapping to enhance student’s clinical learning. Adema-Hannes and Parzen (2005) investigated the practicality and usefulness of concept maps in the clinical area. The purpose of the study was to ascertain the effectiveness of concept mapping in the clinical setting. Ausubel’s Assimilation Theory of Learning was the guiding framework for this research study.

This pilot qualitative study was conducted with third year baccalaureate nursing students. No specific university was stated in the research study. Four groups consisting of thirty-two nursing students in two 12 week rotations on a pediatric medical/surgical

hospital unit participated in the study. No other demographics about the sample population were reported. Students read a journal article based on Schuster's concept map work that was selected for them and participated in a two hour group session outlining how to do a concept map. Then each student was required to complete a concept map according to a given template by gathering data from the unit the day before and spending at least two hours the night before on the process. The maps were then individually modified the next day during the clinical shift after review and discussion with the tutor (Adema-Hannes & Parzen, 2005).

The only tool for this research study was a short answer questionnaire designed by the researchers. The questions addressed the usefulness of concept maps and the ability of the students to connect theory with practice in regards to lab values, medications, pathophysiology, and patient care issues. In addition, students were asked to relate what effect concept mapping had on their clinical reasoning skills (Adema-Hannes & Parzen, 2005).

Overall, students' responses were positive regarding the utilization of concept mapping in the clinical area. A hundred percent of students stated improvement with connecting medications, lab values, pathophysiology, and patient issues as well as enhanced clinical reasoning skills. Students reported improvement in organization, retention of information, critical thinking, and enhanced ability to comprehend the "whole picture". Suggestions for improvement from students included starting earlier in their education with concept mapping and including more pathophysiology and lab values (Adema-Hannes & Parzen, 2005).

The authors concluded that concept mapping was a valuable teaching strategy in the clinical area. It aided the students in organization and prioritization which improved their critical thinking ability. Concept maps provided a link between theory and practice. The researchers themselves found the maps useful for assessing students' knowledge and helping students make relationships between concepts (Adema-Hannes & Parzen, 2005).

Summary

The present health care system is growing more complex and challenging. Better educated nurses with complex skills and abilities are required to deliver safe and quality patient care in a health care system that continually changes (National Advisory Council on Nurse Education and Practice, 2008). The National League for Nursing Accrediting Commission (National League for Nursing Accrediting Commission, 2008) and the American Association of Colleges of Nursing (American Association of Colleges of Nursing, 2009) has required nursing schools to incorporate critical thinking in their objectives and to validate this with outcomes. Educators are faced with the task of how best to prepare nursing students to become problem solvers and critical thinkers for entry into the work force.

This quasi experimental study with a pre and post design is a replication of Wheeler and Collins' (2003) study. The purpose of this study is to determine if baccalaureate nursing students who use concept mapping to prepare for clinical experiences will show greater improvement in critical thinking skills than those who did not.

The literature was divided into four sections. The first section entitled theoretical framework established Ausubel's Assimilation Theory of Learning as the guiding

framework. Ausubel's concept of meaningful learning was explored. The second section entitled critical thinking development reviewed two studies: one regarding faculty perception of critical thinking strategies and the evaluation of critical thinking using structured and unstructured methods of assessments. The third section entitled critical thinking and concept maps reviewed five studies about concept mapping as a teaching/learning strategy to promote critical thinking skills in the classroom and student learning styles and concept mapping was examined. The fourth section entitled concept mapping and clinical learning reviewed six studies about concept map use in the clinical setting to enhance critical thinking skills.

Ausubel's Assimilation Theory of Learning provided a theoretical framework that supported the study. Ausubel theory revolved around the idea that meaningful learning promoted the learner to make relationships between concepts. Meaningful learning aids in the retention of knowledge, and the development of critical thinking and problem-solving skills. Meaningful learning can be supported by educators by utilizing tools that promote active learning, such as concept mapping (Ausubel, 1968).

Educators agree that critical thinking is a highly desirable and necessary skill in graduate nurses because of increased acuity of patients, increased complexity of the health care system, and national accreditation requirements. Although educators realize its importance, the challenge still remains how to incorporate critical thinking into the curriculum and use effective teaching methods that enhance and develop critical thinking skills (Mundy, 2008). Concept mapping has been proposed as a teaching/learning strategy to promote critical thinking. Researchers report that concept mapping "facilitates the productive and analytical phases of critical thinking" which are needed to "gather

relevant information, identify relationships, and produce new ideas” (Alfaro-LeFevre, 2009, p.264). The literature review revealed that concept maps are an effective tool to teach, learn, and evaluate critical thinking in the clinical setting, but more research is still needed in this area.

The literature review started out with investigating critical thinking development and teaching in the clinical area. The first reviewed study explored faculty’s perceptions on what constitutes critical thinking skills and how to support the development of these skills (Twibell et al., 2005). The findings supported other studies about the definition of critical thinking. In addition, this qualitative study provided a framework for understanding critical thinking and strategies for teaching critical thinking.

The second study examined if a structured or unstructured approach to assessment in a clinical course affected critical thinking (Angel, et al., 2000). The researchers concluded that a lone learning strategy did not affect the results, but the interface of the learner and the learning method were more significant. Critical thinking did not increase due to teaching methodology, but through familiarity with the tool.

