

# Clinical concept mapping: Does it improve discipline-based critical thinking of nursing students?

Marzieh Moattari<sup>1</sup>, Sara Soleimani<sup>1</sup>, Neda Jamali Moghaddam<sup>1</sup>, Farkhondeh Mehbodi<sup>1</sup>

## ABSTRACT

**Background:** Enhancing nursing students' critical thinking is a challenge faced by nurse educators. This study aimed at determining the effect of clinical concept mapping on discipline-based critical thinking of nursing students.

**Materials and Methods:** In this quasi-experimental post-test only design, a convenient sample of 4<sup>th</sup> year nursing students ( $N = 32$ ) participated. They were randomly divided into two groups. The experimental group participated in a 1-day workshop on clinical concept mapping. They were also assigned to use at least two clinical concepts mapping during their clinical practice. Post-test was done using a specially designed package consisting of vignettes for measurement of 17 dimensions of critical thinking in nursing under two categories of cognitive critical thinking skills and habits of mind. They were required to write about how they would use a designated critical thinking skills or habits of mind to accomplish the nursing actions. The students' responses were evaluated based on identification of critical thinking, justification, and quality of the student's response. The mean score of both groups was compared by Mann-Whitney test using SPSS version 16.5.

**Results:** The results of the study revealed a significant difference between the two groups' critical thinking regarding identification, justification, and quality of responses, and overall critical thinking scores, cognitive thinking skills, and habits of mind. The two groups also differed significantly from each other in 11 out of 17 dimensions of critical thinking.

**Conclusion:** Clinical concept mapping is a valuable strategy for improvement of critical thinking of nursing students. However, further studies are recommended to generalize this result to nursing students in their earlier stage of education.

**Key words:** Concept mapping, critical thinking, Iran, nursing education, nursing process, students

## INTRODUCTION

Contemporary explosive nature of today's knowledge has created a situation in which our nursing students' achievement in meeting their learning needs is quite difficult.<sup>[1]</sup> Therefore, the importance of critical thinking has been increasingly emphasized in the last decades and nursing educators are challenged to determine appropriate methods of teaching and evaluating critical thinking among nursing students.<sup>[2]</sup>

Critical thinking has been defined by many philosophers in different ways indicating the multifaceted nature of critical thinking as a process or outcome. However, consideration of the context has been highlighted in John Dewey's definition of critical thinking. According to Dewey, critical thinking is active, persistent, and careful consideration of a belief or supposed form of knowledge in the light of the grounds

which support it and the further conclusions to which it tends (Dewey, 1909, page 9).<sup>[3]</sup> Also, context is highlighted in a definition provided by Facion.<sup>[4]</sup> Therefore, it should be considered that definition of critical thinking in different academic disciplines may vary as each discipline has its own specific knowledge. In an attempt to describe critical thinking in nursing, many models have been developed.<sup>[5,6]</sup>

To define critical thinking in the context of nursing, Schefer and Rubenfeld (2000) conducted a five-round Delphi study in which 55 nurse educators were involved. Based on their study, a consensus was made on 17 dimensions of critical thinking under two categories of thinking (cognitive) skills and habits of mind<sup>[7]</sup> [Box 1].

Different strategies have been developed to teach critical thinking. Concept mapping is one example proposed for improvement of critical thinking. Using this strategy, the students draw the map of contents, and therefore use their cognitive skills of analysis, evaluation, and reasoning.<sup>[8]</sup> Also, they will be able to summarize the content while preserving the meaning. This strategy was developed by Novak during the years 1972-1992 based on Ausubel's learning theory.<sup>[2]</sup>

<sup>1</sup>School of Nursing and Midwifery, Shiraz University of Medical Sciences, Shiraz, Iran

**Address for correspondence:** Prof. Marzieh Moattari, School of Nursing and Midwifery, Shiraz University of Medical Sciences, Shiraz, Iran.  
E-mail: moattarm@sums.ac.ir

The effectiveness of using concept mapping in student's achievement and interest<sup>[9]</sup> and self-efficacy<sup>[10]</sup> has been shown previously. Its efficacy in learning and evaluation of critical thinking in music, mathematics, and engineering has led nurses to use this learning strategy.<sup>[2]</sup> Use of concept mapping in clinical learning activities improves critical thinking and encourages students to comprehensively observe the patients, and organize and process the complex information. Furthermore, it enables the students to evaluate what they have learned and what they need to learn.<sup>[1,8]</sup> In a recent research, concept mapping was used as a teaching strategy in the development of critical thinking skills of eight undergraduate nursing students. The researchers designed a concept mapping rubric using Tanner's Clinical Judgment Model to help students construct clinical cases for the development of appropriate clinical judgment skills. Qualitative evaluation of concept mapping activity and rubric revealed that the students positively approached this experience and evaluated it as a means for better clinical decision making and enhancement of clinical judgment.<sup>[11]</sup>

