

CONCEPT MAPPING:

An Effective, Active Teaching-Learning Method

LAURA H. CLAYTON



THE ABILITY TO THINK CRITICALLY and solve problems in a variety of clinical practice settings is a requirement for new nurse graduates. For faculty, factors such as increased patient acuity, shorter hospital stays, and increasing demands on transitional care, long-term care, and home health care have contributed to a growing need to use active teaching strategies to promote meaningful learning. As Black, Green, Chapin, and Owens have stated, “The student in the new millennium can no longer depend on rote memorization to make the transition from theory to clinical” (1, p. 6). • Concept mapping is an active teaching strategy that can help nurse educators prepare graduates to think critically in today’s complex health care environment. THIS ARTICLE examines empirical studies on the use of concept maps as a teaching-learning method in nursing and discusses the effectiveness and limitations for teaching and learning and implications for nursing education.

ABSTRACT Nurse educators, under pressure to prepare graduates who are able to think critically and solve problems in a variety of clinical practice settings, require active teaching strategies to promote meaningful learning, instead of relying on traditional methods that promote rote memorization. A review of the current state of the science with regard to concept mapping demonstrates that this teaching-learning method assists nurse educators to prepare graduates to think critically in the complex health care environment. However, further research is needed to determine the effectiveness of concept mapping on the graduate’s performance on the NCLEX exam and on critical thinking and prioritization skills in the clinical environment.

Definitions and Theoretical Framework Meaningful learning, based on Ausubel’s assimilation theory of learning (2), is the theoretical foundation for concept mapping. Ausubel used the term *meaningful learning* to identify a process of integrating new knowledge acquired by individuals with relevant knowledge that they already possess. He believed that as an individual learns new knowledge, knowledge is rearranged and reordered to allow the learner to develop meaning and understanding of the concepts. Learning is more likely to occur when information is presented in meaningful ways that assist the learner to develop links between the old and new concepts.

Novak and Gowin first introduced concept mapping in 1984 to facilitate the process of meaningful learning. They defined the concept map as a schematic diagram that represents key concepts in a framework of propositions (3, p. 15). The authors also outlined criteria that can be used by nurse educators when evaluating the student’s concept map. These specifically address the student’s understanding and linkage of concepts.

In 1997, All and Havens defined concept mapping as a pictorial arrangement of key concepts that are unique to a specific subject (4). Koehler noted that in nursing education, concept maps are developed from assessment data collected by students either through case studies or their clinical assignments (5). The concept map develops as students diagram the relationships among various clinical data.

Concept mapping assists students to develop relationships among different bits of information (4,6-10) and build on previous knowledge and skills (7,11). As a motivator for student learning (12), concept maps result in higher academic achievement (12-14). In nursing education, maps have been used to help students develop critical thinking skills (6,9,10,15,16), provide holistic, patient-centered care (9), prepare for clinical learning activities (7), and link theory to clinical practice (1,10,17). Irvine noted that concept mapping assists in the development of meaningful learning and may help nurse educators become more effective as teachers (18).

Concept maps have been used in lectures (4-6,12), group work (5), class discussion (19), skills laboratories (19), and clinical learning activities (4-7,12,20). They are also used in continuing education activities (21,22), staff development (21-23), and in patient education (24).

Several authors have recommended replacing traditional care plans with concept mapping (5,9,20). The rationale for this recommendation is based on the notion that care plans typically are done in a retrospective manner with emphasis on students' using the correct format as they develop a single patient problem. Often this process is very structured, resulting in students' copying information directly from textbooks.

The Identification of Research Studies A literature review was conducted to identify research studies on the use of concept mapping as a teaching-learning method in nursing education. Computerized searches of PubMed, CINAHL, ERIC, and Academic Search Premier databases from 1980 to November 2004 used the following keywords: *concept mapping*, *nursing education*, and *research*. The goal was to find evidence on which to base nursing education recommendations for the use of concept mapping as a teaching-learning method.