The remainder of the reviewed studies evaluated both ASN (Hsu, 2004; Hsu & Hsieh, 2005; Abel & Freeze, 2006; Pickens, 2007) and BSN (Hinck et al, 2004; Kostovich, et al., 2007; Daley et al., 1999; Wheeler & Collins, 2003; Adema-Hannes & Parzen, 2005; Hicks-Moore & Pastirik, 2006) students in regards to concept mapping. Some of the studies used the scoring of the maps as evidence of achievement of a greater level of thinking (Kostovich, et al., 2007; Hsu & Hsieh, 2005; Hsu, 2004; Hinck et al., 2004; Daley et al., 1999; Abel & Freeze, 2006; Hicks-Moore & Pastirik, 2006). Other studies (Samawi, 2006; Wheeler & Collins, 2003; Pickens, 2007) utilized traditional

educational measurement instruments, such as the CCTST, CCTDI, and the HESI exit exam to evaluate critical thinking. One qualitative study developed a questionnaire and utilized it exclusively to determine students' knowledge and critical thinking growth (Adema-Hannes & Parzen, 2005). In addition, most studies incorporated an anecdotal/qualitative section for students and/or faculty regarding evaluation of concept mapping as a teaching/ learning strategy in addition to the quantitative measures above (Kostovich, et al., 2007; Hsu & Hsieh, 2005; Hsu, 2004; Hinck et al., 2004; Daley et al., 1999; Abel & Freeze, 2006; Wheeler & Collins, 2003; Hicks-Moore & Pastirik, 2006; Pickens, 2007).

The studies reviewed showed promise for the use of concept mapping to promote critical thinking in nursing students. Kostovich, et al. (2007) explored the correlation of learning styles and the use of concept maps. The study found that concept maps are effective tools for all learning styles. The qualitative study by Adema-Hannes & Parzen (2005) found student's reported improvement in critical thinking and enhanced ability to comprehend the "whole picture".

Six studies reported increase in scores on concept maps from the first map to the last and an increase in complexity of the concept maps (Hsu & Hsieh, 2005; Hsu, 2004; Hinck et al., 2004; Daley et al., 1999; Abel & Freeze, 2006; Hicks-Moore & Pastirik, 2006). This finding was interpreted as an increase in critical thinking. One of these studies, Abel and Freeze (2006) was a partial replication of Daley et al. (1999) and confirmed the original findings.

Three studies that used pre and post tests received mixed results. Wheeler & Collins (2003) discovered students' critical thinking skills increased because of

improvement on the pre and posttest CCTST. Further analysis revealed the increase was not due to method of preparation for clinical: concept mapping or traditional care plans. Samawi (2006) found no significant differences on pre and posttests (CCTST and CCTDI) and thus no increase in critical thinking between those who used concept mapping in a theory class and those who did not. Since the researchers also scored the maps, this study found an improvement in concept map scores with increased complexity in the maps from the first to the second map which the researchers suggested meant that concept mapping triggered critical thinking. Pickens (2007) explored whether the use of concept mapping in the clinical area had an impact on critical thinking scores. Findings indicated concept mapping had a significant impact on HESI posttest scores in contrast to the control group.

Anecdotal comments in these studies (Kostovich, et al., 2007; Hsu & Hsieh, 2005; Hsu, 2004; Hinck et al., 2004; Daley et al., 1999; Abel & Freeze, 2006; Wheeler & Collins, 2003; Hicks-Moore & Pastirik, 2006; Pickens, 2007) supported improvement in critical thinking. Students and faculty reported that concept mapping was beneficial, helped to organize data, and see the patient more holistically.

Recommendations revolved around several themes. Daley et al. (1999), Wheeler & Collins (2003), and Adema-Hannes & Parzen (2005) recommended further research into the most effective time to introduce concept mapping in a nursing curriculum. Wheeler (2003) and Samawi (2006) questioned the use of the CCTST and advocated research into a more sensitive tool to measure critical thinking in nurses due to the complexities in nursing. Both studies mentioned that earlier research studies have also made this recommendation. Finally, samples in many of the studies tended to be small

and convenience-based which limits their generalizability. Many of the studies recommended the need for larger sample populations with more diversity and further replications of these studies in order to develop a sound evidence base for practice (Daley et al., 1999; Wheeler & Collins, 2003; Hsu, 2004; Hicks-Moore & Pastirik, 2006; Samawi, 2006; Pickens, 2007).

Chapter III

Methodology

Introduction

The needs of patients in both acute and long-term health care and cost cutting measures in health care institutions require nursing graduates to make effective clinical judgments. These judgments require complex reasoning based on critical thinking and skilled nursing practices. Nursing educators are confronted with the need to enhance the critical thinking skills of nursing students. Educational theorists note that active processing of concepts and active participation in the learning process are more likely to foster critical thinking skills. One active teaching/learning strategy proposed to stimulate higher-order thinking and meaningful learning is concept mapping. The purpose of this study is to determine if baccalaureate nursing students who use concept mapping to prepare for clinical experiences will show greater improvement in critical thinking skills than those who did not.

Research Question

Are there differences in critical thinking skills in two groups of baccalaureate nursing students, one which used concept mapping and one which used traditional care plans?

Population, Sample and Setting

The population will consist of first and second semester junior level baccalaureate nursing students enrolled at Indiana-Purdue University, Fort Wayne campus (IPFW) in Fort Wayne, Indiana. IPFW is the fifth largest university in Indiana and the largest university in northeastern Indiana. More than 12,500 undergraduates are enrolled at the university (Indiana University-Purdue University Fort Wayne, 2010a). IPFW admits between 60-70 nursing students twice a year in the fall and spring.

The anticipated convenience sample will include 100 students who meet the inclusion criteria. The inclusion criteria will include junior level status in the baccalaureate nursing program, enrollment in NUR 336-Nursing IIIB: Medical-Surgical Nursing of Adults and clinical component in the fall or spring of the research year, and willingness to participate in the study. Age, gender, race, level of education, and previous use of concept mapping will be the demographic data collected. The sample population will be representative of the entire population of junior level nursing students. Since the study will be conducted at one university, the sample may not be representative of characteristics, such as age, gender, ethnicity, and income. This limits the ability to generalize the findings.