Despite the potential benefit of concept mapping in the clinical context, nursing students are encouraged to write nursing care plan for their patients while they see the nursing process as time-consuming paperwork not leading to critical thinking. The more use of nursing process might be due to the fact that clinical instructors, nursing students, and even nursing staff are more familiar with traditional nursing process comparing to concept mapping. However, the use of nursing process (care plan) as the instrument for problem-solving or enhancing the art and creativity of nursing, and also as a method of providing individualized care has been challenged.<sup>[12]</sup> Furthermore, it was recognized that the students prefer reflection compared to written nursing care planning.<sup>[13]</sup>

Admitting the distinction between nursing process and concept mapping, some researchers compared the effects of these two strategies on critical thinking skills of nursing students.<sup>[8,14]</sup> The findings of these researches provide no significant difference between these two methods of care planning in promoting critical thinking. It seems that concept mapping should not be seen as a separate strategy for care planning. To use concept mapping, students need to comprehensively understand nursing process. Therefore, concept mapping based on nursing process might possibly add some benefit to traditional nursing process.

Another point worth mentioning is the approach used in measurement of critical thinking. Critical thinking skills tests used in most studies are more appropriate for measurement of critical thinking in a general context, while measurement of discipline (nursing)-based critical thinking

needs appropriate planning and careful implementation. Complexities of clinical teaching and the difficulties in measurement of domain-specific critical thinking might be the reason for the insufficient evidence in this regard. Therefore, the aim of this study was to determine the effects of concept mapping using nursing process on nursing-specific critical thinking, and its components of cognitive skills and habits of mind.

## **Box 1: Critical thinking skills and habits of the mind for nursing**

### *Critical thinking skills*

- Analyzing: Separating or breaking a whole into parts to discover their nature, function, and relationships
- Applying standards: Judging according to established personal, professional, or social rules or criteria
- Discriminating: Recognizing differences and similarities among things or situations and distinguishing carefully as to category or rank
- Information seeking: Searching for evidence, facts, or knowledge by identifying relevant sources and gathering objectives, subjective, historical, and current data from those sources
- Logical reasoning: Drawing inferences or conclusions that are supported or justified by evidence
- Predicting: Envisioning a plan and its consequences
- Transforming knowledge: Changing or converting the condition, nature, form, or function of concepts among contexts.

### *Critical thinking habits of the mind*

- Confidence: Assurance of one's reasoning abilities
- Contextual perspective: Consideration of the whole situation, including relationships, background, and environment, relevant to some happening
- Creativity: Intellectual inventiveness used to generate, discover, or restructure ideas; imaging alternatives
- Flexibility: Capacity to adapt, accommodate, modify, or change thoughts, ideas, and behavior
- Inquisitiveness: Eagerness to know by seeking knowledge and understanding through observation and thoughtful questioning in order to explore possibilities and alternatives
- Intellectual integrity: Seeking the truth through the sincere, honest processes, even if the results are contrary to one's assumptions and beliefs
- Intuition: Insightful sense of knowing without conscious use of reason
- Open-mindedness: A viewpoint characterized by being receptive to divergent views and sensitive to one's biases

- Perseverance: Pursuit of a course with determination to overcome obstacles
- Reflection: Contemplation upon a subject, especially one's assumptions, and thinking for the purposes of deeper understanding and self-evaluation.

Adapted from: Rubenfeld M, Scheffer B. Critical Thinking Tactics for Nurses. Canada: Jones and Bartlett publishers. 2006;p: 16-17<sup>[15]</sup>

## MATERIALS AND METHODS

In this quasi-experimental study (post-test only design), a convenient sample of 4<sup>th</sup> year nursing students ( $N = 32$ ) who were involved in clinical learning experiences participated giving their consent. They were randomly divided into two experimental and control groups. The intervention of the study was conducted for the experimental group during their usual clinical learning experiences in medical surgical and pediatric wards. Both groups had a similar clinical rotation during the study.

The intervention of the study started with a 1-day workshop. In this workshop, the students in the experimental group were introduced with the use of concept maps based on the nursing process.<sup>[16]</sup> They used concept mapping for application of nursing process in a given scenario specifically designed for this intervention.

The students worked individually and then in groups to illustrate the relevant information from the presented case and provide the concept mapping. They were instructed to do the following:

Identify the patient and his/her medical diagnosis as the central concept in a box in the middle of the page.

