THE EFFECTIVENESS OF CONCEPT MAPPING AS AN EDUCATIONAL TOOL

TO ENHANCE CRITICAL THINKING SKILLS IN UNDERGRANDUATE NURSING

STUDENTS

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RESEARCH SUBJECT: The Effectiveness of Concept Mapping as an Educational

Tool to Enhance Critical Thinking Skills in Undergraduate Nursing Students

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Concept mapping is an educational tool used to diagram relationships among concepts.
This idea of concept mapping used in nursing educational settings, can help foster critical
thinking skills by showing students connections between ideas or concepts they are
currently studying. The purpose of this study is to determine if concept mapping is an
effective educational tool to enhance critical thinking skills in undergraduate nursing
students. This is a replication of the study completed by Wheeler and Collins (2003). The
framework is Ausubel's assimilation theory (Ausubel, 1968). A convenience sample
(n=76) will be randomly assigned to experimental (n=44) and control (n=32) groups. The
experimental group will be taught concept mapping as a means of organizing patient data
in preparation of clinicals. The control group will be taught to organize patient data with
traditional nursing care plans. Critical thinking skills will be measured with the California
Critical Thinking Skills Test, which yields six scores: an overall score and five subscales
(analysis, evaluation, inference, deductive reasoning, and inductive reasoning).

Chapter 1

Introduction

Introduction

Concept mapping is an educational tool used to diagram relationships among concepts. In the nursing educational setting, concept mapping can help foster critical thinking skills in students by showing connections between ideas or concepts they are currently studying. A concept map presents a visual representation of a patient's plan of care. This representation allows the student to see a patient's problems and visually connect those problems to interventions (Adema-Hannes & Parzen, 2005).

Concept maps are described as a hierarchal map structure with links to form valid propositions or linking words. General concepts are placed at the top of the map, and progressively more specific concepts are placed under one another to form a hierarchy (Abel & Freeze, 2006). Major concepts are circled or boxed. Lines show relationships or links, and the direction of the thought process is indicated with arrows. Propositional links between concepts, showing the meaning of the relationship between the two concepts, are represented by connecting lines with words that describe the relationship written along the lines.

Historically, nursing educators have used nursing care plans to teach students to prepare, organize, and plan care for their patients. However, nursing care plans can cause a student to become task focused and therefore fail to understand all the aspects of a patient's plan of care. Nursing care plans are linear and do not allow the student to visualize connections between problems and interventions. Patient acuity is currently more complex than it typically has been in healthcare history. The more complex a patient's problems are, the more difficult it is for the nurse to prioritize interventions and understand the importance of all aspects of the patient's plan of care. Concept mapping, like critical thinking, is a nonlinear cognitive function and is an excellent strategy to develop higher-level cognitive functions and critical thinking (Wilgis & McConnell, 2008).

Concept mapping is a creative tool that is helpful to nursing educators as well as students. Nursing is a field where it is exceedingly important that students build upon prior learned concepts or knowledge. Faculty need to employ methods whereby students learn concepts in a meaningful way and develop the skills necessary to enable them to continue to acquire knowledge (Adema-Hannes & Parzen, 2005). Concept mapping can allow faculty to identify and clarify a student's misunderstanding of a concept before new learning is built on incorrect assumptions (Kathol, Geiger, & Hartig, 1998).

Background and Significance

Concept maps encourage students to develop the ability to organize, relate, and process information in the clinical setting, helping them to learn to think critically and problem-solve. In comparison, nursing care plans have long been used to teach students to use the nursing process as a framework for problem-solving. Nursing care plans are

linear, conceptually flat, and have limited effectiveness for developing critical thinking skills (Kathol, Geiger, & Hartig, 1998).

Nursing educators have recognized that the past way of educating by rote memorization is not promoting meaningful learning in nursing students. Due to increased patient acuity and advanced technology in the clinical setting, nursing education needs to develop and foster connections between new information and past learning. In a fast-paced healthcare setting, students must make an educational shift from learning to thinking (Abel & Freeze, 2006). This requires that educators also must include a shift in their methods of how to teach. Nursing education has begun to include concept mapping as a clinical learning activity to promote meaningful learning.

Novak developed the concept map in 1972 to promote the learning of new content by creating hierarchical arrangements of concepts and subconcepts and identifying the relationships between them (Wheeler & Collins, 2003). Concept maps range from highly structured flow charts to creative graphic or pictorial arrangement of concepts. Many disciplines, including medicine, science, and psychology have used concept mapping effectively in the classroom and clinical settings, as both teaching strategies and an outcome measure for critical thinking skills. Concept mapping has also been used as a tool for clinical preparation, evaluation, and research (Daley, Shaw, Balistrieri, Glasenapp, & Piancentine, 1999). Concept maps use a metacognitive approach to develop cognitive skills in learners, promote pattern recognition, and stimulate retained learning on prior experiences (Novak & Gowin, 1984).

Ausubel (1968) developed the assimilation theory which explains why the concept mapping teaching strategy might be more effective than traditional nursing care

plans (Wheeler & Collins, 2003). Ausubel described a difference between acquiring knowledge through reception and discovery versus through rote and meaningful learning. Reception learning is described as being presented to the learner in a formal setting such as a lecture and is then internalized by either rote or meaningful learning. Discovery learning occurs when the learner discovers content such as in the clinical setting and internalizes it through rote or meaningful learning. Rote learning means to memorize content without processing; therefore, it can be easily lost without repetition. Meaningful learning involves building new concepts and ideas on the learner's prior experiences. Meaningful learning is required to develop knowledge, critical thinking, and problem-solving skills. Concept mapping promotes meaningful learning by allowing students to visualize and organize patient data and connect concepts such as a patient's problem to an intervention to that problem.

Problem Statement

The problems faced by patients in today's healthcare environment are becoming increasingly more complex. Patient stay in the hospital is much shorter than it was in previous years and decades, resulting in a larger number of patients being acutely ill while hospitalized. These problems require nurses to not only be organized in patient care, but to also have excellent critical thinking and problem-solving skills. Nursing educators are faced with the task of teaching these vital skills to nursing students. Concept maps provide educators with the ability to help students learn how to organize data, prioritize patient care needs, and see connections between diagnoses and interventions.

Purpose Statement

The purpose of this study is to determine if concept mapping is an effective educational tool to enhance critical thinking skills in undergraduate nursing students. This is a replication of the study completed by Wheeler and Collins (2003).

Research Question

While preparing for clinical experiences, does the use of concept mapping instead of traditional nursing care plans help student nurses to become better critical thinkers?

Conceptual Theoretical Framework

The theoretical framework for this study is Ausubel's (1962) Assimilation Theory. The Assimilation Theory helps explain why concept mapping as a teaching strategy may be a successful tool for teaching critical thinking and problem-solving skills. Subsumption is the central idea running through the whole of Ausubel's learning theory. Subsumption allows the individual to absorb new information into his/her cognitive structures. Cognitive structure is hierarchically organized in terms of highly inclusive concepts under which are subsumed less inclusive subconcepts and informational data. Ausubel (1963) emphasized the learner's cognitive structure in the acquisition of new information. A cognitive structure that is clear and well organized facilitates the learning and retention of new information; while a cognitive structure that is confused and disorderly inhibits learning. Retention learning can be enhanced by strengthening relevant aspects of cognitive structure. The major concepts in cognitive structure act as anchoring posts for new information. The availability of anchoring ideas facilitates meaningful learning. Antecedent learning usually performs this function.