Protection of Human Subjects

Prior to beginning this research study, an assessment of benefits and risks was conducted to ensure benefits outweigh the risks. The risks to participants in this study are minimal with an increase in student's time as the only inconvenience noted. Potential benefits from participating in this study include learning a new organizing framework for patient care, an increased understanding of the interrelationship of disease processes,

possible increase in critical thinking, and contributing to the advancement of nursing science.

Approval will be obtained from the Institutional Review Board (IRB) at Ball State University and IPFW. Included in the IRB approval at IPFW is approval of the nursing department and consent of the course faculty members. All ethical standards for researching with human subjects will be maintained (Burns & Grove, 2005, p. 181-191). Participation in the research study is voluntary and a student's grade will not depend upon participating. The researcher also is not the faculty member who issues the grades for these students. Written informed consent of all participants will be acquired. Informed consent will consist of introduction of the research activities including purpose of the research, description of risks and benefits, assurance of anonymity and confidentiality, disclaimer about coercion, and option to withdraw (Burns & Grove). A cover letter detailing this information along with a consent form to participate in the research study will be given to all participants. Any additional questions participants have will be answered by the researcher. Anonymity will be maintained by assigning all participants identification numbers for the pretest and posttest scores.

Procedure

Once consent from the IRB units has been approved, the researcher will meet with the nursing faculty of NUR 336- Nursing IIIB: Medical- Surgical Nursing of Adults to prepare and brief them on the research study and their role and responsibilities. The catalog description of this course states "This course utilizes the nursing process in caring for adults who experience complex problems related to selected basic human needs. Laboratory experiences are provided in hospitals and other community agencies"

(Indiana University-Purdue University Fort Wayne, 2009). NUR 336 is a seven credit hour course that meets twice a week for 4 hours and 40 minutes for didactic portion and 9 hours and 30 minutes once a week for clinical experience over a 12 week semester. Clinical experiences are done on a surgical unit or a cardiac/telemetry unit in a local hospital.

Preparation of the course faculty will begin in the summer when the faculty will take a one day seminar on concept mapping by an expert. Course faculty will also learn how to score the maps according to Novak and Gowin's concept map scoring criteria for grading purposes in the course, but scores will not be utilized in the study (Novak & Gowin, 1984). A uniform scoring system is needed to ensure that each student receives the same standardized treatment and assures faculty feedback on the completed concept maps

Students will be asked to participate in the study when they sign up for NUR 336 in the semester before the class starts. All eligible participants who meet the inclusion criteria will be included and randomly assigned to a control group or an experimental group. In order to obtain the anticipated sample (N=100), fall and spring semester NUR 336 courses will be utilized. During fall and spring semester, 25 participants will be randomly assigned to the control group and 25 to the experimental group. This ensures the control and experimental group are at the same time divided over two semesters. As much as possible, clinical groups will be strictly either a control group or an experimental group. When the student agrees to participate, they will take the California Critical Thinking Skills Test Form A, regardless of the group they are assigned, which is offered in the campus testing center during normal hours of operation (Facione & Facione, 1993).

Preparation for the experimental group students will begin the week before classes start. They will be required to attend a day seminar on concept mapping led by an expert. Course faculty will again attend this seminar. Experimental group students will also have access to an interactive computerized program on concept mapping that they can review if needed to assist them with the process.

The experimental group will utilize the concept map format to prepare the night before for clinical. A concept map will be made for each patient. Faculty will review the concept maps with the students during the clinical experience, discuss thought processes, and make suggestions to the concept map. The experimental group students will then make changes to the concept map and hand them in a few days after the clinical experience. Each concept map will be scored, but only a percentage of them will be used for the student's grade. The faculty will determine which ones will be utilized for the course grade and will inform the student through the syllabus requirements.

The control group will utilize the traditional care plan format used by IPFW to prepare the night before for the clinical experience. A care plan will be made for each patient. Faculty will review the care plans with the students during the clinical experience, discuss thought processes, and make suggestions to the care plan. The control group students will then make changes to the care plan and submit them in a few days after the clinical experience. Each care plan will be scored, but only a percentage of them will be used for the student's grade. The faculty will determine which ones will be utilized for the course grade and will inform the student in the syllabus.

At the end of the clinical course, both the experimental and control group students will take the California Critical Thinking Skills Test Form B. This again will be offered

in the campus testing center during normal hours of operation, so that the students can self schedule. A short demographic questionnaire including age, gender, race, level of education, and previous use of concept maps will be completed by both groups on the last day that the clinical course meets in the fall and spring semesters. The experimental group will have one open-ended question on their questionnaire which asks if there is anything else about learning with the use of concept maps that they would like to relate.

Research Design

This study will use a quasi-experimental, pretest-posttest design with a control group. This type of design is appropriate for determining cause and effect relationships among independent and dependent variables (Burns & Grove, 2005, p. 44). The purpose of this study is to determine if baccalaureate nursing students who use concept mapping to prepare for clinical experiences will show greater improvement in critical thinking skills than those who did not. The independent variable in this study is the use of concept mapping and the dependent variable is critical thinking.

Instrumentation, Reliability and Validity

Two instruments are utilized in this research study: a short demographic questionnaire and the CCTST (Facione & Facione, 1993). The demographic questionnaire was developed by the researcher. Questions included are age, gender, race, level of education, and previous use of concept mapping. The experimental group will have one open-ended question on their questionnaire which asks if there is anything else about learning with the use of concept maps that they would like to relate. The course faculty will administer this questionnaire on the last date the course meets for the fall and spring semesters.

