Charting critical paths: Exploring how concept mapping amplifies nursing students' critical thinking and elevates patient care – A scoping review

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Abstract:

Concept mapping (CM) is a pedagogical approach that allows nursing students to improve their critical thinking (CT) abilities, which is paramount for providing quality patient care that underpins their ability to make sound clinical decisions and judgments by visually understanding the relationships and interconnections between various concepts. The purpose of the present review was to assess the outcome of CM on the CT skills. We searched Scopus, Web of Science, Science Direct, PubMed, and other sources to evaluate the effect of CM on CT among nursing students. The review included articles published between 2012 and 2023. Two authors individually extracted the data, identified the bias risk, and analyzed the data using the PRISMA-ScR framework. Database searches found 985 articles, 11 of which matched the inclusion criteria. 63.64% employed quasi-experimental approaches. 45.45% employed concept mapping instead of integration, whereas 9.09% used sophisticated technology. Second-year BSc Nursing students accounted for 54.55%. In 45.45% of the studies, sample sizes varied between 51 and 100. The studies' overall post-test CT scores were higher in groups which received CM as compared to other conventional pedagogical approaches. Most studies demonstrated minimal bias risk and P values greater than 0.05. The findings of the present study considered CM as an effective teaching method to enhance CT skills and also suggest the implementation of CM. It is recommended that nursing educators, administrators, and faculty evaluate curriculum to integrate CM into courses focused at promoting CT abilities in nursing students to improve the quality of patient care.

Keywords:

Concept mapping, concept maps, critical thinking, effectiveness, impact, nursing, students, traditional teaching method

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Introduction

Quality in nursing services is vital for a nursing professional to achieve a better patient prognosis. Nurses must possess adequate knowledge, critical thinking (CT), and clinical competence to deliver quality nursing care. The word "critical thinking" was introduced by John Dewey (1910), who defined it as an active method of applying knowledge with proper consideration by channeling information and reflective thinking.[1] Nursing students who participate in CT activities are better able to solve issues and make wise clinical judgments on patient care.[2] Decision-making requires CT skills to provide any form of nursing service. CT in nursing education is essential to meet today's societal expectations. It encompasses quick thinking, better communication, and problem-solving.[3] Nursing students should be able to make critical analyses, valid conclusions, justification, concept clarification, and recognition of conditions to provide efficient nursing care. Hence, nursing educators play a vital role in

understanding the students' requirements to make proper clinical decisions by imbibing CT in nursing education.[2] Therefore, nursing professionals must adopt newer, more reliable techniques to promote CT and refine clinical reasoning skills under challenging circumstances.[4]

Furthermore, leadership styles in nursing managers can also play a significant role in amplifying the nursing students' CT and help improve patient care.[5] The significance of nursing leaders and nursing students' critical thinking skills is multifaceted and essential for sustaining patient care of the highest standards while advancing the field of nursing. Leadership in nursing is essential in creating an atmosphere where nursing students feel encouraged to think critically. Some key aspects include role modeling,[6] introducing and supporting educational strategies that enhance critical thinking,[7] guidance and mentorship,[8] development of curriculum and policy,[9] creating supportive culture,[8] instilling professional values,[6] and encouraging continued education.

Research studies have shown that new nurses have low CT abilities, which challenges the new graduate nurses' competencies and care delivery.[10] Factors affecting CT among nurses included education,[10,11] hospital type, shift work, professional role and category,[11] reading habits, attitude toward the nursing profession,[10] teaching methods, empathy, emotional intelligence, and caring behavior.[12] Nurses can contribute to quality health by acquiring critical thinking, clinical competence, clinical reasoning, good decision-making, and problem-solving skills. Appropriate utilization of teaching–learning methods can be very crucial for improving quality education and CT among nursing students. Some of such teaching and learning strategies are CM,[13–17] simulation-based education,[17,18] mind mapping,[19–21] problem-based learning,[22,23] blended learning,[24,25] reflective learning,[21] game-based learning,[26] and team-based learning[27,28]. However, innovative educational strategies such as CM in nursing education over traditional methods are being applied to boost CT skills[29] and clinical judgment[14] among nursing students to impart efficient, timely, and quality patient care.