Seven research studies were found that focus on the use of concept mapping in undergraduate nursing courses such as fundamentals, research, pharmacology, medical-surgical, and pediatrics (21,22,25-29). Five studies were conducted in the United States; two were conducted in Australia. The studies are summarized in Table 1 (page 200).

Of the seven studies, five involved the use of pretests and

posttests; two involved posttests only. The mean sample size for all studies was 48 (range 6 to 111 participants). Three had sample sizes between 50 and 100; in three studies, the sample size was less than 50. Methods for sample selection varied. All studies used a convenience sample; two used random selection and one study used random assignment for the selection of participants. Two studies compared control and experimental group outcomes. The duration of the studies ranged from 28 hours to 16 weeks; most studies lasted between 10 and 16 weeks.

Student exposure to concept map development occurred in a variety of ways. In five studies, students were exposed to concept maps through classroom instruction, handouts, and examples. In one study, the researchers interviewed students and clinical instructors and constructed concept maps based on their comments and on information in the course syllabus. These were provided to students and clinical instructors for their review and input prior to data analysis. In the last study, the method of exposure was unclear.

In three of the six studies in which students created concept maps, students worked alone. In the other three studies, they worked in groups. Feedback on completed concept maps was received from peers in two studies and faculty in four studies. In two studies, students created concept maps in the classroom or clinical setting; in three studies, maps were created outside the classroom or clinical setting.

The following brief descriptions of the seven studies supplement the analysis in Table 1.

1. ROODA (25) found concept mapping to be an effective tool for improving the academic performance of sophomore-level BSN nursing students in an introductory nursing research course. Using an experimental group and comparable control, Rooda compared average exam grades on each of three exams administered during the course. Students in the experimental group commented that this course was the most informative they had completed and that the concept mapping teaching strategy was fun to use and helpful for learning content.

2. DALEY (21) constructed concept maps through structured interviews with students and faculty and from information obtained in a course syllabus for a unit on oxygenation. The purpose was to identify how first-year, first-semester associate degree nursing students applied theory to practice. The maps reflected the difficulty that beginning students have in linking concepts of the nursing process and basic science.

3. GAINES (26) examined the effectiveness of using concept maps as a teaching strategy for juniors in a BSN pharmacology course. Working in small groups, students developed concept maps for certain drug categories. Comparing exams with grades

While it appears from these studies that CONCEPT MAPPING is an effective TEACHING-LEARNING METHOD, the existing research on concept mapping is too limited for drawing generalizations.

There is a lack of between-group studies and pretest to posttest research on KNOWLEDGE ACQUISITION. Sample sizes are small, there is a lack of instrument reliability and validity, and a lack of control for extraneous variables.

on concept maps, Gaines concluded that concept maps may help students attain success in the course and in the nursing program.

4. CAELLI (27) explored the effectiveness of concept mapping in helping beginning nursing students develop a positive concept of health. Students constructed concept maps related to health and brought them to lectures and small-group discussions. This provided an opportunity to debate appropriate linkages, concepts, and the identification of positive states of health. At the conclusion of the unit, students completed a final concept map. Caelli concluded that concept mapping can play an important role in assisting nurses toward health promotion practice.

5. DALEY, SHAW, BALISTRIERI, GLASENAPP, AND PIACENTINE (28) implemented concept mapping as a method for teaching and evaluating critical thinking in BSN students during the final semester of the senior year. Using a random sample of three students from each of six clinical groups, they compared first and last maps for hierarchical organization and differentiation of concepts. A significant improvement in the students' ability to conceptualize ideas and think critically was noted. Commenting that concept mapping requires in-depth preparation, students indicated that this teaching strategy may be more beneficial if introduced earlier in the curriculum. Faculty stated that the maps helped them assess which students were safe practitioners. Interestingly, faculty noted that students who had difficulty demonstrating their knowledge verbally were able to do so with concept maps; more outspoken students, thought by faculty to understand the information, demonstrated misperceptions and knowledge gaps in their maps.