Ausubel's (1962) views of retention were linked to his larger theory of subsumption. Subsumers, anchoring ideas, help to facilitate learning and retention. In reception learning content is presented in its final form, as in a classroom lecture, where it can be retained by either rote or meaningful learning. Meaningful learning is necessary for the development of knowledge, critical thinking, and problem-solving skills.

Definition of Terms

Conceptual.

Critical thinking (CT) is defined by the American Philosophical Association's Delphi study (Facione, 1990).

We understand critical thinking to be purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based. CT is essential as a tool of inquiry. As such, CT is a liberating force in education and a powerful resource in one's personal and civic life. While not synonymous with good thinking, CT is a pervasive and self-rectifying human phenomenon. The ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fairminded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit. Thus, educating good critical

thinkers means working toward this ideal. It combines developing CT skills with nurturing those dispositions which consistently yield useful insights and which are the basis of a rational and democratic society (Facione, 1990, pp. 2).

Operational.

Critical thinking will be measure by The California Critical Thinking Skills Test (CCTST). The CCTST yields six scores: an overall score and five subscale scores (analysis, evaluation, inference, deductive reasoning, and inductive reasoning).

Limitations

The sample size that will be used in this study is relatively small. Using a larger sample size could be valuable in determining the efficacy of concept mapping in promoting critical thinking in nursing students. The level of improvement of various skills that are being measured in this study may require more than one semester to be determined.

Assumptions

Critical thinking is a required skill needed by nursing students to become successful nurses. In order to teach this essential skill, nurse educators have a responsibility to use learning methods that enhance the development of critical thinking skills.

Summary

This chapter has discussed the problem, purpose, theoretical framework, definition of terms, limitations, and assumptions on concept mapping. A background on the significance of this topic reveals that concept mapping may be an effective teaching

strategy that encourages students to learn the valuable skills of critical thinking and problem-solving. A study conducted on concept mapping could be beneficial to both nursing educators and students if the results reveal what researchers have long suspected, that concept mapping enhances meaningful learning. Educators would be confident that their teaching efforts are helping nursing students to learn the needed skills of critical thinking and problem-solving. Students would have the benefit of learning the skills of critical thinking, organization, and prioritizing nursing tasks needed to function as a nurse in the clinical setting.

Chapter 2

Review of Literature

Introduction

Concept mapping is a teaching strategy that is used to encourage students to learn

the valuable and needed tools of critical thinking and problem-solving. This chapter is a

literature review of research studies on the use of concept mapping. This chapter is

organized into two sections: concept maps in the clinical setting and concept maps in the

classroom setting. Concept maps in the clinical setting contains eight article reviews and

is further divided into two categories: process of learning and concept maps and critical

thinking and concept maps. Concept maps in the classroom setting contains four article

reviews.

Theoretical Framework

The theoretical framework for this study is Ausubel's (1962) Assimilation

Theory. Subsumption is the central idea running through the whole of Ausubel's learning

theory. According to Ausubel's theory,

> The big boxes in the mental pyramid subsume the small boxes. Subsumers
>
> constitute the general categories around which we organize our thinking.
>
> Subsumption allows us to absorb new information into our cognitive structures.

Teaching and learning, therefore, are largely matters of erecting cognitive structures (scaffolding) to hold new information. By placing information into its proper box, we are better able to retain it for future use. Similarly, forgetting occurs when the smaller boxes (being made of less durable cognitive stuff) fall apart and become incorporated into the larger boxes. (Ivie, 1998, pp. 3).

Cognitive structure is hierarchically organized in terms of highly inclusive concepts under which are subsumed less inclusive subconcepts and informational data. Ausubel (1963) emphasizes the learner's cognitive structure in the acquisition of new information. Present experience is always fitted into what the learner already knows. "Existing cognitive structure, that is an individual's organization, stability, and clarity of knowledge in a particular subject matter field at any given time, is the principal factor influencing the learning and retention of meaningful new material" (Ivie, 1998, pp. 3). A cognitive structure that is clear and well organized facilitates the learning and retention of new information. A cognitive structure that is confused and disorderly, on the other hand, inhibits learning and retention learning can be enhanced by strengthening relevant aspects of cognitive structure. Putting the mind in order is one of the principal objectives of all education.

Ausubel and Robinson's (1969) theory of learning assumes the existence of a hierarchical structure of knowledge. Fields of inquiry are organized like pyramids, "with the most general ideas forming the apex, and more particular ideas and specific details subsumed under them" (Ivie, 1998, pp. 4). Learning occurs as potentially meaningful material enters the cognitive field, interacts with and is appropriately subsumed under a relevant and more inclusive conceptual system (Ausubel & Robinson, 1969).

The major concepts in cognitive structure act as anchoring posts for new information. The availability of anchoring ideas facilitates meaningful learning. Antecedent learning usually performs this function. "If this ideational scaffolding is clear, stable, and well organized, it is reasonable to suppose that it provides better anchorage for new learning and retention than if it is unclear, unstable, and poorly organized" (Ausubel, 1962, pp. 244).

Organizers are not to be confused with introductory remarks or brief overviews, which are typically written at the same level of abstraction, generality, and inclusiveness as the learning material (Ausubel, 1963). Organizers are abstract ideas presented in advance of the lesson. They represent a higher level of abstraction, generality, and inclusiveness than the new material. Ausubel believes organizers can be used to assist learners in assimilating new information.

Ausubel's (1962) views of retention are linked to his larger theory of subsumption. Subsumers, anchoring ideas, help to facilitate learning and retention. Retention is influenced by three factors: (a) the availability in cognitive structure of relevant subsuming concepts at an appropriate level of inclusiveness; (b) the stability and clarity of these concepts; and (c) their discriminability from the learning task. Learners who possess well organized cognitive structures tend to retain information effectively. Conversely, learners who have poorly organized cognitive systems tend to forget information rapidly.

Concept Maps in the Clinical Setting

    Process of learning and concept maps

    Only a few research studies have been conducted on the process of learning in baccalaureate nursing students. The purpose of a study by August-Brady (2005) was to examine the effect of concept mapping on approach to learning and self-regulation of learning in a sample of nursing students. The following two questions were proposed in this study: How do baccalaureate nursing students who use concept mapping differ in approach to learning from students who do not use concept mapping? How do baccalaureate nursing students who use concept mapping differ in the self-regulation of their learning from students who do not use concept mapping? The Presage-Process-Product (3P) Model of Teaching and Learning (Biggs, Kember, & Leung, 2001) served as the conceptual model for this study.

    The sample consisted of nursing students ($N = 80$) from four state approved and/or accredited baccalaureate nursing programs in eastern Pennsylvania. All students were enrolled in a maternal and child health nursing course with a clinical component. The control group consisted of 45 students and the treatment group consisted of 35 students. The mean age of the participants was 22.7. The majority was female (94%). Eighty-six percent of the participants were Caucasian, 5% were Hispanic, 2.5% were African American, 2.5% were Indian, 2.5% were self-identified as other and 1.5% was missing data. Ninety percent of participants in the sample were enrolled as full-time students. The mean grade point average (GPA) was 3.15 (August-Brady, 2005).