Novak and Gowin (1984) created a concept map based on "David Ausubel's (1968) Assimilation theory of cognitive learning".[13] The theory states that the learners learn by understanding the concepts and finding the relationship between them using subsumption, reformist diversity, and integrative understanding.[30] A concept map is a diagram with a main idea/concept, related ideas/concepts, and their relationships and interconnections with each other and related ideas/concepts. A concept map connects concepts with labeled arrows and linking phrases.[31]

Concept mapping (CM) allows individuals to learn things in a manner that enhances their ability to judge and evaluate things in the working environment. It serves as a tool to establish relationships between concepts. This method of learning and understanding how one concept relates to the other increases the chances of CT and an individual's judgment.[31] Concept maps have been incorporated into the nursing curriculum since 1992, and their use has advanced.[30] Multiple studies indicate that subjecting nursing students to CM enhanced their ability to make proper judgments and improved CT.[32,33] CM has also been able to help prelicensure nursing students improve their clinical judgment.[34] Additionally, as leadership style plays a vital role in establishing the CT skills among nursing students, CM-based leadership development programs can also be implemented for nursing administrators or managers to help them opt for the most effective leadership style.[5] However, it has been shown that democratic leadership styles implemented by the nurse managers enhance the nurses' feeling of belongingness and commitment, which ultimately enhances the quality of nursing care.[35]

CM has proven a useful teaching–learning technique in nursing curricula, even with limited applications. It is difficult to confirm its utility in the past decade, along with its newer applications and the evolution of newer teaching–learning strategies concerning its effectiveness. Therefore, the researchers are keen to discover the current potential of using CM in the nursing curriculum to enhance CT abilities. Research aims to conduct a scoping review of the literature on the effect of CM on nursing students' CT abilities.

Materials and Methods

The current review follows the criteria and protocols specified in the Joanna Briggs Institute (JBI) Reviewers' Manual[36] as well as systematic scoping review standards.[37] Based on the present study's objectives, a scoping review was the best review technique. The scoping review aims to explore the literature volume, explain the main concepts, evaluate the methodology, identify research gaps, and categorize the available evidence types in CM and CT.[38] The current study's findings are reported in compliance with the PRISMA and scoping review protocols.[39] This scoping review analyzed the data already published in several literature databases.

Problem identification
The primary objective of this study is to discover and assess existing data on the influence of CM on nursing students' critical thinking. The research question focuses on the following issues:

1. What are multiple ways to implement concept maps to improve the CT skills of nursing students?
2. What are the CT outcomes in terms of the effects of concept maps?
3. To what extent can the nurses use the concept maps in their education, and how does this influence their CT skills in patient care?
4. At which semester/years of nursing program concept maps can be started to use?
5. What are the key gaps in the existing body of research on the impact of CM on nursing students' CT?

Eligibility criteria or study inclusion

This scoping review considered studies admissible if they met the predetermined inclusion and exclusion criteria. For an article to be included in this review, it must meet the following requirements: (i) samples from nursing students, (ii) articles from peer-reviewed journals, (iii) articles written in English, (iv) concept maps or CM used as an intervention, (v) CT was evaluated as a dependent variable, and (vi) randomized controlled trials (RCTs) and non-RCTs along with comparative study and qualitative studies. (i) Review papers and (ii) full articles not yet available were the exclusion criteria. Nursing students with experience in CM approaches for teaching or learning were targeted, taking into account PEO factors to achieve CT outcomes.

Search strategies and selection process

The first reviewer (MT) conducted a thorough literature search in electronic databases, including Scopus, Web of Science, Science Direct, Google Scholar, and PubMed. The second reviewer (SD) searched for more information in Embase and Delnet. We restricted the search to 2012–2023 to assess the effectiveness and significance of the previous 11 years. The researchers looked into pertinent systematic literature reviews and studied the titles, abstracts, and keywords to identify the search keywords. The key search items used for searching the literature included a Boolean operator, which was "Effect* OR application OR Impact," "Concept map*," "Critical thinking," and "Nursing student*."