The CCTST is a commercially prepared test by Facione and Facione to measure critical thinking. The test covers analysis, evaluation, deductive reasoning, and inductive reasoning which are the “five cognitive skills identified by the Delphi experts” (Facione & Facione, 1993, p.12). Six scores are provided by the test: an overall score and five subscales that correlate with the five cognitive skills. Two equivalent forms of the test with norms are available and will be utilized. The test is scored by the providing company which provides descriptive statistics.

The authors of the CCTST established reliability and validity of the test. Reliability was established by selecting questions from a group of questions already known to measure critical thinking and also that incorporated the five cognitive skills. A Kuder Richardson-20 test value of .70 on Form A and .71 on Form B demonstrated internal consistency. This is known to be acceptable for this level of a test (Facione & Facione, 1993). Face validity was determined previously by other users of the test by answering questions and anecdotal remarks. Construct validity was verified two ways by the developers of the test. First, the test included items that are consistent with the American Philosophical Association’s Delphi study definition of critical thinking. Second, pretest and posttest experiments were done with students in a critical thinking course. The test showed growth in students who completed the course as compared to no growth in students who did not take the course (Facione & Facione).

Measures of Data Analysis

Descriptive statistics consisting of mean ages and percentages for gender, race, level of education, and previous concept map experience will be calculated. Means for overall score and subscales for pretest and posttest on the CCTST will be reported by

group (experimental and control). An analysis of covariance will be completed on the mean differences between the pretest and posttest overall CCTST scores and subscales. The covariant will be the pretest score. If a significant F value is obtained, the Fisher LSD of mean pretest/posttest scores on overall CCTST and the five subscales by group will be calculated. The mean difference, standard deviation, and p value will also be determined. This Fisher LSD test will show which mean contributed to the effect of increasing critical thinking skills. Significance level will be set at .05. Percentile rankings for overall score and each of the five subscales will be calculated for the pretest and the posttest.

Summary

This chapter explains the methodologies for this research study. This study is a partial replication of the Wheeler and Collins (2003) research study. The purpose of this study is to determine if baccalaureate nursing students who use concept mapping to prepare for clinical experiences will show greater improvement in critical thinking skills than those who did not. A quasi-experimental study using a pretest-posttest research design with a control group will be employed. The variables studied will be use of concept mapping and critical thinking skills. The anticipated sample is 100 baccalaureate junior level nursing students with 50 students randomly assigned to the control group and 50 students to the experimental group. The CCTST will be utilized for the pretest and posttest. Descriptive statistics, analysis of covariance, and the Fisher LSD will be used for data analysis. As a replication of the Wheeler and Collins (2003) study, this study will add to the evidence base for evaluating the effectiveness of concept mapping by determining if baccalaureate nursing students who use concept mapping to prepare for

clinical experiences will show greater improvement in critical thinking skills than those who did not.

Literature Review Table

Source	Problem	Purpose	Sample	Framework or Concepts	Design	Instruments	Results	Implications
Twibell, Ryan, & Hermiz (2005)	Nurses are needed in health care who can problem solve and think critically in clinical settings. Nurse educators need to prepare students think critically. Nurse educators need to understand the thinking methods of expert nurses prepare student nurses for practice. There is little consensus on the definition of critical thinking (CT) and few strategies for teaching CT have been researched and tested.	The purpose of this study was "to explore the perceptions of nursing faculty members as they teach critical thinking skills to baccalaureate student nurses in clinical settings" (p.72).	Convenience sample of 6 clinical nursing instructors from a Midwestern US public school of nursing; all women ranging in age from 40 to 55; Four of the subjects had doctoral degrees and two had masters. Their years in nursing practice ranged from 17-36. Their years as a clinical instructor ranged from 2-24 years.(p.73)	No framework cited Concepts: Critical thinking Nursing education	Qualitative Ethnographic, multiple case study approach	Interview of each participant three times in one semester at two week intervals after a clinical experience; each interview was audio taped, transcribed, & analyzed. Sample questions included: 1) Describe a student who performed well in clinical this week and describe the student's behavior that evidenced progress toward satisfactory critical thinking. 2) What did you say or do to support this student's critical thinking? 3) What characteristics of your instruction were intended to stimulate or support the development of critical thinking?(p.73)	This study examined four research questions. First, it explored whether a nursing student's measured level of knowledge and critical thinking were different before the course and after the course. An increase in both level of knowledge and critical thinking was supported by the data. The total knowledge and total CT scores significantly improved ($p \leq .001$). The second question studied whether a structured or unstructured method for health pattern assessment teaching had an effect on level of knowledge and CT ability in the first clinical semester of BSN students. A split plot ANOVA was performed and no significant difference was found between structured and unstructured groups (total scores). Therefore the type of format used for health pattern assessment did not alter total	It may not be the learning strategy alone the affects educational results, but it may be the interface of the learning method and the characteristics of the learner. Older students profited by an unstructured approach; whereas, younger students benefited by a more structured approach. Significant increase in critical thinking not because of the structured or unstructured teaching methodology, but seemed to be "related to the repeated experiences using the tool during the semester."(p.228) Further studies to explore the relationship between teaching methodologies, attainment of knowledge, and learner individuality; need to develop a tool to measure CT that is more specific to nursing.