    A quasi-experimental, non-equivalent control group, pretest-posttest design was used for this study. Participants in the treatment group were provided a one-hour session

on the construction of concept maps and then were asked to construct a concept map as a group based on a case study. Participants in the treatment group were required to individually complete six concept maps on their assigned clients to prepare for clinicals during the 15 week semester. Concept maps were scored by the researcher and researcher assistant using Novak and Gowin's (1984) criteria. Data on outcome variables were obtained from students in the treatment and control groups at the end of the 15 week semester.

The revised Study Process Questionnaire-2 Factor (rSPQ-2F) used in the study is a 20-item self-report questionnaire consisting of two main scales-deep approach and surface approach, each consisting of ten questions. Participants respond using a 5-point Likert scale, with descriptors ranging from 1 (this item is never or only rarely true of me) to 5 (this item is always or almost always true of me). Scores range from ten points to fifty points. A high score on the deep approach to learning scale indicates the individual is motivated to learn and uses appropriate strategies to learn. A high score on the surface approach to learning scale indicates the individual's motive to learn is extrinsic to the real purpose of learning and uses corresponding strategies to learn (August-Brady, 2005).

The Strategic Flexibility Questionnaire (SFQ) is a 21-item self-report questionnaire. It contains three main subscales: adaptive, inflexible, and irresolute control beliefs. It is scored using a 5-point Likert scale. The subscale with the highest score indicates the individual's control beliefs about learning (August-Brady, 2005).

Sample characteristics were assessed using a demographic questionnaire developed by the researcher. The participants' demographic variables were included in this study because conflicting evidence exists regarding the influence of these variables.

The researcher and a research assistant used Novak and Gowin's (1984) criteria to score each concept map completed by the participants.

Paired *t* test were performed to assess for pretest and posttest differences in deep and surface approaches to learning. No significant pretest-posttest difference was found in the treatment group in deep approach to learning ($t = -1.01$, $df = 34$, $p = 0.316$) or in surface approach to learning ($t = -0.45$, $df = 34$, $p = 0.66$). Statistically significant pretest-posttest differences were found in the control group in the mean scores for both deep approach to learning ($t = 2.13$, $df = 42$, $p = 0.04$) and surface approach to learning ($t = -3.26$, $df = 42$, $p = 0.002$). An ANCOVA was performed to control for the effects of the pretest score on the posttest score. A statistically significant result was found for deep approach to learning in the treatment group [$F(1) = 5.62$, $p = 0.02$]. No statistically significant result was found for the effect of the treatment on the surface approach to learning scores (August-Brady, 2005).

Paired *t* tests were performed on pretest and posttest scores for adaptive, inflexible, and irresolute control beliefs in the treatment and control groups. No significant differences were found in inflexible and irresolute control beliefs in either group. In the treatment group, adaptive control beliefs were found to be significantly different ($t = -2.79$, $df = 34$, $p = 0.009$). ANCOVAs were performed to control for the effect of the pretest on the posttest scores for each subscale. Statistically significant differences were found between groups for the adaptive control belief subscale [$F(1) = 8.70$, $p = 0.004$]. No significant difference was found between groups for inflexible or irresolute control beliefs (August-Brady, 2005).

The researcher concluded that the results of this study provide empirical support for the use of concept mapping as a metacognitive intervention. The findings suggested that concept mapping facilitates deeper approaches to learning and greater flexibility in control of that learning. The researcher included that a major limitation to this study was the inability to generalize the findings due to the non-random, convenience sampling. The small size of the sample was also a limitation and could have affected certain outcome variables of the study (August-Brady, 2005).

Understanding that there are different preferences for learning styles, the faculty of an undergraduate nursing program inquired if a student's learning style could indicate their ability to develop concept maps. The purpose of a study by Kostovich, Poradzisz, Wood, and O'Brien (2007) was to describe the relationship between nursing students' learning style preference and aptitude for concept maps. The authors did not identify a conceptual/theoretical framework that guided this study. They did note that Novak and Gowin (1984) proposed concept mapping as a strategy to promote meaningful learning based on Ausubel's (1968) assimilation theory.

The population used in this study was 370 students in the undergraduate nursing program at a private Catholic university in a large Midwestern United States city. The majority of the population was female (96%) and only 4% were males. Minorities represented in the population included 28% African American, 11% Hispanic and 2% Asian with the majority of students being Caucasian (59%). The majority of students were age 23 or older. The sample for the study was 120 undergraduate nursing students enrolled in an adult health nursing course. All participants were enrolled in an adult

health nursing course in either the second semester of their junior year or the first semester of their senior year (Kostovich et al., 2007).

Participants completed two instruments. The first was the Learning Style Survey (LSS). The LSS is an adaptation of Kolb's Learning Style Inventory (LSI). The LSS provides three kinds of scores. The first contains four subscale scores, which describe the participant's preferences for concrete experience (CE), active experimentation (AE), abstract conceptualization (AC), and reflective observation (RO) modes of learning. The participant's scores from this section are used to calculate the second set of scores, which describe the participant's ability to apprehend new knowledge (grasping score) and integrate it into existing cognitive structures (transforming score). The last two scores (grasping and transforming) are then plotted on a grid which then can reveal the participant's learning style preference: concrete, active, abstract, or reflective. No reliability or validity information the LSS was available from previous research. In this study, internal consistency reliability of the subscale scores of the LSS was stated to be low (Kostovich et al., 2007).

The second instrument used in this study was a series of nine open-ended questions developed by the researchers. These questions were related to preferences for creating concept maps and also included demographic data. Completion of each instrument required approximately ten minutes. The instruments were completed at the beginning of two different classes three quarters of the way through the semester after the concept map and case study assignments had been completed.

The majority of students had not created concept maps previously, so researchers provided both written and verbal instructions on concept map development. The

researchers emphasized that the purpose of creating concept maps was to link new learning to previous knowledge, organize thought patterns, stimulate critical thinking, and display relationships among concepts. Students were required to link the following elements on the concept maps: pathophysiology, nursing diagnoses, treatment and interventions, diagnostic tests, and clinical manifestations. A grading rubric was developed from the one advocated by Novak and Gowin (1984). Participants' concept maps were graded on the following criteria: hierarchy, propositions, cross-links, and thoroughness. For increased reliability, one faculty member graded all of the concept maps which had been previously sorted by diseases and then organized from the best map to least favorable map. The maps were then graded in order according to the preliminary sorting, allowing the best map to be graded first. This created an informal standard for grading the maps within the class.

A total of 120 participants completed the LSS. Of the 120, 29% ($n = 35$) were concrete, 26% ($n = 31$) were reflective, 23% were abstract ($n = 28$), and 22% ($n = 26$) were active. The mean concept map grade was 89.98 ($SD = 9.15$). The mean final course grade was 82.68 ($SD = 7.04$). Concept map grades and final course grades were weakly correlated ($r = 0.37, p < 0.01$). Participants in the active learning style had higher mean concept map grades than other participants, however the difference was not significant. Nearly twice as many participants in the active learning style preferred concept maps to case studies. No distinct preference was discovered for the other three learning styles (Kostovich et al., 2007).