Using MESH keywords, two authors conducted independent reviews of every manuscript they discovered through database searches. They collaborated with a third reviewer to resolve any differences they discovered. We acquired the full texts of the studies selected at level 1, and each was subjected to an independent evaluation by the same two reviewers to ascertain eligibility. The reasons for exclusion were carefully documented and categorized. One reviewer (SD) made searches using gray sources of information. We removed duplicate entries from Endnote and added the gathered materials to make it easier for us to decide which research to include.

Two reviewers (SD and MT) then independently assessed the titles and abstracts for their eligibility. The discussion between the two reviewers (SD and MT) effectively addressed their initial disagreements over the classification of the article. Both reviewers (SD and MT) separately examined the reference lists of every paper, and any newly published research was subjected to the same data extraction, screening, and synthesis processes.

Data extraction and collection process

The reviewers used data extraction tables to collect data, which allowed data synthesis and analysis with authors, year of publication, country, research design, samples, sample size, interventions used for experimental and control groups, duration of interventions, instruments used, and results. The figures' data were extended and extracted following the measurement. The reviewers independently extracted data from all publications.

Quality and bias assessment

A scoping review seldom includes a research quality evaluation.[37] However, in this scoping review, a quality evaluation was carried out to assess the research studies' quality and identify gaps in the literature. It is vital to highlight that this assessment was not conducted to omit the research article. The included studies were sent for review to the System for Unified Management, Assessment, and Review of Information (SUMARI software program, JBI 2019). We used the 13-item Joanna Briggs Institution (JBI) Critical appraisal checklist for RCTs and the 9-item JBI Critical appraisal checklist to evaluate quasi-experimental studies. We independently evaluated the robustness of the methodology of the publications encompassed in our analysis using SUMARI's critical appraisal criteria. Recognizing the lack of a specific checklist for mixed-methods studies in SUMARI, the Mixed Methods Appraisal Tool (MMAT)[40] was used to assess the quality of studies with mixed-methods design. Any reviewer quality evaluation discrepancies were thoroughly addressed and resolved through conversation. The studies included in the current were categorized as high quality if they obtained a positive (yes) score of ≥75% on critical appraisal questions, moderate quality if they scored 50–74%, and low quality if they scored <50%.

Collating and summarizing the results

The synthesis and interpretation of data involved the collaboration of two reviewers (SD and MT). When numerical data accompanied specific study characteristics, descriptive statistics were applied to outline the information concisely. When numerical data were unavailable, a wording statement search approach was employed to collect and compile the information.

Results

Identification of articles and study selection

Figure 1 illustrates the research selection process. It started with a database and gray literature search that produced 985 results. Following deduplication, 879 entries were eliminated from title and abstract screening because they were unrelated to nursing research. We deleted 52 duplicates from the 106 articles found in electronic database searches. Further screening excluded 22 publications based on their titles and abstracts and ten more for failing to assess CT. We eliminated nine publications because they were unavailable, were published before 2012, or did not measure CT among the 20 completely examined ones—finally, we included 11 articles in the current review.

Synthesis of results

Tables 1 and 2 present the results that were synthesized using convergent synthesis, which focused on the research question, specifically covered in two sections: the utilization of CM and the CT outcome. Necessary outcomes were collected both before and after the interventions and were evaluated using a variety of questionnaires and scales.

Additional description of the studies

The various instruments used in the included studies to assess CT were California Critical Thinking Skill Test (CCTST),[16,41,42] Critical Thinking Motivational Scale (CTMS),[13] Health Education System Incorporated (HESI) CT[43] Critical Thinking Scale (CTS) by Cheng *et al*., 1996,[44,45] California Critical Thinking Disposition Inventory (CCTDI),[46] and self-prepared instruments.[47] Concept map-based nursing processes were evaluated using instruments like Concept Map Evaluation Keys[13] and Concept Map Care Plan Evaluation.[46] Participants' data were collected using semi-structured personal interviews and reflective reports.[48] Apart from those, Structure Interview Form[13] was also used to assess nursing students' perception regarding web-based concept maps. Other instruments also used in the included studies that did not measure CT were Approaches to Learning and Studying (ASI),[45] the College Academic Self-Efficacy Scale (CASES),[41] and tools like the Simulation Design Scale (SDS), the Educational Practice Questionnaire (EPQ), and Student Satisfaction and Self-Confidence in Learning Scale (SSSC) developed by National League for Nurses (NLN) to measure self-confidence.[49]