Source	Problem	Purpose	Sample	Framework or Concepts	Design	Instruments	Results	Implications
							<p>knowledge or critical thinking ability. The third question investigated whether completing a degree or chronological age affected level of knowledge or CT. At first using age and previous degree as covariates in the split plot analysis, no difference was discovered in knowledge or critical thinking due to age or previous degree. Yet after controlling for age and previous degree, important differences were noted. The most significant was the interaction between age, previous degree, and learning strategy. On many of the specific items (as opposed to the total), older students in the unstructured group exhibited a significant difference. Older students benefitted from unstructured clinical teaching strategy; whereas younger students benefitted more from structured strategy.</p> <p>The last research question focused on whether certain academic</p>	

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							<p>markers could be used to forecast growth in level of knowledge and critical thinking ability in BSN students. These were the Nelson Denney Reading Score, Watson Glaser Critical Thinking Appraisal, entrance grade point average, previous degree, age, and gender. Predictors of change in total knowledge were age, gender, and previous degree. Multiple regression was performed. The study found young female student with degrees increased more in level of knowledge in the semester. No variables were found to be able to forecast CT ability.</p>	
Angel, Duffey, Belyea (2000)	<p>There is a need for improvement of knowledge and critical thinking ability in nursing education. However, "there is a lack of evidence investigating the most appropriate learning strategies for improving those abilities" (p.222).</p>	<p>Investigate structured and unstructured teaching approaches that might be reflective or indicative of changes or transitions in critical thinking skills</p>	<p>Convenience sample of N= 142 undergraduate junior nursing students who completed N56:Basic Theories, Processes, and Skills for Beginning Clinical Practice during fall semester 1996 93% female, 86%</p>	<p>Perry's Scheme of Intellectual and Ethical Development</p> <p>Concept-Critical Thinking (CT)</p>	<p>Longitudinal Quasi Experimental</p>	<p>A pretest- post test design which consisted of "an open-ended questionnaire using a case study approach was developed to measure growth in substantive knowledge and to elicit characteristics of critical-thinking ability" (p.224). Data was collected on the first day of the course and at the end of the course.</p>	<p>This study examined four research questions. First, it explored whether a nursing student's measured level of knowledge and critical thinking were different before the course and after the course. An increase in both level of knowledge and critical thinking was supported by the data. The total knowledge and total CT</p>	<p>It may not be the learning strategy alone the affects educational results, but it may be the interface of the learning method and the characteristics of the learner. Older students profited by an unstructured approach; whereas, younger students benefited by a more structured approach. Significant increase in</p>

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			<p>white; average age = 24 years with a standard deviation of 5.5 years. Study was conducted at a large mid-Atlantic public research university.</p>			<p>Nelson Denney Total Score, Watson Glaser Critical Thinking Appraisal</p> <p>No specifics given on reliability/validity, but they did provide information on controlling variation in subjects by assigning students to clinical groups by keeping a balance of admission WGTCA scores, gender, ethnicity, and entrance GPA. They also examined differences in outcome by using an open-ended questionnaire.</p>	<p>scores significantly improved ($p < .001$). The second question studied whether a structured or unstructured method for health pattern assessment teaching had an effect on level of knowledge and CT ability in the first clinical semester of BSN students. A split plot ANOVA was performed and no significant difference was found between structured and unstructured groups (total scores). Therefore the type of format used for health pattern assessment did not alter total knowledge or critical thinking ability. The third question investigated whether completing a degree or chronological age affected level of knowledge or CT. At first using age and previous degree as covariates in the split plot analysis, no difference was discovered in knowledge or critical thinking due to age or previous degree. Yet after controlling for age and previous degree, important differences were noted. The most</p>	<p>critical thinking not because of the structured or unstructured teaching methodology, but seemed to be "related to the repeated experiences using the tool during the semester."(p.228)</p> <p>Further studies to explore the relationship between teaching methodologies, attainment of knowledge, and learner individuality; need to develop a tool to measure CT that is more specific to nursing.</p>

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							<p>significant was the interaction between age, previous degree, and learning strategy. On many of the specific items (as opposed to the total), older students in the unstructured group exhibited a significant difference. Older students benefitted from unstructured clinical teaching strategy; whereas' younger students benefitted more from structured strategy.</p> <p>The last research question focused on whether certain academic markers could be used to forecast growth in level of knowledge and critical thinking ability in BSN students. These were the Nelson Denney Reading Score, Watson Glaser Critical Thinking Appraisal, entrance grade point average, previous degree, age, and gender. Predictors of change in total knowledge were age, gender, and previous degree. Multiple regression was performed. The study found young female student with degrees</p>	

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							increased more in level of knowledge in the semester. No variables were found to be able to forecast CT ability.	
Kostovich, Poradzisz, Wood, O'Brien (2007)	Problem: Selecting effective methods to teach critical thinking and assure safe and effective client care for students and nurses with differing learning styles is a challenge for faculty. Suggested that concept mapping may be useful for students with diverse learning styles. No previous research was found in this area.	Describe the relationship between the learning style preference of nursing students and aptitude for concept maps.	Convenience sample of all students enrolled in a medical surgical nursing course (either 2 nd semester junior or 1 st semester seniors) at a private Catholic university in a large city in the Midwest No demographic data available for students in study.	Ausubel's Assimilation Theory of Learning Kolb's Learning Style Preference Model Concepts: Critical Thinking Concept Maps (CM) Nursing education Learning style preference	Correlational descriptive study to describe the relationship between learning style preference and concept mapping aptitude in nursing students.	Learning Style Survey (LSS) based on Kolb's Learning Style Inventory that ranked statements on scale of 4 to 1 according to the degree the statement reflects the characteristics of the respondent. This ultimately identifies the preferred learning style (concrete, active, abstract or reflective). No literature supported the validity and reliability of the LSS. Validity was supported by negative correlations between abstract vs. concrete, active vs. reflective. 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. One faculty member graded all CMs to improve reliability.	LSS: 29% (n=35) were concrete learners, 26% (n=31) reflective, 23% (n=28) abstract, 22% (n=26) active. Concept maps/final course grade showed weak correlation (r=0.37, p<.01) Learning preference influence on CM grade: one-way ANOVA was used. Active group had higher mean CM scores but not significant (p=.435). Student survey: 11/18 abstract, 9/17 concrete, 7/18 active (4 no preference) 4/13 (2 no preference) reflective learners preferred CM vs. Case studies.	Complex learning strategy like CM can be effective for all kinds of learning styles. No relationship was seen between learning style preference and aptitude for creating CMs; A variety of strategies should be used to meet the learning needs of students Small sample and limited population limited generalization of findings. Need further development of instruments to measure learning styles to achieve reliability and validity. Need to examine relationship of critical thinking skills and learning styles to facilitate CT and problem solving skills

