

Effectiveness of concept mapping and traditional linear nursing care plans on critical thinking skills in clinical pediatric nursing course

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ABSTRACT

Introduction: Concept map is a useful cognitive tool for enhancing a student's critical thinking (CT) by encouraging students to process information deeply for understanding. However, the evidence regarding its effectiveness on nursing students' CT is contradictory. This paper compares the effectiveness of concept mapping and traditional linear nursing care planning on students' CT. **Methods:** An experimental design was used to examine the CT of 60 baccalaureate students who participated in pediatric clinical nursing course in the Shahrekord University of Medical Sciences, Shahrekord, Iran in 2013. **Results:** Participants were randomly divided into six equal groups of each 10 student, of which three groups were the control group, and the others were the experimental group. The control group completed nine traditional linear nursing care plans, whereas experimental group completed nine concept maps during the course. Both groups showed significant improvement in overall and all subscales of the California CT skill test from pretest to posttest ($P < 0.001$), but *t*-test demonstrated that improvement in students' CT skills in the experimental group was significantly greater than in the control group after the program ($P < 0.001$). **Conclusions:** Our findings support that concept mapping can be used as a clinical teaching-learning activity to promote CT in nursing students.

Key words: Concept mapping, critical thinking, nursing students, traditional nursing care plan

INTRODUCTION

In a contemporary health-care environment characterized by rapidly changing developments and relentlessly increasing knowledge, professional nurses need to develop critical thinking (CT) skills that will provide them with expertise in flexible, individualized, situation-specific problem-solving.^[1-3] CT has been defined as "a nonlinear and cycled process that allows people to make decisions on what to believe and what to do within a given context."^[2] According to Kostovich *et al.*,^[4] the ability to think critically is an essential attribute

for today's nurses, and the development of this skill in nursing students requires multiple approaches and techniques.^[5-7] Use of the nursing process is an essential element to cultivate CT and judgment skills in nursing students.^[8] The nursing process is a nonlinear, dynamic activity,^[9] which focuses on the multifaceted aspects of a patient, their family, and the environment. Nurses and nursing students must develop and write nursing care plans to provide and organize nursing interventions based upon identified patients' needs.^[5] However, some researchers have reported that the current linear nursing care plan format does not meet the educational needs of students to develop CT skills and visualize the interconnectedness of patient clinical data.^[5,7] In addition, nurse educators feel that the nursing care plans developed

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by students are not case sensitive and need in-depth comprehension of each client's physical, psychological, social, and spiritual health.^[8] In the authors' program, the traditional linear format nursing care plan used in the first five semesters was found not to meet the needs of sixth-semester nursing students. These students need to be able to quickly conceptualize the plan of care in a functional format as they graduate and enter the practice arena, where they will be expected to care for multiple patients simultaneously and to rapidly use the nursing process to develop a nursing plan of care based upon priority needs of these patients.

Concept map development is an alternative to using care plans as a method to document a plan of care based on evidenced-based practices.^[5] They were originally developed by Novak quoted by Lee *et al.* based on Ausubel's assimilation theory of cognitive learning. When constructing a map, concepts are organized hierarchically in a descending order. The relationships between concepts are specified with cross-links. Through propositional linkage, learners assimilate new concepts into their existing cognitive structure. When new concepts are integrated by identifying relationships with concepts already possessed, learning becomes meaningful.^[10] Hence, concept maps provide a format to visualize physiological, pathological, and psychological relationships and interactions in a concrete fashion. Visualization of patient care priorities through a holistic view of the patient^[9] can be achieved through concept mapping.^[5,11] In addition, the minimal use of text or words makes it easy to scan for a word, phrase, or the general idea that is being explored.^[11,12]

Some studies have explored the short-term effects of concept map teaching on students' CT and found positive effects in clinical or classroom teaching.^[10,13-17] Concept mapping has also been described in an online course on "distance education to adults" in nursing to assess thinking processes of the students where it was found that they helped the students to self-assess their own thinking processes,^[18] thus facilitating reflective practice. It has also identified by Gerdeman *et al.*^[11] to improve clinical judgment skills in nursing students. However, contrary to previous positive results, some other studies reported contradictory results, for example in a quasi-experimental study, Wheeler and Collins^[19] found that the experimental group scored significantly higher on the overall analysis and evaluation scores in the pre and posttest comparisons, but no significant differences between the groups were found. Yeh and Chen^[20] also found no significant differences of CT scores between their experimental and control groups, and one longitudinal study on concept mapping, conducted in a United States medical school with 1st year medical students, found no significant differences between CT scores in the pre- and post-tests.^[21] Possible explanations for the findings of these studies may stem from several factors, such as measurement error, instrumentation, the curriculum and various definition of CT adopted by the studies.