6. WILKES, COOPER, LEWIN, AND BATTS (22) used concept mapping as part of an independent learning package to teach science to RNs in a BSN program in Australia. Students rated this experience as a positive teaching strategy that facilitated their learning and understanding of concepts of homeostasis, cellular needs, acute inflammation, and blood pressure control. Faculty found that pride in the quality of concept maps was evidence of

student motivation to learn. The use of concept maps allowed faculty to spend more time with students who were having a difficult time understanding concepts. The authors noted that concept mapping helped students link science with nursing practice.

7. WHEELER AND COLLINS (29) found concept mapping to be effective in helping junior-level BSN students develop critical thinking skills in the clinical setting. In general, scores on the California Critical Thinking Test (CCTT) increased after the completion of one semester of clinical experience. However, statistically significant differences were not found between the experimental and control groups, suggesting that both methods were effective in helping students develop critical thinking skills.

Comparison of Study Results An overview of study comparisons is found in Table 2 (page 202). This comparison of results focuses on three broad areas: student knowledge, student perceptions, and comments by faculty and students. Three studies suggested that students using concept maps were able to attain higher mean exam scores compared with other students; in two studies, results were statistically significant. In two studies, one of which was statistically significant, higher mean content mapping scores were obtained when comparing scores from initial concept maps with later maps. Two studies suggested an increase in critical thinking skills when students used concept maps to link knowledge and practice.

Students' perceptions regarding the use of concept maps appear to be positive. In three studies, students reported that concept mapping enhanced their ability to integrate knowledge and helped them retain complex information. Three studies identified student perceptions of concept mapping as an appropriate teaching-learning strategy. In one study, students reported an increased motivation to learn and an increased level of satisfaction with courses using concept mapping as a teaching method.

Overall comments from students and faculty were positive

Table 1. Characteristics and Findings of Study

Author	Design Length of Intervention	Sample	Student Exposure and Development of Concept Maps	Study Findings
Rooda, 1994	<p>Posttest comparison of two different classes</p> <p>16 weeks</p>	<p>Students enrolled in BSN nursing research course</p> <p>Control (n = 36, spring semester) and experimental (n = 24, subsequent fall semester)</p> <p>No significant differences in age, overall grade point averages, and gender</p>	<p>Students developed concept maps following class instruction, handouts, and group practice. Feedback was initially received from peers and faculty. Concept maps were prepared during class time.</p>	<p>Mean grade exam scores were 76.8 percent and 84.4 percent for control and experimental groups, respectively. This was found to be statistically significant at 0.001 (t = 4.65, df = 176.6).</p> <p>Overall mean scores were 4.53 and 4.25 for experimental and control groups, respectively. The difference between the mean scores was found to be statistically significant at the 0.001 level (t = -6.08, df = 97.3).</p>
Daley, 1996	<p>Pre/Posttest</p> <p>Results of concept maps developed from student interviews were compared with maps developed from instructor interviews and review of course syllabus.</p>	<p>Randomly selected associate degree students enrolled in nursing fundamentals clinical (N = 6)</p> <p>Age 19 to 45, female</p>	<p>Concept maps were developed by researchers following interviews with students and faculty and review of course syllabus.</p>	<p>The instructor and student concept maps revealed four areas of difference between students and faculty: 1) students identified general assessment observations rather than meaningful observations; 2) students were unable to link goal setting and outcome establishment with the evaluation process; 3) students had difficulty linking clinical preparation/study to actual clinical practice; 4) students had difficulty linking anatomy/physiology to clinical practice.</p>
Gaines, 1996	<p>Posttest</p> <p>10-week summer or 16-week fall course (each with 48 hours of class time)</p> <p>Comparison of concept maps and corresponding exam scores</p>	<p>BSN students enrolled in pharmacology course (N = 54)</p> <p>Mean age = 24.7 44 women/10 men</p> <p>Ethnic breakdown: African American, 43, Asian, 5, Caucasian, 2, Hispanic, 4</p>	<p>Students developed concept maps following class discussion, handouts, and group practice in which they received faculty feedback. Concept maps created outside of class time.</p>	<p>Significant correlations of students' knowledge were shown between three of eight concept maps and exams.</p>