The findings of this study indicated that learning style preference does not play a role in students' ability to perform well on concept maps. This finding supported the

conclusion that concept maps can be effective for students with all kinds of learning style preferences. The researchers suggested that in order to further study relationships between learning style preferences and teaching strategies, further development and validation of instruments are needed. The researchers also suggested that in the future it may be useful to examine the influence of learning style preferences on the development of critical thinking skills over the course of the nursing curriculum.

Nursing students often face the challenge of learning to link concepts together when planning care for patients in the clinical setting. It has been suggested that concept mapping can be an effective strategy to help promote critical thinking in nursing students. The purpose of a study by Adema-Hannes and Parzen (2005) was to evaluate the perceived effectiveness of concept maps in the clinical setting. The authors did not state a specific conceptual/theoretical framework; however they did state that the idea of concept mapping was based on the work of Ausubel, Novak, and Hanesian (1978) who compared meaningful to rote learning methods.

The population used for this study was 32 third year nursing students who were asked to use concept maps as a learning tool over two 12-week rotations on a pediatric medical and surgical unit. The students reviewed an article that outlined how to complete a concept map with patient data. The students then completed a two hour interactive group tutorial. They also were provided a template to guide the process (Adema-Hannes & Parzen, 2005).

Students collected data on patients the day before their clinical and then constructed a map using the data. The nursing students were provided with potential

nursing interventions for each issue identified. The students were expected to spend approximately two hours in preparation for each clinical.

Tutors had discussions with the students during their clinicals to identify relationships among patient data such as assessment findings, current medication use and response, diagnostic tests and results, and medical regimen. The updated patient data was incorporated into the plan of care. Maps were updated during shifts to include more knowledge and increased understanding of concepts. Tutors helped students who failed to recognize connections in patient data and helped point out missing links (Adema-Hannes & Parzen, 2005).

Students were asked to provide input on the use of concept maps during course evaluations at the end of each rotation. Some difficulty was initially identified among the students but overtime with more use of the concept maps students showed improvement. Students commented that the use of concept maps was fun and allowed them to see all aspects of patient care and improve their critical thinking. When asked to share their thoughts on concept maps the students gave positive feedback. Students rated their improvement as 100% on the following issues: ability to link lab values, medications, pathophysiology and patient issues. Students also rated their clinical reasoning as improved 100% versus having no change or deterioration (Adema-Hannes & Parzen, 2005).

Adema-Hannes and Parzen (2005) concluded that concept maps were extremely useful in assessing students' knowledge of patient data, preparedness of clinicals, and ability to link concepts within patient data and care. The authors suggested that future research be done on the use of concept maps in the clinical setting to link theory to

nursing practice using validated tools. They recommended that future researchers use a tutorial to teach nursing students about concept maps and how to use them. The authors also suggested that future researchers could study the use of grades on concept maps as a way of grading a clinical class instead of using the traditional pass/fail system; they also point out that a concept map care plan grading tool has already been developed but the reliability and validity has not been established.

Concept mapping is a teaching strategy that can be used to help students understand concepts and relationships and to plan and evaluate nursing care. The purpose of a study by Hinck et al. (2006) was to test the effectiveness of student learning and satisfaction with concept mapping. Two research questions were proposed in this study. Is there a difference in the concept maps of care plans at the beginning and end of the course? What are students' self-evaluations of their learning and satisfaction with use of concept mapping? A conceptual/theoretical framework was not identified to guide this study.

A quasi-experimental pre- and posttest design was used in this study. Participants were junior-level baccalaureate nursing students ($n = 23$) at a Midwest metropolitan university. Students created concept maps at the beginning and the end of a 16-week mental health course in spring 2004. This was the third clinical course for the participants, who had used nursing care plans in the previous two courses. Researchers developed a 21-item questionnaire based on the Student Assessment of Learning Gains Instrument. Participants completed the questionnaire reporting their self-assessed learning and level of satisfaction with concept maps at the end of the course (Hinck et al., 2006).

Students and faculty participated in a comprehensive training program to learn how to create concept maps. Participants developed a total of eight concept maps during the course. The researchers used the first and the seventh concept maps for this study, identifying the maps as CM1 and CM7. The maximum amount of points possible was twenty. Researchers awarded points for the presence of nine items: main health concern, two nursing diagnoses, prioritization of diagnoses, supporting data, short- and long-term goals, interventions, teaching, evaluation of care, and cross-links. To establish reliability of the findings, two researchers scored all the concept maps (Hinck et al., 2006).

The scores improved from the first to the seventh maps (CM1: M = 17, range 8-20; CM7: M = 19, range 16-20), no students decreased in score. Means of the first (CM1: M = 15.35, SD = 2.95) and the second set (CM7: M = 17.39, SD = 1.12) of concept maps were calculated. A significant increase in comprehensiveness of concept maps over the course was found (t = -3.01, df = 22, p = .006). Results of the questionnaire indicated that students most favored in-class practice with concept mapping and least favored the reading assignments to learn to create concept maps. Satisfaction with grading of the maps was high and feedback was appreciated. Students reported that concept maps improved thinking ability, preparation for the real world, and ability to understand complex situations. Students also reported that concept maps helped them create care plans for clients and enhanced overall learning. Students recommended that adequate time be allowed to complete the concept maps, several students reported spending three or more hours constructing each map (Hinck et al., 2006).

Hinck et al. (2006) concluded that the comprehensiveness of students' care plans improved when they diagramed the main concepts and relationships between concepts.

Most students were satisfied with this teaching strategy. The researchers advised that because nursing care in the community is often complex and changes in each setting, students are best served if they are helped to learn how to process new information rather than memorize care required in a specific setting. The researchers also concluded that concept mapping is an effective learning strategy to help students apply new knowledge and skills to clients with complex health-care needs.

Critical thinking and concept maps

Nursing education is moving away from simple memorization and toward teaching students to be able to think critically and to problem solve. This change requires educators to shift from traditional teaching methods to new educational strategies. The purpose of a study by Abel and Freeze (2006) was to 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. Three research questions were used to guide this study. Can associate degree nursing (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? How do ADN students and faculty evaluate the use of concept maps as a clinical learning activity? This study was a partial replication of a study by Daley et al. (1999). A specific conceptual or theoretical framework for this study was not described; however the study by Daley used the assimilation theory by Ausubel (1963).

The participants in this study were 28 senior associate degree nursing students. Twenty-four of the participants were Caucasian, two were African American, one was Hispanic, and one was Asian. Twenty-five students were female and three were male. The age range was 21 to 43 years, with a mean age of 28 years. The geographic location for the study was not identified (Abel & Freeze, 2006).

Students received instruction and guidance on concept map construction from the same two instructors throughout the year the study took place. Students completed four maps during the study. Each completed concept map received a numerical score. The concept maps reflected the student's ability to identify and describe client needs, nursing care, and relevant relationships between concepts. For grading purposes, the concept maps were evaluated as satisfactory or unsatisfactory based on guidelines provided to the students. Each completed concept map also received a numerical score for data analysis purposes. The total score on the maps indicated critical thinking used in the nursing process. The concept map scoring criteria were the same as those used by Daley et al. (1999). The scoring criteria for the study were: (a) Propositions are the meaningful relationships between two concepts indicated by the connecting line and linking words = 1 point each. (b) Hierarchy shows a general to specific approach = 5 points for each level. (c) Cross-links show meaningful connections between one segment of the hierarchy and another segment = 10 points each. (d) Examples describe specific instances of a concept = 1 point each. Scoring reliability was determined for the two instructors involved in the project during a pilot study performed by Freeze and Abel (2002) using the same scoring criteria and the same instructors.