On the other hand, some studies indicate that CT skill of nursing students in different countries had been different.^[20,22]

According to the findings of Kermansaravi *et al.*^[23] and Islami *et al.*^[24] in Iran, it can be stated that although CT is important in clinical judgments and decisions but during the training period, have had no significant development therefore the traditional education system needs evolution and revision in order to realize training purposes in line with fostering creative and efficient students. With regard to the need for finding best way to promote nursing students' CT and the limited evidence of comparing concept mapping with traditional nursing care plan in clinical setting, this study was performed to compare the effect of concept mapping with traditional nursing care plan on nursing students' CT in clinical pediatric course.

METHODS

Design

A before-after experimental design with the control group was used to compare the effect of concept mapping and traditional linear nursing care planning on baccalaureate nursing student's CT skills at Shahrekord University of Medical Sciences in Shahrekord, Iran.

Setting and sample

All 60 students from the nursing faculty of the Shahrekord University of Medical Sciences, Shahrekord, Iran, who had enrolled in pediatric nursing clinical course, and in sixth-semester of their study in the year 2011, were invited to participate in this study. The course met for 5 h, twice a week, for 10 weeks.

Students were randomly divided into six equal groups of 10 students; three groups as the control group and the other three groups as an experimental group. To prevent contact between the control and experimental groups, they take the pediatric clinical course in sequential time order. During the course, students cared for patients from an assigned pediatric setting. Because students were not able to have prior contact with their patients, they began developing their nursing care plans on the 1st day of their clinical experience. They were asked to create a nursing care plan for a child they were caring for, which required gathering information on complete patient histories, relevant medications, treatments and medical diagnoses.

Intervention procedure

On the 2nd day of clinical experience, clinical instructor who has the experience of concept mapping development taught the students in the experimental group how to create concept maps. The students were informed in advance that a concept map should display each nursing diagnosis and more importantly, its relationship to the patient's data, pathophysiology of the disease and interventions in a holistic view. Students were required to analyze assessment data and identify nursing diagnoses, relevant pathophysiology and interventions related to those diagnoses.

After this introductory session, students completed concept maps during the course. They used diagrams, color, and shapes to code the parts of the nursing process. They also had 5 days after the clinical experience to reflect on and evaluate the effectiveness of their nursing care before the concept maps were due. Each student in the experimental group created nine concept maps during the course.

During clinical group discussions, students discussed their concept maps with their teacher and peers. This activity provided all students with the opportunity to think out aloud about the accuracy and completeness of the nursing diagnoses, goals, nursing interventions and relationship depicted on their concept maps. Students constructed nine concept maps. Figure 1 demonstrated a sample of concept map which was completed by a student.

Students in the control group received traditional clinical teaching to create linear nursing care plans on a blank sheet. The students were asked to read and analyze the patient profile data, formulate initial problems, prioritize nursing diagnoses and identify the relationship between nursing diagnoses, then develop and implement interventions to solve the problems, and to evaluate the effectiveness of their nursing care. Each student was asked to create nine linear nursing care plans during the course. Linear care plans were in text format without using any shapes, propositions or arrow

to illustrate the interconnectedness between the data, nursing diagnosis and interventions. They also had the opportunity to discuss their care plans in group discussion with guidance provided by the teacher. Nobody in the control group asked about concept mapping showing that control groups did not contaminate with the intervention by experimental groups.

Critical thinking measurement

A well-known, validated and reliable tool was selected for this study. CT skills were measured using the California critical thinking skill test (CCTST) with subscales of analysis (9 items), evaluation (14 items), inference (11 items), and two types of reasoning (deductive reasoning and inductive reasoning included 16 and 14 items respectively).^[25] We selected this scale because it was tested for reliability and validity in Iranian nursing students. Khalili and Hossein Zadeh^[26] reported that this scale in comparison with the other measuring tools of CT is more comprehensive. The reliability coefficient of subscales after factor analysis in their study was in the range of 62-67%. Facione *et al.*^[25] (14 items) note that a KR-20 range of 0.65–0.75 for this type of instrument is acceptable. This instrument contains 34 items in multiple-choice format, 19 four-option multiple-choice items and 15 five-option multiple-choice items. The range of possible total scores was 0–34, with each subscale having a possible score range of 0–12. An overall score of <11 indicated a lack of CT skills, a score of 11–25 indicated average CT skills, and a score above