Table 1. Characteristics and Findings of Study / Continued

Author	Design Length of Intervention	Sample	Student Exposure and Development of Concept Maps	Study Findings
Caelli, 1998 Australia	Pre/Posttest 28-hour unit on health Comparison of first and last concept maps	Paired concept maps from beginning nursing students (N = 111)	Students developed concept maps outside of class time.	Clarity of maps increased by 86 percent. Seventy-six per- cent of students rated the use of concept mapping as an effective learning strategy for health (range 4 to 5 on 5-point Likert scale).
Daley, Shaw, Balistrieri, Glasenapp, Piacentine, 1999	Pre/Posttest 16 weeks Comparison of first and second concept maps following feed- back from faculty	Three final semester clinical BSN students randomly selected from each of six clinical groups for data analy- sis and scoring (N = 18)	Students developed concept maps after class instruction and handouts during clinical time/received feedback from peers and faculty.	Comparison of concept maps revealed that group scores were 40.38 and 135.55 on first and second concept maps, respectively. This finding indicated a sig- nificant improvement ($t = -$ 5.69, $p = 0.001$) in the stu- dents' ability to conceptual- ize and think critically.
Wilkes, Cooper, Lewin, Batts, 1999 Australia	Pre/Post-test 14 weeks Comparison of first and last concept maps in a nursing science course.	Students enrolled in one of two classes completing a science unit in an RN to BSN program (N = 14)	Students developed concept maps after class instruction, handouts, and group practice. Faculty provided feedback.	Student thinking changed from "what is" at the begin- ning of the course to "how does" at the end of the course, suggesting acquisi- tion of new knowledge/ deeper understanding of content.
Wheeler, Collins, 2003	Pre/Posttest 16 weeks Comparison of results from the overall California Critical Think- ing Test (CCTT) and subscale scores for analysis, evaluation, inference, deductive/inductive reasoning between the groups	Junior BSN clinical students Experimental (N = 44)/ control group (N = 32) Mean age = 23.7 years 72 women/4 men Students randomly assigned to one of four theory/clinical courses (adult health, pedi- atrics, women's health, psychi- atric nursing) for first half of semester, then randomly assigned to another course for second half. Students in adult health and one section of pediatrics prepared con- cept maps as part of weekly clinical preparation; students in other courses completed traditional care plans.	After class instruction and handouts, students developed concept maps outside of clinical time.	Overall mean CCTT experi- mental group score (M = 1.04, SEM = 0.44, $p = 0.02$) differed significantly from pretest scores, but scores did not differ significantly for control group (M = 0.23, SEM = 0.52, $p = 0.52$).

Table 2. Comparison of Study Results KEY: X = Criterion met / S = Criterion statistically significant

Author(s)	STUDENT KNOWLEDGE			STUDENT PERCEPTIONS			COMMENTS		
	Higher mean exam scores	Higher mean mapping scores	Higher critical thinking scores	Appropriate learning strategy/active learning	Increased knowledge integration, understanding, retention	Increased learning motivation	Increased satisfaction with course	Positive faculty comments	Positive student comments
Rooda	X, S				X		X, S		X
Daley									
Gaines	X			X	X				X
Caelli		X		X					X
Daley, Shaw, Balistrieri, Glasenapp, Piacentine,		X, S	X					X	
Wilkes, Cooper, Lewin, Batts				X	X	X		X	X
Wheeler & Collins	X, S		X, S					X	

regarding the use of concept mapping as an appropriate teaching and assessment tool. Students reported that the use of concept mapping was helpful for understanding complex information, identifying areas for further study, and preparing for exams. Faculty reported that the use of concept mapping assists in the assessment of students’ knowledge and critical thinking skills and in the evaluation of clinical performance.

Discussion Analysis of the seven studies yielded three major themes. 1) Concept mapping results in generally positive effects on academic performance. 2) Concept mapping improves students’ critical thinking abilities. 3) Concept mapping serves as an appropriate teaching method.