Add the patient's medical diagnosis/chief complaints or reason for hospitalization.

From the patient's medical diagnosis/chief complaints or reason for hospitalization, add as many relevant nursing diagnoses as possible in the boxes related to the main box (categorize all the information presented in scenario).

For each nursing diagnosis, list the subjective and objective data, identified from the case study, that are associated with the diagnosis.

List the current information about medical diagnosis, patient's medical history, risk factors and etiologies, diagnostic tests, treatments, and medications under the relevant nursing diagnoses.

Draw lines between concepts to indicate the relationships. Link the relevant data using different types of lines (e.g. arrows, bolded lines, direct lines, or broken lines), based on the nature of the relationship. On each line, use

words (such as related to, lead to, associated with) to explain the relationship between the related concepts.

Draw red lines to connect the related nursing diagnosis.

List the nursing interventions such as assessment, monitoring, procedures, therapeutic interventions (therapeutic communication and or teaching) for each diagnosis.

Add the expected outcomes associated with the nursing interventions for each nursing diagnosis.

Update the concept map based on the new information and patient's possible responses.

The students in the experimental group were required to apply concept mapping at least on two patients during their 10-week clinical practice. The first author provided a weekly 2-h counseling session for the students to present their concept mapping and receive feedback. For ethical considerations, they were told that their attendance in these activities dose not influence their clinical evaluation.

Demographic data including age and grade point average (GPA) were reported by the students on the first page of the instrument used in the study. The instrument for measuring critical thinking was developed based on the instruction provided in another study<sup>[17]</sup> in which 17 dimensions of critical thinking under two categories of cognitive skills and habits of mind were considered. Therefore, 14 scenarios were developed to measure analyzing, applying standards, discriminating, information seeking, logical reasoning, predicting, transforming knowledge, contextual perspective, creativity, inquisitiveness, intuition, open-mindedness, perseverance, and self-reflection. The first draft of scenarios was developed by a group of medical surgical and pediatric nursing instructors based on their lived experiences in relation to each critical thinking dimension. The scenarios then were examined in a group of students to ensure that they are thought provoking. Ultimately a panel of experts consisting of experienced faculty members from different nursing specialties confirmed the appropriateness of scenarios for the measurement of the above-mentioned critical thinking dimensions. For the dimensions of confidence, flexibility, and intellectual integrity, the students were offered a free response opportunity to select their own appropriate clinical experiences to illustrate the use of critical thinking.

To develop the test format, each of the 17 critical thinking skills or habits of mind was defined in a square on top of the page specific to that critical thinking. Scenarios developed for 14 critical thinking dimensions were inserted in any of its associated definitions. For the three other mental habits or critical thinking skills, we provided only the definitions. The students were instructed to read the definitions carefully and then try to analyze their related scenarios and/or their



own experience. They were asked to carefully explain how they used that critical thinking in a given scenario or their own selected experience. For this purpose, they should write their own analysis based on the two tips given below.

- Write in detail what you will do. Explain in detail so that someone reading your content would be able to realize that you have used that critical thinking
- Explain why you believe your actions illustrate the designated habits or skill.

As the methodology of the study was post-test only design, the tests were given to the students at the end of the 10<sup>th</sup> week of their clinical course and they were required to return them in the next 2 weeks. The students were instructed not to share their responses with other students.

All the test packages received from the students were copied and evaluated anonymously by two different evaluators who were blind to the groups. They were instructed to evaluate the students' responses based on the guideline for evaluation of critical thinking provided elsewhere.<sup>[17]</sup> Therefore, the students' responses were assessed based on three criteria: Identification of critical thinking, justification, and quality of responses. Identification includes a 3-point scale (2, 1 and 0) for clear illustration of the skill or habit, partial identification/misidentification, and no evidence of understanding of the related critical thinking dimension, respectively. Justification was based on a 2-point scale (2, 1) for either adequate or inadequate/absence of reasoning for the actions each student described as an exemplar for the related critical thinking dimensions. Quality or level of the response was scored based on a 3-point scale: 3 for clear and appropriate, 2 for unclear or inadequate description, and 1 for below the student's academic level. Inter-rater agreement on scoring between the two evaluators was measured to maintain reliability. The result showed an agreement between the two evaluators in scoring of more than 80% of the responses. However, a consensus was made between the two evaluators on the scoring of the remained responses. The agreed upon scores in the three criteria for evaluation of critical thinking including identification, justification, and quality of responses were used in data analysis. Data were analyzed by Chi-square, *t*-test, and Mann-Whitney U test using SPSS, version 16.5.