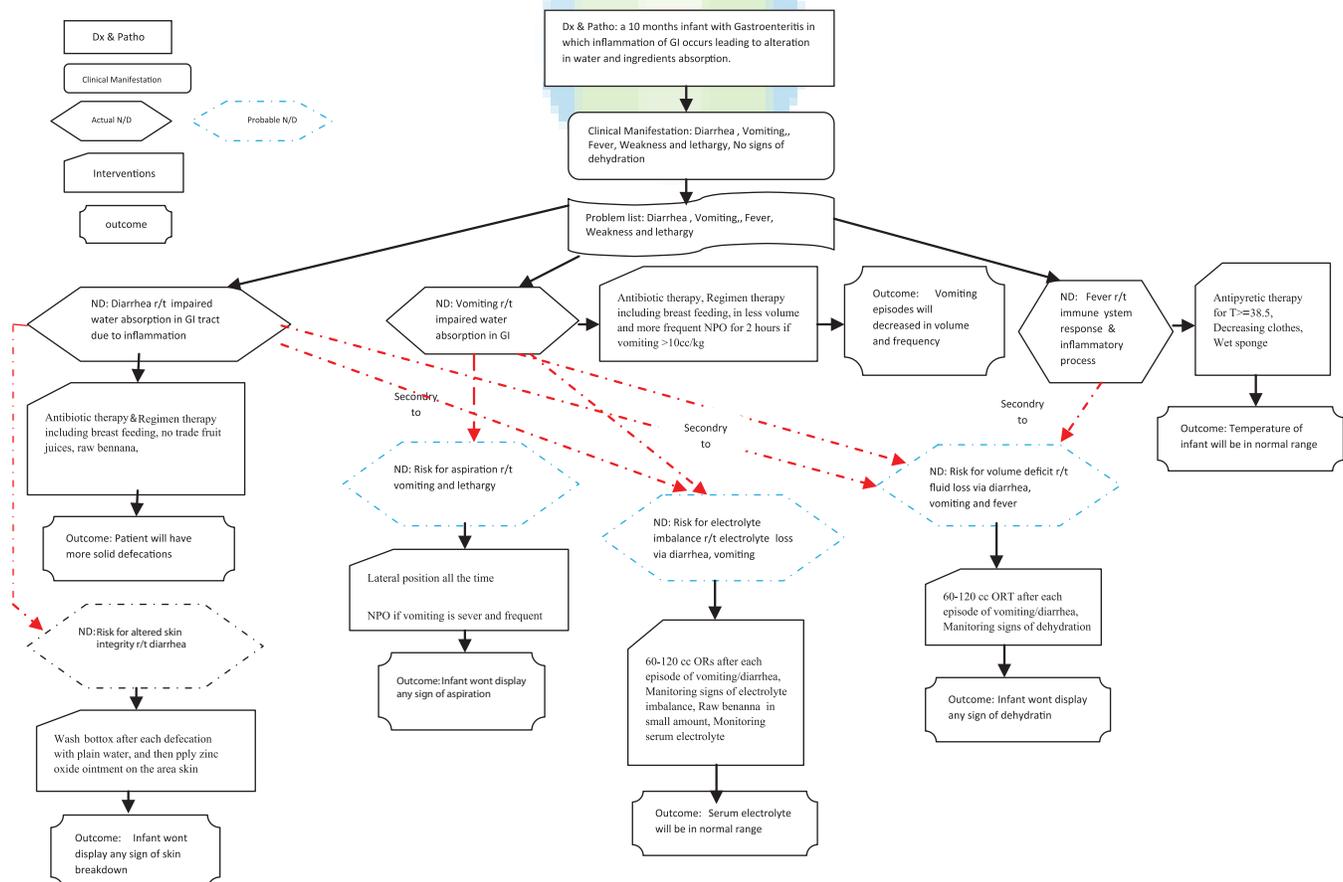


Figure 1: A sample concept map demonstrated by student

25 indicated strong CT skills. For a given CT skill, a subscale score of 4 or less indicated weakness, whereas a subscale score of 7 or above indicated strength. The internal consistency reliability, as demonstrated by the Kuder–Richardson-20 test, ranged from 0.69 to 0.74^[25] and was 0.43–0.53 in this study. Data were collected before and after the program in a clinical setting at the beginning and end of clinical education.

Ethical review

Agreement to use and evaluate concept mapping as a teaching strategy in clinical courses was obtained from the nursing Department of Shahrekord University of Medical Sciences, Shahrekord, Iran. Information about the study was given to every participant to assure the protection of human rights by the clinical teacher. Verbal informed consent was obtained from all the students. Participants in the experimental group were informed that they would be free to change to the traditional teaching strategy at any time without effects on their course evaluation. To ensure students in the control group were not disadvantaged, after completing the study, they were taught concept mapping during a 1-day workshop.