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Samawi, (2006)	What teaching strategies promoted and enhanced critical thinking dispositions and skills in nursing students- proposed strategy was concept mapping, but prior research lacking in this area.	Assess the effectiveness of concept mapping on junior and senior baccalaureate nursing students' critical thinking (CT) skills and dispositions over time.	Convenience nonrandom sample of 77 junior and senior BSN primarily female and Caucasian or African-American 32 -experimental group-Illinois university 45-control group (29 in Illinois site and rest in Pennsylvania & Idaho).	Ausubel's Assimilation Theory of Learning and Novak and Gowin's work based on Ausubel	Quasi-experimental, non-equivalent, control group, pretest-posttest.	California Critical Thinking Skills Test (CCTST) and California Critical Thinking Disposition Inventory (CCTDI). No reliability or validity of the tools reported. Maps scored utilizing Novak and Gowin's method and scoring criteria.	No significant difference between experimental and control groups' means on pre and posttest CT skills after t test ($t=-1.26, p=.213$) or in critical thinking disposition after t test ($t=67, p=.507$). Use of CM did not promote critical thinking. No significant relationship between post CCTST and second concept map scores after pretest scores removed ($r=.001, p=.994$). No significant relationship between CCTDI and second CM after removing pretest scores ($r=.39, p=.832$). Improvement in scores between first and second map (CM 1= mean 107.06, CM 2=mean 119.56).	Concept maps do increase in complexity over time. Researchers questioned the use of CCTST to accurately measure the effect of concept mapping on CT. Researchers "suggested that concept mapping triggered critical thinking which guided the student to engage in meaningful learning" (p.1).

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Hsu & Hsieh (2005)	Asian nursing students were passive learners and relied on rote learning-proposed concept mapping was an active strategy that would promote critical thinking.	Investigate effectiveness of the active teaching strategy of concept mapping used with case scenarios by two year nursing students.	No geographical location mentioned- authors were from Taiwan. 43 nursing students in Nursing I course No other specific demographics. Students divided into seven groups and completed the concept maps in these groups.	Ausubel's Assimilation Theory of Learning Constructivist Theory	No specific design mentioned.	Modified concept map scoring system based on Novak and Gowin's concept map scoring criteria. "Proposition Inventory"- qualitative tool, used to "account for variation in the quality of concept maps" (p.146). No reliability or validity of either tool was addressed.	Low scores on first draft maps by all groups, but higher score on the third and fourth map- improved mean scores from first to last map. Total mean score increased from 8 to 18.64.	Students gained a more holistic view of the patient and their problems; students learned to organize data and explored deeper relationships Concept mapping was an effective tool to promote critical thinking and engaged student in active learning. Students worked in groups which required more active participation.
Hsu (2004)	There was a high level of anxiety in Taiwan nursing students regarding their adequacy of learning; problem-based learning methods proposed to help students develop problem solving skills.	Examined whether concept maps using scenarios as a problem-based learning method enhanced learning outcomes of nursing students.	First year nursing students at the Chang Gung Institute for Technology of Taiwan. 92 students and 2 teachers 19-20 year old female students with similar educational preparation and entrance qualifications. Randomly assigned to either control group (N=49) or experimental group (N=43).	Constructivist Theory and Problem-Based Learning Theory.	Experimental	Concept maps scored using Novak and Gowin's scoring criteria. Evaluated the two teachers who scored the maps using Pierson's correlation- significant correlation ($p < 0.01$) for propositions, hierarchies, and cross-links on the CM. No correlation in the subscale of examples- researchers attributed this to strictness of one rater in the example category. No validity of the tool was reported.	Low map scores for the control and experimental group. Statistically higher score noted ($p < 0.0001$) noted for propositions and hierarchies, but not cross-links in the experimental group. Total map score higher in experimental group = better concept map skills. Students incorporated Roy's four concepts into the maps- CM aided in organization, textbook comprehension, and preparation for exams.	Concept mapping with scenarios as a problem-based learning method aided in evaluation of student's thought processes. Small sample size = limited generalization. Future longitudinal studies- ascertain what level of thinking process is needed to construct CM.