## RESULTS

No statistically significant demographic differences were found between the students of the two groups. Chi-square analysis revealed that the groups were similar in terms of age and overall cumulative GPA. Dimensions to which most of the students did not respond were confidence, flexibility, and intellectual integrity. These dimensions were

free choice responses for which no vignettes were provided. Next, the scores from each of the 17 subscales for both groups were analyzed. Table 1 reveals the two groups' scores related to evaluation criteria in all areas of critical thinking. The experimental group was significantly better in identification ( $P = 0.002$ ), justification ( $P = 0.001$ ), and quality of responses ( $P = 0.003$ ). Table 2 reports the scores related to each dimension of cognitive critical thinking skills. The experimental group performed significantly better in 5 out of 7 areas related to cognitive thinking skills, including analysis ( $P = 0.008$ ), logical reasoning ( $P = 0.01$ ), discriminating ( $P = 0.03$ ), applying standards ( $P = 0.001$ ), transforming of knowledge ( $P = 0.001$ ). As it is shown in Table 3, 6 out of 10 areas of habits of mind including perseverance ( $P = 0.02$ ), contextual perspective ( $P = 0.003$ ), open-mindedness ( $P = 0.008$ ), confidence ( $P = 0.01$ ), intuition ( $P = 0.008$ ), and intellectual integrity ( $P = 0.01$ ) were improved.

## DISCUSSION

This study examined the impact of concept mapping in the clinical context on discipline-based critical thinking skills of nursing students. Based on the results of this study, application of concept mapping resulted in an increase in students' ability to identify dimensions of critical thinking, justify their reasoning, and provide appropriate explanation. The results also support the effectiveness of concept mapping in the improvement of both cognitive critical thinking skills and habits of mind. Cognitive critical thinking skills improved in this study are analyzing, applying standards, discrimination, logical reasoning, and knowledge transformation, and the improved habits of mind are perseverance, contextual perspectives, open-mindedness, confidence, intuition, and intellectual integrity. This improvement can be attributed to the structure of concept mapping which was implemented based on the nursing process. Although nursing process as a systematic approach to care planning is widely accepted, its relation to critical thinking has been criticized. According to Jones and Brown, nursing process is a linear problem-solving approach which prevents the development of critical thinking in students.<sup>[18]</sup> In contrast, development of reasoning map leads to the improvement of interpretation, analysis, evaluation, inference, explanation, self-regulation, and self-evaluation.<sup>[19]</sup>

Habits of mind also have been improved as a result of the intervention of the study. According to Costa, a habit of mind is knowing how to behave intelligently when someone does not know the answer.<sup>[20]</sup> He developed 16 habits of mind useful for everyday life. However, in this study, we used habits of mind as defined in the context of nursing. These dispositions or attributes/attitudes or habits of mind could

be considered as the elements of a process of reasoning in an individual's character that propels or stimulates an individual toward using critical thinking. The engagement of critical thinking will not occur without these dispositions.<sup>[21]</sup> In one study, concept or mind mapping is introduced as a nonlinear teaching strategy that helps students evaluate how they think.<sup>[22]</sup> The result of this study is not in agreement with that of the study conducted by Samawi *et al.* (2006). They concluded that concept mapping does not improve critical thinking skills and dispositions.<sup>[23]</sup> However, there are some evidences supporting the effect of concept mapping on critical thinking and critical thinking disposition. One example is the research conducted by Wheeler and Collins using a pre-test – post-test design with control group to figure out the effect of concept mapping on critical thinking skills of nursing students. Although they did not find any significant difference between experimental and control groups, their within-group results showed that concept mapping is effective in helping students develop critical thinking skills.<sup>[8]</sup> In another study performed by Atay and Karabacak (2012), the effects of care plans prepared using concept maps on the critical thinking dispositions of students were investigated in a pre-test – post-test control group design. The critical thinking dispositions of the groups were measured using the California Critical Thinking Disposition Inventory. They found a significant difference in the total and sub-scale post-test scores between the experimental and control groups.<sup>[24]</sup>

There is one study conducted in Iran in which the effectiveness of concept mapping on critical thinking was confirmed.<sup>[25]</sup> Other studies mostly focused on determining the effects of concept mapping as compared to other strategies. In a study conducted in Iran, concept mapping was compared with integrated method of learning. Researchers concluded that concept mapping is a better strategy in developing meaningful (deep) learning.<sup>[26]</sup> In another study, concept mapping was compared with lecture to find out its effectiveness on learning, wherein no significant difference was found between the two groups of the study.<sup>[27]</sup> However, a different finding was revealed in another study in which concept mapping was found to be better than lecture in producing meaningful learning.<sup>[28]</sup>