Data analysis

Data analysis was performed using Statistical Package for the Social Sciences (SPSSInc., Chicago, IL, USA) software. In all analyses, $P < 0.05$ was considered as statistically significant. We used independent and paired t -tests to compare mean scores between the experimental and control groups at pre- and post-tests.

RESULTS

Almost all students were 21 years old except one who was 22 years old (range: 21–22). One-third of the

sample were men. The statistical analysis showed that two groups did not appreciably differ in age or sex. Tables 1-4 summarize the analysis results for the CCTST. There was no significant difference between the groups overall, and in all subscales before the program [Table 1]. Paired t -test showed significant improvement in overall and all subscales of CCTST from pretest to posttest in both groups ($P < 0.001$) [Tables 2 and 3] but t -test demonstrates that improvement in students' CT skills in the experimental group was significantly greater than that in the control group after the program ($P < 0.001$) [Table 4].

DISCUSSION

This study was developed to examine whether concept mapping helped students develop better CT skills than the traditional method in an undergraduate pediatric clinical course. In the current study, it was found that either concept map or traditional linear nursing care plan could promote CT skills in nursing students from lacking to an average CT standard. However, similar to findings of other prior studies which observed improvements to nurses' CT abilities following a concept mapping teaching strategy,^[1,4,6,13,19,27-30] the present study provided evidence to indicate that the effects of concept mapping were greater than those of traditional linear nursing care plans, with greater improvements to students' overall and all subscales of CT skills as indicated by CCTST scores. Considering that the test of CT is based on the problem-solving process and the nursing process in the defined problem-solving stages, the use of which could improve CT skills.

The CT skills overall describe overall strength in using reasoning to form reflective judgments about what to believe or what to do and includes core reasoning skills such as analysis, inference, evaluation, induction, and deduction.^[25] Analytical reasoning skills enable people to identify the elements of a situation and determine how these parts interact. In the nursing process, students identify bio-psycho-social aspects of patients' health and determine how these parts interact. In our study, students tried to understand the relationship between patient data, nursing process, interactions and connections between sign and symptoms, diagnostic data and medications as they developed traditional care plans or concept maps. Although both care plans and concept maps could reinforce the students' analytical reasoning skills, concept mapping had a greater effect. According to Cook *et al.*,^[5] the linear format

Table 1: Student's CT skills on the pretest

CT skill (maximum score)	Experiment group		Control group		t-test		
	Mean	SD	Mean	SD	t	df	P
Analysis (12)	2.5	0.62	2.3	0.53	1.5	58	0.1
Evaluation (12)	2.4	0.77	2.3	0.47	0.8	58	0.4
Inference (12)	2.4	0.62	2.3	0.49	0.68	58	0.4
Deduction (12)	2.4	0.50	2.3	0.54	0.97	58	0.3
Induction (12)	2.6	0.71	2.5	0.56	0.39	58	0.6
Total score	12.5	1.75	11.9	0.92	1.8	58	0.07

SD=Standard deviation, CT=Critical thinking

Table 2: Comparison of overall and subscales of CCTST-A in the experimental group

Critical thinking skill (maximum score)	Pretest		Posttest		Paired t-test			
	Mean	SD	Mean	SD	Mean difference	t	df	P
Analysis (12)	2.5	0.62	3.5	0.57	0.23	-10.42	29	<0.001
Evaluation (12)	2.4	0.77	3.4	0.85	0.13	-12.79	29	<0.001
Inference (12)	2.4	0.62	5.3	0.83	0.1	-22.20	29	<0.001
Deduction (12)	2.4	0.50	3.6	0.71	0.13	-9.89	29	<0.001
Induction (12)	2.6	0.71	4	0.74	0.06	-12.17	29	<0.001
Total score	12.5	1.75	19.9	1.61	0.66	1.8	29	<0.001

SD=Standard deviation, CCTST=California critical thinking skill test

of the nursing care plan is based upon the nursing process that does not always allow for a holistic picture of patient needs and does not allow for visualization of the interrelatedness of patient data. In contrast, concept maps provide a format to visualize physiological, pathophysiological and psychological relationships and interactions in a concrete fashion, which is more effective to support quality analysis. Schuster^[9] also suggested that visualization of patient care priorities through a holistic view of the patient can be achieved through concept mapping. Nirmala and Shakuntala^[8] also supported that the cross-links in concept maps are useful for correlating patients' diagnoses, symptoms, treatment and interventions and then to thinking critically in clinical decision-making.