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Hinck et al. (2006)	Community care settings require a different skill set and knowledge. Prior research indicated concept mapping (CM) studied as teaching and learning tool in acute care settings and not the community.	Evaluate whether concept mapping was an effective method to implement the nursing process in a community-based mental health course.	23 junior level BSN students in a 16 week community-based mental health course; conducted at a Midwest metropolitan university. No other demographics about the population were given.	Ausubel's Assimilation Theory of Learning	Quasi experimental pre- and posttest design	Concept map grading criteria tool developed by the nursing clinical faculty. Reliability established by randomly choosing concept maps, scoring them and then comparing scores. 21 question student questionnaire based on the Student Assessment of Learning Gains Instrument. Twenty questions were 5 point Likert scale questions about the degree of student learning and one question was open ended asking for comments on concept mapping.	First and seventh map showed increased in thoroughness with little variation by a paired t test (t=3.01, p=.006). Students stated high satisfaction with concept map process- reported critical thinking ability improvement, better preparation for the real world, enhanced care planning activities in the community setting and improved overall learning. General positive comments to open ended question. Students commented on the time consuming nature of concept mapping	Concept mapping enhanced learning and critical thinking ability in the community setting. Recommended further research with a direct measurement of critical thinking.
Daley, Shaw, Balistrieri, Glasenapp, & Placentine (1999)	The emphasis on outcome-oriented education and NLN requirements for demonstration of critical thinking make research into methods to teach and evaluate this learning important. Traditional methods to teach CT have	Describe a study that implemented concept maps to teach critical thinking and evaluate critical thinking.	All 6 senior-level clinical groups within a baccalaureate nursing program (n=54) for student evaluation (convenience sample). 3 students from each of six groups (n=18) were randomly	Ausubel, Novak and Hanesian Assimilation Theory of Learning. Concepts: Concept maps Critical thinking Nursing education	Descriptive	Scoring formula used for concept maps with points awarded for hierarchical organization, progressive differentiation and integration. Reliability and content validity were established in relation to the APA Delphi study definition of critical thinking. Correlation scores established	Map scoring: Difference of group mean score from first to last concept map was 98.16. The t value was -5.69 (p=.001) indicating students' increase in conceptual and critical thinking. Student evaluation: mixed reviews about use of concept maps.	Further study and replication was needed. Construct validity of concept maps as measure of critical thinking needed to be established. Needed to determine most beneficial time to introduce technique of CM.

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	not connected well to nursing practice. More research was needed to find methods to teach and evaluate CT in nursing and to determine if CM is such a method.		selected for scoring and analysis of concept maps. No other demographic data provided on students. Unknown number of faculty for evaluation.			reliability with a score of .82. Anecdotal evaluation by students and faculty.	Faculty evaluation: demonstrated students' gained knowledge, helped assess which students were safe practitioners and allowed for correction of misperceptions.	
Wheeler & Collins (2003)	No previous data on the effectiveness of CM used to prepare for clinical experiences to promote critical thinking.	Examine whether CM use instead of traditional nursing care plans to prepare for clinical experiences helped students become better critical thinkers as required by NLN and desired by employers.	Convenience sample (n=76: control: n=32 experimental n=44) of sophomore baccalaureate students enrolled in introductory nursing course at a southeastern university in spring 1998 who had been accepted into the upper-division program. Participation was voluntary and all eligible students participated.	Ausubel's Assimilation Theory of Learning. Concepts: Concept mapping Critical thinking Nursing education	Quasi-experimental pretest-posttest design with a control group	Demographic questionnaire: age, sex, level of education and previous concept map experience California Critical Thinking Skills Test (CTST), the instrument's authors provided norms for evaluating results. Form A=pretest Form B=Posttest Each test was examined for validity and reliability to cover the 5 critical thinking skills noted by the American Philosophical Association's Delphi study experts. Kuder Richardson-20 test determined acceptable internal consistencies.	Sig diff (<.05) between mean pre and post test scores and each subscale. Difference between groups insignificant. Anecdotal: In subsequent clinical rotations, students who had done concept mapping showed better problem solving skills. CM was effective in helping students develop critical thinking skills.	Longitudinal study was needed to track long-term effect of CM and how long it takes to master. Significant loss of inference skills in control group and small in exp group needed further study. CM stimulated discovery learning. The attitude of the critical thinker might be more important than cognitive skills. California Critical Thinking Disposition Inventory (CCTDI), another inventory test might better reflect skills of those who use CM. CM stimulates meaningful learning as noted from the educator and student perspective. Better objective measurement and analysis methods needed.

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Abel & Freeze (2006)	As nursing education shifts from rote learning to more meaningful learning, the style of teaching must also shift. Can concept mapping be used as meaningful learning activity in clinical and with ASN students?	Evaluate concept mapping as a clinical teaching-learning activity that reflects critical thinking by promoting identification of nonlinear relationships among the components of the nursing process" (p.356).	A convenience sample of 28 graduating nursing students from one class in an ASN program (5 semesters); 25 were women & 3 were men; 24 participants were Caucasian, 2 were African American, 1 was Hispanic & 1 was Asian. Mean age: 28 years.	Not specifically noted but it is a partial replication of Daley et al. (1999) study which used Ausubel's Assimilation Theory of Learning Concepts: Concept maps Critical thinking	Descriptive Partial replication of Daley et al (1999) study-this study differed by emphasizing the nursing process and included client's 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.	Students finished 4 concept maps during one year, but only the first one and 1 of the last 2 scores were used. Concept map scoring criteria was also used by Daley (1999). Scoring formula used on concept maps with points awarded for propositions, hierarchy, cross-links and examples. The total score indicated a student's critical thinking ability within the nursing process. Reliability and content validity were established in relation to the APA definition of critical thinking in a previous pilot study by Abel and Freeze (2002). Inter-rater reliability was verified by two instructors rescoring the maps. Anecdotal evaluation by students and faculty was accomplished through questionnaire.	CM 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 CM scores. Total mean scores rose each semester from the first map (mean =73) to the semester 5 map-3 (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 <i>t</i> test <i>t</i> value of -3.76 and critical <i>t</i> value with 27 <i>df</i> of 2.05 ($p=0.05$). A paired <i>t</i> test was performed on the total score and evaluated the	Concept mapping is an effective teaching strategy to promote critical thinking and nonlinear thinking in an ASN program. Early introduction of the concept of concept mapping needs to take place in the program before students become too focused on traditional nursing care plans. The clinical setting for concept mapping in an ASN program needs to be explored because ASN students are prepared more as generalists and may have more trouble with concept mapping with complex patients found in the ICU setting. Further research needed to investigate successful methods to apply concept mapping in clinical nursing education; could lead to concept mapping being considered as a primary teaching method.