The maps were analyzed on the basis of the scoring criteria. Mean scores of the maps increased each semester. Data analysis demonstrated a group mean score of 173 on the first map completed during the second semester. The average of the mean scores for the last two maps completed in the fifth semester was 249. A paired t test was performed to determine whether a statistically significant difference existed between the two scores. The t value was $1.70(p = 0.05)$, indicating a statistically significant difference between the scores for the first and last maps (Abel & Freeze, 2006).

An increase was noted in the number of cross-links identified in the maps from the second semester through the fifth. The group's mean score for cross-links on the first map was 89, and the average mean score for the two maps in the fifth semester was 143. The t value was $2.05(p = 0.05)$, indicating a statistically significant difference between the first and last maps (Abel & Freeze, 2006).

Able and Freeze (2006) concluded that early introduction to concept mapping increases students' critical-thinking ability over time. The findings in this study support the use of concept mapping as an evidence-based nursing education strategy. The researchers recognized that more research is needed to assess the most effective ways to implement the concept-mapping process in clinical nursing education.

Nurses currently face complex challenges in health care and need the ability to be skillful and knowledgeable critical thinkers and decision makers. Concept mapping as a teaching strategy is believed to promote critical thinking skills in nursing students. The purpose of a study by Hicks-Moore and Pastirik (2006) was to determine the level of critical thinking demonstrated in the clinical concept maps developed by nursing students. The researchers posed the following four research questions: To what extent

and at what level is critical thinking identified in the clinical concept map of second year baccalaureate nursing students? Is the Holistic Critical Thinking Scoring Rubric (HCTSR) an effective tool for evaluating evidence of critical thinking in written clinical concept maps? How do second year baccalaureate nursing students evaluate the experience of developing and using concept maps to promote critical thinking in clinical nursing education? How do clinical instructors evaluate the experience of developing and using concept maps to promote critical thinking in clinical nursing education? A conceptual/theoretical framework was not identified to guide this study.

The sample consisted of eighteen second year baccalaureate nursing students enrolled in family medicine, restorative care, and obstetrics and gynecology hospital-based nursing clinicals. The study took place during the last five weeks of the semester. During the orientation to the course, researchers gave students information about the purpose and method of the study. Students who volunteered for the study were asked to submit their final concept map to be scored at the end of the semester using the HCTSR and to participate in a focus group at the end of the practicum. The clinical instructors who volunteered participated in a separate focus group. Demographical information was not provided on the participants (Hicks-Moore & Pastirik, 2006).

The HCTSR developed by Facione and Facione (1994) was the instrument used in this study to measure critical thinking. Concept maps are scored from 1 to 4 points, the higher the score indicating a higher level of critical thinking. Concept maps receive higher scores for specific criterion including interpreting evidence accurately, drawing warranted, non-fallacious conclusions, and justifying assumptions. The HCTSR was derived from the California Critical Thinking Skills Test (CCTST) and California Critical

Thinking Dispositions Inventory (CCTDI) (Facione & Facione, 1992). There were no reliability measures for the HCTSR, however this tool was derived from reliable critical thinking instruments.

Clinical instructors attended an information session led by the two researchers to review scoring concept maps with the HCTSR. Several cases studies and sample concept maps were used to demonstrate scoring methods. During the clinical rotation, the instructors scored students' concept maps and provided feedback using the HCTSR. Instructors graded the final concept maps, with no identifying information from the students. Concept maps were then given to researchers who were blinded to the HCTSR scores by instructors and graded again by the researchers. Scores given by the instructors and those given by the researchers were then compared to further establish reliability (Hicks-Moore & Pastirik, 2006).

Two central themes were derived from the focus groups: critical thinking and clinical preparedness. Students and instructors expressed that concept maps increased critical thinking ability and clinical preparedness. Students described the concept mapping process as helping them to prepare for clinical practice, giving them an understanding of the whole picture of the client. Instructors described concept maps as helpful in determining levels of student preparedness and assessment of knowledge and understanding of the patient situation (Hicks-Moore & Pastirik, 2006).

The results of the HCTSR revealed scores ranging from 2 to 4 points on the concept maps. The mean was 2.83 with a standard deviation of 0.71. The majority of the concept maps received a score of 3, suggesting strong evidence of critical thinking. Students accurately interpreted and analyzed client data, identified relevant problems and

made accurate conclusions regarding plans of care. Students were able to provide evidence and justification for their nursing interventions (Hicks-Moore & Pastirik, 2006).

The researchers recommended that future research be conducted to refine the HCTSR to better reflect the critical thinking process that occurs during concept mapping exercises. The researchers also suggested that participants should be at different levels of nursing education and that a pre and posttest design could reflect the level of critical thinking changes that occur over time. This study supports the use of concept maps as a teaching strategy to promote critical thinking as evidenced by the high HCTSR scores and the perspectives of the participants and instructors (Hicks-Moore & Pastirik, 2006).

Increasing demands are being placed on nursing educators to prepare graduates who are able to think critically and problem-solve in a variety of clinical practice areas. Wheeler and Collins (2003) conducted a study to determine if concept mapping was an effective tool in promoting critical thinking and problem-solving skills in baccalaureate nursing students. Ausubel's (1968) assimilation theory was used as the theoretical framework for this study.

A convenience sample ($N = 76$) of sophomore baccalaureate students enrolled in a nursing course at a Southeastern university in spring 1998 participated in the study. Participation in the study was voluntary and all eligible students participated. Each student's anonymity was maintained by assigning an identification number so that pretest and posttest scores could be compared. All participants were upper division-nursing program students. Each participant was randomly assigned to one of four courses (Adult Health, Pediatric Nursing, Maternity, or Psychiatric Nursing) and a related clinical rotation for the first 7.5 weeks of the fall semester. They were then randomly reassigned

to one of the remaining three courses for the second 7.5 weeks (Wheeler & Collins, 2003).

A demographic questionnaire developed for this study asked respondents for sex, age, and level of education, and to specify use of concept mapping in Adult Health and in Pediatrics, or no experience with concept mapping. Critical thinking skills were measured with the California Critical Thinking Skills Test (CCTST), which yielded six scores: an overall score and five subscales (analysis, evaluation, inference, deductive reasoning, and inductive reasoning). The CCTST was used in this study to measure critical thinking skills. The authors of the instruments have provided norms for evaluating results based on college students with a mean age of 22, an average class standing of beginning junior, and no prior coursework in critical thinking (Wheeler & Collins, 2003).

The experimental group was made up of 44 students who used concept maps to prepare for clinicals. The control group was 32 students who had no experience with concept mapping. There was no significant difference in age or sex between the two groups. The pretest scores of the two groups did not differ significantly. When analysis of covariance (ANCOVA) was performed on the mean difference between pretest and posttest scores on the overall CCTST and the subscales, with pretest scores used as a covariant, a significant F was obtained for each of the tests. However, no significant differences between groups were indicated by the model. The mean experimental group score on the posttest significantly differed from the pretest mean score on the overall CCTST, but the scores were not significantly different for the control group. When subscale results were analyzed, only the experimental group showed a significant mean

difference on the analysis subscale. The mean difference of both groups was significant on the evaluation subscale (Wheeler & Collins, 2003).