According to Facione *et al.*^[25] inductive reasoning helps in isolating the cause of an ailment or arriving at a theory to explain the relationship between symptoms. Evaluative reasoning skills enable students to assess the credibility of resources of information and the claims they make. In our study, after the 5 weeks program, the concept mapping participants demonstrated greater CT abilities to assess the credibility of, and relationships between statements and to provide reasoning according to evidence and using deduction, comprehend, express and clarify meaning and to perform inductive reasoning tasks.

Inference skills enable people to draw conclusions from reasons and evidence. Similar to some previous studies (Yeh and Chen)^[15,19,20], our study found that the experimental group had significantly higher scores of inference and deduction than those of the control group in the posttest. When constructing concept maps, students need to draw logical conclusions from factual knowledge or promises known through a process of

inference such as identifying the major concepts, determining the relationship between concepts and making propositions using cross-links before coming to conclusions. In summary, converting to a concept map format allow for visualization of all aspects of patient clinical data, physical assessment, disease process and the relationship between this information, facilitating CT in nursing students in a clinical area.

Previous researches on the CT of nursing students in Iranian faculties showed that learning in the educational system takes place at the initial cognitive levels, and higher levels such as analysis or synthesis and evaluation are less addressed. In fact, less attention is paid to the growth of the CT power^[23,24] According to Kermansaravi *et al.*^[23] there are main and serious obstacles in the development of CT, one of which is the predominant use of traditional teaching methods in the current education system which is preventing from the development of decision making and troubleshooting (or problem-solving) skills in the learners and as a result limits the opportunities for students' CT. Considering that the test of CT is based on the problem-solving process and the nursing process is the defined problem-solving stages, the use of which is one-way emphasized in nursing education programs to the growth of CT. Our study suggested that preparing nursing care using the concept map is more effective in promoting CT in nursing students than traditional linear nursing care plans.

Limitations

As with all studies with small samples, generalization of findings must be made cautiously. However, this study adds to the growing body of knowledge that suggests concept mapping improves students' abilities to see patterns and relationships. Although this study identified some short-term effects of the concept mapping program, its long-term effects remain unknown. Hence, longitudinal studies are warranted. The sample set came from only one university in Iran limiting the feasibility of generalization of results to other universities and countries. Future investigations should include multisite evaluations in a range of geographic locales with larger sample sizes.

CONCLUSIONS

When presented with complex health-care situations and the need to process vast amounts of information, clinical nurses must be in ownership of CT skills in order to make appropriate professional judgments and clinical decision making. Results

Table 3: Comparison of overall and subscales of CCTST-A in the control group

Critical thinking skill (maximum score)	Pretest		Posttest		Paired t-test		
	Mean	SD	Mean	SD	t	df	P
Analysis (12)	2.3	0.53	2.6	0.66	-4.78	29	<0.001
Evaluation (12)	2.3	0.47	2.5	0.56	-6.23	29	0.01
Inference (12)	2.3	0.49	2.8	0.57	-6.15	29	<0.001
Deduction (12)	2.3	0.54	2.9	0.66	-4.09	29	<0.001
Induction (12)	2.5	0.56	3.1	0.62	-2.53	29	<0.001
Total score	11.9	0.92	14.2	1.32	1.8	29	<0.001

SD=Standard deviation, CCTST=California critical thinking skill test

Table 4: Student's CT skills on the posttest

CT skill (maximum score)	Experiment group		Control group		Mean difference	t-test		
	Mean	SD	Mean	SD		t	df	P
Analysis (12)	3.5	0.57	2.6	0.66	0.86	5.4	58	<0.001
Evaluation (12)	3.4	0.85	2.5	0.56	0.86	4.6	58	<0.001
Inference (12)	5.3	0.83	2.8	0.57	2.4	13.1	58	<0.001
Deduction (12)	3.6	0.71	2.9	0.66	0.70	3.9	58	<0.001
Induction (12)	4	0.74	3.1	0.62	0.86	4.8	58	<0.001
Total score	19.9	1.61	14.2	1.32	5.7	15	58	<0.001

SD=Standard deviation, CT=Critical thinking

from the present study support the application of concept mapping as a clinical teaching strategy to promote the development of CT skills. Concept mapping, in comparison with the traditional linear nursing care plan, resulted in greater improvements in all CT skills. However, the 5 weeks program demonstrated only short-term effects, therefore, further longitudinal studies are suggested.

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Conflicts of interest

There are no conflicts of interest.

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