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							<p>first map against the average of the last two maps (done in the fifth semester)-t value of -3.76, critical t value 27, df was 2.05 (p=0.05). This showed a significant difference between the first map and the last two. The paired t test done on the maps of the rehabilitation unit and the ICU unit had a t value of 1.983 with a critical t value of 2.051 (p=0.05) No significant difference between the maps on these two units. Scores were higher on the rehabilitation unit. 79% (n=22) reported increased nursing care knowledge. Eighteen students (n=64%) felt CM should be used in addition to traditional care plans and 68% (n=19) suggested introducing the maps in the first or second semester. Faculty noted CM directed student focus to holistic patient perspectives, were easier to read, score, and recognize student insight; knowledge deficits were identifiable to more easily intervene; critical thinking was evident.</p>	

Source	Problem	Purpose	Sample	Framework or Concepts	Design	Instruments	Results	Implications
Hicks-Moore & Pastirik (2006)	Researchers found gaps in the literature regarding the effectiveness of concept mapping.	Examined whether concept maps of second year baccalaureate nursing students would show proof of critical thinking.	Second year students enrolled in a five week clinical practicum course in a baccalaureate program. No other information about the demographics of the students was given.	No specific framework identified Concepts: Concept maps Critical thinking	Descriptive exploratory	Holistic Critical Thinking Scoring Rubric (HCTSR) used to score the concept maps-measures critical thinking on six competencies: interpretation, analysis, evaluation, inference, explanation, and self-regulation. No reliability measurements, but developed from the California Critical Thinking Skills Test and the California Critical Thinking Dispositions Inventory. Inter-rater reliability established. Also had focus discussion groups.	Score on the concept maps on the HCTSR between 2-4 with a mean of 2.83, standard deviation of 0.71 and a mode of 3; Score of 3 on the map represented critical thinking most of the time. Discussion Groups-HCTSR reliable tool, but difficult to use for nursing because of its generic terms. Students reported concept maps helped them prioritize and see the "whole picture". Instructors stated concept maps aided them in understanding students' level of thinking and allowed them to identify strengths and weaknesses.	Concluded concept mapping was an effective tool in the clinical area. HCTSR was a reliable tool for assessing the critical thinking ability of nursing students. Recommended modifications to the HCTSR to better reflect the nursing process. Recommended further testing with a greater number and different levels of students.
Pickens (2007)	Wanted to bridge the gap between theory and practice for nursing students.	Examined if a relationship existed between the use of concept mapping and critical thinking in the clinical area for first year nursing students.	Convenience sample Selection criteria-students enrolled in a basic adult medical nursing clinical course, had not previously taken the course and had not used concept mapping.	Ausubel's Assimilation Theory of Learning	Quantitative/ Qualitative design	The Health Education System Incorporated (HESI) pretest and posttest. Reliability established with Kuder-Richardson Formula 20. Content validity and inter-rater reliability established.	Analysis of covariance showed no significant relationship between pretest scores and age, GPA, and credit hours ($p=.884$)-no variable had an impact on pretest scores. A statistically significant increase in posttest scores of both groups was	Concept mapping in the clinical setting does promote critical thinking. Age, gender, and number of credit hours had no effect on pre and posttest scores. Limited generalization of findings because of small sample size.

Source	Problem	Purpose	Sample	Framework or Concepts	Design	Instruments	Results	Implications
			<p>20 students met criteria- only 11 students in sample because of dropouts due to of the failure of the companion theory course.</p> <p>All female, nine Caucasian and two European with English as their second language. Ages ranged from 19-41 with a mean age of 28.8 yrs old.</p> <p>Assigned to a control group(N=5) or experimental group (N=6)</p>			<p>Concept maps scored with a tool designed by the researcher based on McHugh-Schuster(2002) tool that used the nursing process.</p> <p>Focus interview conducted by researcher.</p>	<p>obtained with a paired t-test (control-p=.028, experimental- p=.006).</p> <p>Because of small sample size, analysis of covariance showed mean change scores were significant while controlling covariants (p=.022)-concept mapping had a significant impact on posttest scores in contrast to the control group.</p> <p>Six themes in qualitative research: the participant's feelings of anxiety regarding hospital clinical, development of the concept map or clinical focus, relevance to the client, knowledge attained, satisfaction or dissatisfaction, and utilization of either the concept map or clinical focus.</p> <p>Concept map group reported feeling more organized, concept maps helped them put it all together. Map became their "model for thinking and their guide for inquiry"(p.77).</p>	Recommended to replicate study with larger and more diverse sample.

Source	Problem	Purpose	Sample	Framework or Concepts	Design	Instruments	Results	Implications
Adema-Hannes & Parzen (2008)	Explored the gap in nursing literature that exists regarding the effectiveness of concept mapping to enhance students' clinical learning.	Investigated the practicality and usefulness of student use of concept maps in the clinical area.	32 nursing students in two 12 weeks on a pediatric medical/surgical hospital unit. No other demographics were reported in the study.	Ausubel's Assimilation Theory of Learning	Pilot qualitative	Short answer questionnaire designed by the researchers- questioned the usefulness of concept mapping and the ability of the students to connect theory with practice. Asked students what effect concept mapping had on their clinical reasoning skills.	Overall, student responses were positive. Students reported improvement of connecting didactic with clinical area, improvement in organization, retention of information, critical thinking, and enhanced ability to see the whole picture.	Concluded that concept mapping was a valuable teaching strategy in the clinical area. Researchers found the concept maps useful for assessing students' knowledge and helped students make relationships between concepts.

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