The authors found a significant difference ($p < .05$) between the mean pretest and posttest scores and each subscale. Post hoc tests found differences between groups to be insignificant, while various differences within a group were significant. The experimental group had significant score improvements on the overall score and the analysis and evaluation scores. The control group scores improved significantly only on the evaluation subscale and declined significantly on the inference subscale. The findings of this study suggest that concept mapping is effective in helping students develop critical thinking skills (Wheeler & Collins, 2003).

Wheeler and Collins (2003) suggested that students using traditional methods such as nursing care plans tend to summarize facts rather than link concepts. Concept mapping enhances the reasoning process by stimulating discovery and meaningful learning in students. The authors suggested that a longitudinal study be conducted to determine the long-term effect of concept mapping as well as how long it takes students to master the method of concept mapping

Novice graduate nurses often do not have the experience and knowledge needed to think critically and problem solve regarding complex patient needs and situations. The purpose of a small descriptive comparison study by Wilgis and McConnell (2008) was to determine whether concept mapping used during a hospital orientation program improved critical thinking skills in novice graduate nurses. Benner's (1984) Novice to Expert Theory provided the theoretical framework for this study.

Fourteen graduate nurses ($N = 14$) attending a hospital orientation program in northeast Florida were the sample used in this study. Participants were asked to use case studies to construct concept maps of patient's main health problems, key assessment findings, appropriate nursing diagnoses, and interventions at the beginning and end of the orientation program. The participants' ages ranged from 23 to 50, with a mean age of 33. Thirteen participants were female, one was male. The effectiveness of concept mapping in developing critical thinking skills was evaluated using a descriptive comparison design, examining differences between pre- and post- concept maps (Wilgis & McConnell, 2008).

An instrument developed by Schuster (2002) was used to grade the concept maps in this study. This grading tool is designed to assess critical thinking and patient care planning skills based on the six American Nurses Association standards of nursing care practice, including collection of health data, analysis of data to determine a nursing diagnosis, identification of expected patient outcomes, development of a patient's plan of care, implementation of nursing interventions, and evaluation of patient progress toward outcomes. Points were given for achievement of nursing care standards, logical flow of thought processes, complexity, and hierarchical order demonstrated by connections and cross-links on the concept maps. Schuster (2002) reported that concept map care plans for clinical evaluation of critical thinking, communication, and nursing interventions are reliable ($r = 0.70$ or higher) if the same faculty that taught the course also graded the concept maps. This was done in this study to achieve reliability of scoring.

The total score for all participants' pre-concept maps was 197 and the total score for the post-concept maps was 230, demonstrating a total score increase of 33 points.

Review of individual pre- and post-concept scores showed that 10 of 14 participants'

scores increased, two participants' scores stayed the same, and two participants' scores

decreased. The post-concept map mean score was substantially higher (16.43) than the

pre-concept map mean score (14.07). A paired sample t test showed a significant

improvement (t = -2.797; df = 13; p = .008) in post-concept maps at a set alpha level of p

= .05 (Wilgis & McConnell, 2008).

The graduate nurses completed a concept mapping evaluation form after

constructing the post-concept map. The results indicated that 10 of the 14 participants

believed concept mapping assisted them in linking knowledge together, improving

prioritization and organization of patient care planning, and improving critical thinking.

Two participants were unsure of how they felt and two participants believed concept

mapping was not helpful and was too confusing. Twelve participants reported they would

recommend concept mapping as a teaching strategy and they believed learning increased

as a result of concept mapping. Two participants said they would not recommend this

strategy due to the time involved to complete a concept map (Wilgis & McConnell,

2008).

Wilgis and McConnell (2008) concluded that concept mapping was useful in this

group of graduate nurses as indicated by the improvement of scores in the post-concept

maps. The researchers recommended that a descriptive comparative longitudinal study be

conducted on a larger sample of graduate nurses to further investigate the effectiveness of

concept mapping as a teaching and evaluation strategy during a hospital orientation

program. They also noted that using a larger sample would be more valuable in

determining the efficacy of concept mapping in promoting critical thinking in professional nurses.

Concept Maps in the Classroom Setting

Teaching baccalaureate nursing students to think critically has long been a difficult task faced by nursing faculty. The purpose of a study by Chen, Liang, Lee, and Liao (2011) was to discover the effects of concept mapping on students' ability to think critically and approach learning and studying compared with traditional lecture-based classroom teaching. No conceptual/theoretical framework was identified to guide this research study, however students were taught to construct concept maps in accordance with the steps outlined by Novak (1998).

Researchers used a quasi-experimental, pretest-posttest design with a control group to compare the effects of concept mapping on critical thinking and approach to learning and studying. The study was conducted in the second semester of the first year during a 15-week medical-surgical nursing course. The sample was drawn from a 2 year RN to Bachelor of Science in Nursing (BSN) program in Taiwan. The experimental group consisted of 47 students while the control group consisted of 48 students. The mean age of the study sample was 21.98 years; the mean age difference between the experimental group and the control group was 1.21 years. Most of the students gained admission to the university by entrance examination test (72.6%) and were without any work experience related to nursing (87.4%). None of the students had been exposed to concept maps or taught how to construct concept maps (Chen et al., 2011).

During the first week of the medical-surgical course, the students in the experimental group were taught to construct a concept map. Five case scenarios related to

the course content were designed for group discussion at the end of each class. During each class, instructors used concept maps to summarize course content and guided the students' scenario exercise using concept mapping. Students in the experimental group presented their findings using concept maps. Students in the control group received traditional lectures and presented their assignments using the nursing process framework (Chen et al., 2011).

Researchers used the Critical Thinking Scale (CTS) developed by Cheng, Wang, Wu, and Hwang (1996) to measure critical thinking skills. The scale consists of five subscales: inference, recognition of assumption, deduction, interpretation, and evaluation of arguments. Each subscale has 12 items for a total of 60. Each correct answer is assigned 1 point, scores range from 0 to 60. Higher scores indicate stronger critical thinking skills. The CTS also demonstrates adequate convergent and known group validity.

The Approaches to Learning and Studying Inventory (ALSI) developed by Entwistle, McCune, and Hounsell (2002) was used to assess how the students had been studying within the course unit. The ALSI consists of 36 questions on five subscales: deep approach, surface approach, organized studying, monitoring study, and effort management. Each item has a 5-point response scale from 1 to 5 with 1 being strongly disagree to 5 being strongly agree. The total score ranges from 5 to 180 with higher scores indicating greater proficiency with the strategies.

Pearson product moment correlation was performed to examine relationships between variables. The paired *t* test and independent sample *t* test were used to determine

differences between groups after the intervention. Analysis of covariance (ANCOVA) was used to determine the mean differences in scores.

The correlations analysis showed no statistically significant associations between critical thinking and monitoring study, organized study, or effort management. The deep approach was positively associated with overall critical thinking ($r = 0.26$, $p = 0.01$) and inference ($r = 0.41$, $p = 0.001$), while the surface approach was negatively correlated with overall critical thinking ($r = -0.30$, $p = 0.004$), inference ($r = -0.22$, $p = 0.03$), recognition of assumptions ($r = -0.20$, $p = 0.04$), and evaluation of arguments ($r = -0.26$, $p = 0.01$) (Chen et al., 2011).