The use of concept maps was shown to enhance academic performance by enabling students to synthesize and retain complex information, thus promoting meaningful learning. And it appears to foster the development of critical thinking abilities, providing a way for faculty to measure students’ ability to apply critical thinking skills to client situations. Gaines (26), who incorporated the use of concept mapping into lectures, concluded that their use may have helped decrease attrition by enhancing students’ understanding of basic pharmacology. Students also used concept mapping to assist with preparation for class and clinical activities, linking theory with clinical practice, and clarifying key concepts.

While it appears from these studies that concept mapping is an effective teaching-learning method, the existing research on con-

cept mapping is too limited for drawing generalizations. There is a lack of between-group studies and pretest to posttest research on knowledge acquisition. Sample sizes are small, there is a lack of instrument reliability and validity, and a lack of control for extraneous variables. Only two of the seven studies used a control group, and most lacked randomization. Therefore, the results reported here should be used with caution.


Recommendations for Further Research Further research regarding the use of concept mapping in nursing education is needed to address the best times to introduce concept maps, identify methods for assessment and evaluation, and understand how concept maps facilitate student learning and critical thinking abilities. Studies also need to focus on the integration of theory with clinical practice, the effects of using concept maps on NCLEX exam results, and the role of concept maps on knowledge development in practice among experienced nurses. It is important to note that studies need to be conducted on larger, heterogeneous samples in order to determine measurement reliability and validity.

Implications for Nursing Education Despite the limitations in these studies, it seems apparent that concept mapping has the potential to be an effective teaching strategy in nursing education. Wheeler and Collins state, “Concept mapping works. It works from the perspective of the educator trying to develop and

measure critical thinking skills, and it works from the perspective of the student trying to master a very complex field” (29, p. 345). However, the challenge to nurse educators occurs when trying to measure outcomes objectively across time and students.

Daley and colleagues (28) recommended introducing concept mapping techniques to beginning level nursing students. If concept maps are to be used for evaluation criteria, students should be given feedback on their maps prior to this use (30). Faculty may choose to introduce concept maps through lectures, providing examples, and providing instruction.

Grading of concept maps can be based on Novak and Gowin’s criteria (3). Alternately, the level of student achievement can be

evaluated based on the inclusion of the steps in the nursing process and by the number of concepts, relationships identified, quality of relationships presented, and the degree of hierarchies established (7). 

About the Author *Laura H. Clayton, MSN, RN, is an assistant professor of nursing education, Shepherd University, Shepherdstown, West Virginia. For more information, contact Ms. Clayton at lclayton@shepherd.edu.*

Key Words Concept Mapping – Critical Thinking – Nursing Education – Teaching-Learning Method

References

1. Black, P., Green, N., Chapin, B.A., & Owens, C. (2000). Concept mapping: An alternative teaching strategy. *Pelican News*, 56(4).

2. Ausbel, D., Novak, J., & Hanesian, H. (1978). *Educational psychology: A cognitive view* (2nd ed.). New York: Werbel and Peck.

3. Novak, J. D., & Gowin, D. B. (1984). *Learning how to learn*. New York: Cambridge University Press.

4. All, A. C., & Havens, R. L. (1997). Cognitive/concept mapping: A teaching strategy for nursing. *Journal of Advanced Nursing*, 25, 1210-1219.

5. Koehler, C. J. (2001). Nursing process mapping replaces nursing care plans. In A. J. Lowenstein & M. J. Bradshaw (Eds.), *Fuszard’s innovative teaching strategies in nursing* (3rd ed., pp. 303-313). Gaithersburg, MD: Aspen.

6. All, A. C., Huycke, L. I., & Fisher, M. J. (2003). Instructional tools for nursing education: Concept maps. *Nursing Education Perspectives*, 24(6), 311-317.

7. Baugh, N. G., & Mellott, K. G. (1998). Clinical concept mapping as preparation for student nurses’ clinical experiences. *Journal of Nursing Education*, 37(6), 253-256.

8. Gaines, C. (1999). Clearing up the “concept fog.” *ABNF Journal*, 10(2), 52-53.

9. Mueller, A., Johnston, M., & Bligh, D. (2002). Joining mind mapping and care planning to enhance student critical thinking and achieve holistic nursing care. *Nursing Diagnosis*, 13(2), 24-27.