The present study is different from the other studies mentioned. In the current study, concept mapping based on nursing process was used in the context of clinical experience, which is more appropriate to nursing as a practical field. Also, critical thinking was measured using scenarios or real clinical experience. Nonetheless, the students did not respond completely to all the critical thinking dimensions. In another study aiming at determining the reliability of vignettes for measurement of critical thinking also, the students did not

**Table 1: Mean score of both groups post-test in evaluation criteria for measurement of critical thinking**

Evaluation criteria	Experimental mean±SD	Control mean±SD	P value (t test or Mann-Whitney U test)
Identification	19.63±10.03	7.13±4.45	<0.002
Justification	8.7±5.15	1.8±2.25	<0.001
Quality	10.6±0.57	3.07±3	<0.003
Total	39.24±25.61	12.19±9.33	<0.002

SD: Standard deviation

**Table 2: Mean scores for dimensions of cognitive critical thinking skills in two experimental and control groups**

Critical thinking skills dimensions	Groups		P value (t test or Mann-Whitney U test)
	Experimental mean±SD	Control mean±SD	
Analyzing	2.90±1.81	1.12±1.40	<0.01
Logical reasoning	2±2.09	0.62±0.25	<0.01
Information seeking	2.27±2.14	0.81±1.22	0.06
Discrimination	2.45±2.06	0.81±1.22	<0.03
Applying standards	2.72±1.90	0.12±0.34	<0.001
Transforming knowledge	3.9±1.92	0.18±0.75	<0.001
Predicting	3.9±1.70	2.75±1.34	0.059
Total	20.14±13.62	6.41±6.52	<0.001

SD: Standard deviation

**Table 3: Mean scores for dimensions of habits of mind in two experimental and control groups**

Habits of mind dimensions	Groups		P value (t test or Mann-Whitney U test)
	Experimental mean±SD	Control mean±SD	
Inquisitiveness	2.36±2.33	1.12±1.02	0.1
Innovativeness	3.27±1.90	2±1.03	0.06
Perseverance	2.72±2.28	0.81±0.98	<0.02
Contextual perspective	2.63±1.62	1±0.96	<0.01
Self-reflection	2.45±2.11	1.12±1.08	0.07
Open-mindedness	2.09±2.11	0.0±0.0	<0.01
Confidence	2.36±2.37	0.0±0.0	<0.01
Intuition	2.63±2.41	0.25±0.44	<0.01
Intellectual integrity	2.36±2.20	0.0±0.0	<0.01
Flexibility	0.81±1.25	0.0±0.0	0.055
Total	23.68±20.58	6.30±5.51	<0.01

SD: Standard deviation

respond to all dimensions.<sup>[17]</sup> But there is an important difference between these two studies. In the current study, the students' response to the vignettes was more than that to their own clinical experiences, while the opposite was true about that study. This difference may be attributed to the different contexts of these two studies. It appears that in the context of the present study, the students prefer the structured situations for thinking and have low motivation

to reflect on their own experiences. These findings could be considered as the hints to produce a more motivating environment in which the students have more contribution. Such a motivating and supportive atmosphere is more important when we consider that concept mapping as well as other strategies known to be effective in the improvement of critical thinking (e.g. reflection) are time consuming compared to conventional strategies.<sup>[16,29]</sup>

In most studies, critical thinking has been measured by context-free tests such as California Critical Thinking Skill Test (CCTST) and the Watson Glaser Critical Thinking Appraisal (WGCTA).<sup>[30,31]</sup> In a study, National League for Nursing (NLN) Critical Thinking in Clinical Nursing Practice/PN Examination (NLNCT exam) was used to measure the students' critical thinking abilities of interpretation, analysis, evaluation, inference, and explanation. The researchers found that using concept mapping method is not better than or even equal to the traditional care planning in improvement of critical thinking.<sup>[32]</sup> Although measurement of discipline-based critical thinking is a challenging issue, the test developed in our study as a nursing-specific test of critical thinking showed acceptable inter-evaluator agreement as a sign of reliability.

The results of this study support the effectiveness of concept mapping on cognitive critical thinking skills and habits of mind. This post-test only design study was conducted on a small sample size. Therefore, further studies on larger sample size and with more rigorous design, such as randomized controlled trials, are needed to generalize the findings. Furthermore, it is suggested that clinical instructors be trained to apply this strategy on their students and its effectiveness on critical thinking be evaluated.

## CONCLUSION

Overall, it can be concluded that concept mapping based on nursing process is effective in the improvement of critical thinking skills and habits of mind. Nursing-specific measurement of critical thinking is feasible and application of concept mapping in clinical context is suggested. However further studies are needed to generalize the finding of this study.

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