After the concept map intervention, the average scores for overall critical thinking were 41.08 for the control group and 42.98 for the experimental group. No statistically significant differences were found between groups for any of the subscales. The paired t tests revealed statistically significant differences in mean scores for all the ALSI subscales in the control group. In the experimental group, paired t tests found statistically significant differences for the deep approach ($t = 4.70$, $p = 0.001$), the surface approach ($t = 3.02$, $p = 0.004$), and organized study ($t = 2.30$, $p = 0.03$) (Chen et al., 2011).

ANCOVA was used to examine the mean differences in the scores for critical thinking. The findings revealed that the adjusted means of overall critical thinking ($F[1,94] = 6.67$, $p = 0.01$) and inference ($F[1,94] = 5.86$, $p = 0.02$) were significantly higher in the experimental group than in the control group. No statistically significant differences were found between the groups in the other subscale scores (Chen et al., 2011).

The researchers concluded that the increase in critical thinking scores found in the experimental group suggested that concept map teaching may foster critical thinking skills, such as inference. Concept mapping was a useful tool to encourage students' learning process to shift from a passive acquisition of knowledge to an active and deep approach to learning. The results also implied that cognitive thinking skills can be taught and that instructors should include different teaching strategies in the classroom and not use lectures as the sole method of teaching. The researchers recognized that this study may be limited by the small sample size and that measuring improvement of various critical thinking skills may require more than one semester. They suggested that further work is needed to evaluate the longitudinal effects of concept map teaching on students' approach to learning and studying and on their critical thinking skills (Chen et al., 2011).

Concept mapping promotes critical thinking skills and problem-solving abilities in students. Concept mapping also encourages students to become active learners and to have a deeper understanding of complex problems in patients. The purpose of a study by Hsu (2004) was to examine the effects of adopting concept mapping in problem-based learning (PBL) scenario discussions on learning outcomes in a nursing course. Roy's (1984) adaptation model was used to guide this study.

The sample consisted of 92 nursing students and 2 nursing instructors from the Chang Gung Institute of Technology of Taiwan. Forty-three participants were in the experimental group and 49 participants were in the control group. All participants in this study were female. The students were 19 to 20 years old. Students had similar educational backgrounds and entrance qualifications (Hsu, 2004).

Students were randomly assigned to either the control or the experimental groups. The control group received traditional teaching while the experimental group received teaching that incorporated concept mapping in PBL scenario discussions. During the nursing course, students in both groups watched a video entitled 'Hilary and Jackie,' a film about the relationship between sisters after one is diagnosed with a serious illness. At the end of the course all participants drew a concept map about the video applying the four concepts from Roy's model, physical function, self-concept, role-function, and interdependence. The scoring system purposed by Novak and Gowin (1984) was used to score the concept maps. This system awards the following: proposition- 1 point, hierarchy- 5 points, cross-links- 10 points, and examples- 1 point.

The experimental group received significantly higher proposition and hierarchy scores for their concept maps than the control group. There were no significant differences in cross-links and example score between the two groups. A total of 30 points was available for the maps. Only one student in the experimental group gained a high score (greater than or equal to 20 points). Twenty-six out of forty-three in the experimental group and 46 out of 49 in the control group obtained low scores (less than or equal to 10 points). Eighteen of the control group students received a zero while four students in the experimental group received a zero (Hsu, 2004).

The total scores of the experimental group were as follows: 1(2.3%) student scored between 21 and 30 points, 16(37.2%) students scored between 11 and 20 points, 22(51.2%) students scored between 1 and 10 points, and 4(9.3%) students scored 0 points. The total scores of the control group were as follows: 0(0%) students scored between 21 and 30 points, 3(6.1%) students scored between 11 and 20 points, 28(57.1%)

students scored between 1 and 10 points, and 18(36.7%) students scored 0 points. The results of this study indicated that the experimental group received significantly higher proposition and hierarchy scores for their concept maps than the control group. There were no statistically significant differences in the cross-link and example scores between the groups. There was a statistically significant difference in total scores for the concept maps between the two groups. A *t* test was performed to compare mean total scores between the two groups. The *p*-values ($P < 0.0001$) were as follows: propositions < 0.000, hierarchies < 0.000, cross-links 0.386, examples 0.274, total < 0.002. The experimental group developed stronger concept mapping ability that the control group. Students complained that concept mapping consumed extra hours and subsequently took time away from studying (Hsu, 2004).

Hsu (2004) concluded that concept mapping is useful for analysis of individual student's thinking processes during course work. The findings of this study suggest that concept mapping emphasizes key concepts and helps students understand relationships between different concepts. Concept mapping also allows students to review propositions, hierarchies, and cross-links in a logical way to revise concept structures to agree with theory and experience. The researcher suggested that instructors allow needed time for teaching the construction of concept maps to students and to give students the necessary time to complete a concept mapping task.

In today's complex health environment, educators are faced with the difficult challenge of promoting critical thinking and judgment in nursing students. The purpose of a study by Hsu and Hsieh (2005) was to use concept maps as a teaching strategy in a

nursing course and to evaluate the students' learning progress as they constructed concept

maps based on provided scenarios. The conceptual/theoretical framework used in this

study was Ausubel's (1963) assimilation theory. The researchers used a scoring system

originally proposed by Novak and Gowin (1984) to grade the concept maps.

The participants of this study were 43 students in a 2-year nursing program

enrolled in a Nursing I course in the fall semester of 2002. The participants were assigned

into seven different map groups; each group consisted of six or seven students. The

nursing program location and demographic data on the participants were not included

(Hsu & Hsieh, 2005).

Participants were instructed on the development of concept maps over the first

week of class. They were taught to develop the concept maps using three steps. The first

step was to read and analyze the scenario through group discussions. The next step was to

formulate patient profile problems such as symptoms and illness conditions which can be

connected to major problems. Students then could focus on finding solutions or

interventions to these problems. The final step in learning how to develop concept maps

was for the participants to represent relationships found in each scenario's data,

diagnosis, treatments, human responses, and nursing interventions. Six scenarios were

developed by researchers. Participants completed six group concept maps on the

scenarios over the semester (16 weeks). Five of the scenarios dealt with physical

functions. Those functions were activity and rest (AR), fluids and electrolytes (FEs),

neuroendocrines (NEs), sensory perception (SP), and sexuality (SEX). The sixth scenario

dealt with role functions (RFs) (Hsu & Hsieh, 2005).

In this study, researchers graded each map by giving points based on four categories: concept links, hierarchies, crosslinks, and examples. Each map was scored using the following point system: concept links worth two points each, crosslinks worth ten points each, hierarchies worth five points each, and examples worth one point each. The total map score was 30 points. To account for the difference in the quality of the maps, the researchers used a "proposition inventory" evaluation tool to conduct qualitative evaluation of the participants' concept maps. The first drafts of concept maps received low scores but the third and following drafts made by the groups showed improvement. The participants showed improvement in higher order thinking skills only after drawing two maps (Hsu & Hsieh, 2005).