10. Reynolds, A. (1994). Patho-flow diagramming: A strategy for critical thinking and clinical decision making. *Journal of Nursing Education*, 33(7), 333-336.

11. Dobbin, K. R. (2001). Applying learning theories

to develop teaching strategies for the critical care nurse. *Critical Care Nursing Clinics of North America*, 13(1), 1-11.

12. Beitz, J. M. (1998). Concept mapping: Navigating the learning process. *Nurse Educator*, 23(5), 35-41.

13. Horton, P. B., McConney, A. A., Gallo, M., Woods, A. L., Senn, G. J., & Hamelin, D. (1993). An investigation of the effectiveness of concept mapping as an instructional tool. *Science Education*, 77(1), 95-111.

14. Okebukola, P. A., & Jegede, O. J. (1989). Students’ anxiety towards and perception of difficulty of some biological concepts under the concept-mapping heuristic. *Research in Science & Technology*, 7(1), 85-92.

15. Luckowski, A. (2003). Concept mapping as a critical thinking tool for nurse educators. *Journal for Nurses in Staff Development*, 19(5), 228-233.

16. Staib, S. (2003). Teaching and measuring critical thinking. *Journal of Nursing Education*, 42(11), 498-508.

17. Kathol, D. D., Geiger, M. L., & Hartig, J. L. (1998). Clinical correlation map: A tool for linking theory and practice. *Nurse Educator*, 23(4), 31-34.

18. Irvine, L. M. C. (1995). Can concept mapping be used to promote meaningful learning in nursing education? *Journal of Advanced Nursing*, 21, 1175-1179.

19. Ignatavicius, D. D. (2004). From traditional care plans to innovative concept maps. In M. H. Oermann & K. T. Heinrich (Eds.), *Annual review of nursing education: Vol. 2* (pp. 205-216). New York: Springer Publishing.

20. Schuster, P. M. (2000). Concept mapping: Reducing clinical care plan paperwork and increasing learning. *Nurse Educator*, 25(2), 76-81.

21. Daley, B. J. (1996). Concept maps: Linking nurs-

ing theory to clinical nursing practice. *Journal of Continuing Education in Nursing*, 27(1), 17-27.

22. Wilkes, L., Cooper, K., Lewin, J., & Batts, J. (1999). Concept mapping: Promoting science learning in BN learners in Australia. *Journal of Continuing Education in Nursing*, 30(1), 37-44.

23. Phillips, L. D. (1994). Teaching intravenous therapy using innovative strategies. *Journal of Intravenous Nursing*, 17(1), 40-50.

24. Marchand, C., D’ivernois, J. F., Assal, J. P., Slama, G., & Hivon, R. (2002). An analysis, using concept mapping, of diabetic patients’ knowledge, before and after patient education. *Medical Teacher*, 24(1), 90-99.

25. Rooda, L. A. (1994). Effects of mind mapping on student achievement in a nursing research course. *Nurse Educator*, 19(6), 25-27.

26. Gaines, C. (1996). Concept mapping and synthesizers: Instructional strategies for encoding and recalling. *Journal of the New York State Nurses Association*, 27(1), 14-18.

27. Caelli, K. (1998). Shared understandings: Negotiating the meanings of health via concept mapping. *Nurse Education Today*, 18, 317-321.

28. Daley, B. J., Shaw, C. R., Balistrieri, T., Glasenapp, K., & Piacentine, L. (1999). Concept maps: A strategy to teach and evaluate critical thinking. *Journal of Nursing Education*, 38(1), 42-47.

29. Wheeler, L. A., & Collins, S. K. R. (2003). The influence of concept mapping on critical thinking in baccalaureate nursing students. *Journal of Professional Nursing*, 19(6), 339-346.

30. Kirkpatrick, J. M., DeWitt-Weaver, D., & Yaeger, L. (1998). Strategies for evaluating learning outcomes. In D. M. Billings & J. A. Halstead, *Teaching in nursing: A guide for faculty* (pp. 375-376). Philadelphia: W.B. Saunders.

Copyright of Nursing Education Perspectives is the property of National League for Nursing and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.