Hsu and Hsieh (2005) concluded that teachers need to provide adequate guidance and instruction time for students to be able to learn critical thinking skills. Concept maps also are very useful in helping students incorporate nursing skills from the provided scenarios. The researchers included that concept maps helped students acquire the problem-solving and critical thinking skills needed to make connections between nursing problems, identify priority problems that exist, and develop interventions to these problems.

Concept mapping has been used as a teaching strategy to encourage meaningful learning in the clinical setting; however research is lacking to explain how concept mapping can be utilized in the classroom. The purpose of a study by Kinchin and Hay (2005) was to stimulate interest in the practical classroom application of concept mapping strategies as an approach that teachers can easily use to enhance collaborative learning. A conceptual/theoretical framework was not identified to guide this study.

The participants of this study were 12 postgraduate trainee teachers enrolled in a part-time postgraduate certificate in the education of adults (PGCEA) program. All participants were studying to be nurse educators and all had educational backgrounds in biological science. None of the participants were familiar with the use of concept maps. No demographic data concerning the participants was provided in this study (Kinchin & Hay, 2005).

The participants were provided a two-hour training class on the construction of concept maps. The topics chosen for this study were pathogenic microbes and genetics because all participants had a basic level of knowledge on these subjects. Participants were given a list of 20 basic concepts associated with pathogenic microbes. Participants were asked to construct a concept map individually without the use of colleagues or other materials. The maps were assessed and categorized as a "spoke" a "chain" or a "net" type map. Maps were then sorted in to groups of three consisting of one map from each category. The triad of students were then asked to compare their maps and to produce a consensus map from the group. Each individual map and each group map was then scored by the number of acceptable propositions. A gain score from individual to group map was calculated for each participant. This process was then replicated using the topic of genetics except students were placed with other students who produced similar maps. The average individual and group scores for the microbes (heterogeneous/mixed groups) and genetics (homogeneous/similar groups) trials were calculated for comparison (Kinchin & Hay, 2005).

A significant difference in average gain scores between the two groups was found: +7 for the heterogeneous groups (microbes) and -0.825 for the homogenous groups (genetics). The scores achieved by the heterogeneous groups were greater than the sum of the scores gained by the individuals. Participants arranged in groups of individuals having different knowledge structures were found to make a greater improvement than participants arranged in groups with individuals having similar knowledge structures (Kinchin & Hay, 2005).

Kinchin and Hay (2005) concluded from the findings of this study that arranging student groups to maximize the variation in the gross structure of concept maps represented within the group does promote more effective exchange of information during collaborative episodes. The purpose of group work is to allow students to share and challenge each others' ideas; this is most likely to occur if groups consist of students with different perspectives. The researchers suggested that future research should be conducted on how student interactions inform the development of knowledge structures "spoke," "chain," or "net" type concept maps.

Summary

This chapter has described a literature review of the use of concept mapping as a teaching strategy to improve critical thinking skills in nursing students in both the clinical and classroom settings. Each study discussed in this literature review found concept mapping to be successful at helping students to understand concepts, organize and prioritize complex patient care data, and improve problem-solving skills. It can be concluded from this review that concept mapping is a valuable teaching strategy and can help nursing students understand patient care concepts.

Chapter 3

Methodology

Introduction

  Nurses are expected to be able to prepare, organize, and plan patient care efficiently. As patient care becomes increasingly more complex, nursing educators recognize that nursing students need the ability to think critically and problem-solve. Concept mapping has been proposed as an effective teaching strategy for encouraging students to think critically, link key concepts in patient care, and organize and prioritize data. The purpose of this study is to evaluate the effectiveness of concept mapping in developing critical thinking skills in junior level baccalaureate nursing students.

Population, Sample, and Setting

  The study population will be junior level baccalaureate students enrolled in a Medical-Surgical course with a clinical during the fall semester of 2012 at Ball State University in Muncie, Indiana. A convenience sample (N=72) of BSN students will be used in this study. Participation in the study will be confidential and voluntary. Each student will be assigned an identification number so the pretest and posttest scores can be compared while maintaining anonymity. Students will be randomly assigned to one of six different clinical groups, each consisting of twelve students. Three clinical groups ($n =$

36) will be assigned to the experimental group, three clinical groups ($n = 36$) will be

assigned to the control group.

Protection of Human Subjects

The study, prior to implementation, will be submitted to the Ball State University

Institutional Review Board for approval. Participation in this study will be voluntary. The

purpose, risks, and benefits will be explained to potential participants. There are no

identified risks. The benefit of participating is that participants will be helping nurse

educators to better understand how to help students develop critical thinking skills.

Written consent to participate will be obtained. Each student will be assigned an

identification number so the pretest and posttest scores can be compared while

maintaining anonymity.

Procedures

The students in the experimental group will be taught how to construct a concept

map during the orientation to the course. Students in the experimental group will

construct a concept map as part of their clinical preparation each week. Students in the

control group will use traditional nursing care plans to prepare for their clinical

experience each week.

Instrumentation

A demographic questionnaire will ask participants their sex, age, level of

education, and to specify any previous use of concept mapping. The California Critical

Thinking Skills Test (CCTST) will be used to measure critical thinking skills, the

dependent variable. The CCTST yields six scores: an overall score and five subscale

scores (analysis, evaluation, inference, deductive reasoning, and inductive reasoning).

The various users of the test have established face validity through anecdotal comments of test takers and by assessing the questions. Construct validity is supported by the inclusion of test items that reflect the consensus definition of critical thinking by the American Philosophical Association's Delphi study (Facione & Facione, 1992). Construct validity has also been confirmed through pretest and posttest experiments in which the instrument successfully identified growth in the critical thinking skills of students who completed a course in critical thinking and identified no growth in a comparable group of students who had never taken such a course (Facione & Facione, 1992). Form A of the CCTST will be used for the pretest. At the end of the fall semester of their junior year, students will be asked to voluntarily complete a brief demographic questionnaire and retake the CCTST using Form B.

Design

The study will use a quasi-experimental, pretest-posttest design with a control group to determine if students who use concept maps to facilitate clinical preparation will show increased improvement in critical thinking skills than students who do not prepare with concept maps. This design will allow the researcher to obtain quantitative data for a comparison analysis. Participants in the experimental group and the control group will take Form A of the CCTST before the intervention. After the intervention, participants in the experimental group and the control group will take Form B of the CCTST.

Data Analysis

Critical thinking will be measured using Form A as the pretest and Form B as the posttest of the CCTST. An analysis of covariance (ANCOVA) will be performed on the

mean difference between pretest and posttest scores on the overall CCTST and the subscales. Post hoc tests will be performed to compare the total mean pretest and posttest scores of each group to discover any significant difference. Post hoc tests will be performed to compare each of the five subscales of the CCTST between the two groups.

Summary

This chapter has described the methods and procedures that will be conducted for this research study. The study is a quasi-experimental pretest-posttest design to determine if concept mapping improves critical thinking skills in junior level baccalaureate nursing students. Participants will take the CCTST Form A at the beginning of the semester and Form B at the end of the semester. An ANCOVA will be performed to determine a significant difference between the scores of the pretest and posttest in the experimental and control groups. This study will replicate a study previously conducted by Wheeler and Collins (2003) with the anticipation of validating previous results while providing further information on the significance of using concept mapping to improve critical thinking skills.

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