Use of concept maps in nursing education

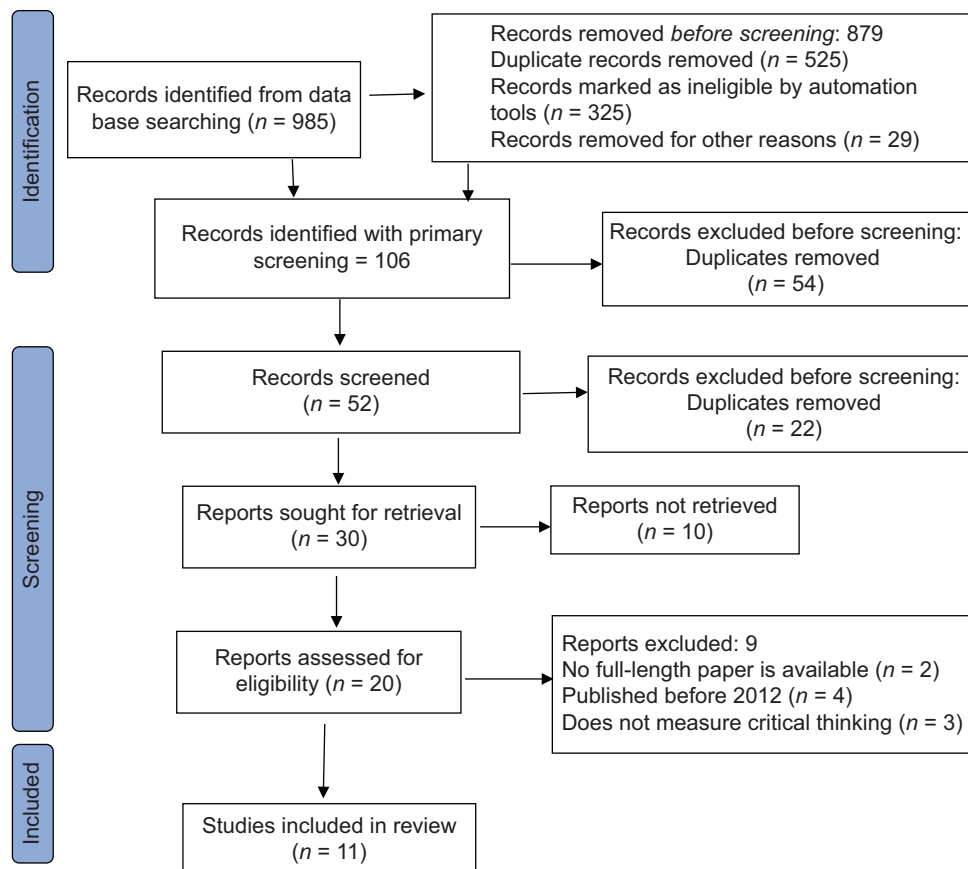Nursing care plans were created using concept maps

Figure 1: Flow diagram for selection of the articles

Table 1: Characteristics of the selected studies for the scoping review

Study Characteristics	Frequency	Percentage	References
Type of Intervention			
Web-based concept mapping education	1	9.09	13
Case-based learning with CM	1	9.09	41
Concept map-based care plan vs traditional care Plan	3	27.27	42,46,50
Workshops on CM/skill-based	1	9.09	47
CM vs. integration methods (group discussion, conference, and lectures based)	5	45.45	16,43,45,48,49
Study design			
RCT	1	9.09	13
Quasi experimental	7	63.64	16,41,43,45–47,50
Pre-experimental research design	1	9.09	42
Qualitative research study	1	9.09	48
Mixed methods of research	1	9.09	49
Setting			
Government set up	3	27.27	48–50
Private set-up/deemed universities	0	-	-
Not reported	8	72.73	13,16,41–43,45,47,49
Sample Size			
20-50	4	36.36	41,47–49
51-100	5	45.45	16,42,43,45,46
More than 100	2	18.18	13,50
Programme duration			
1-2 days	2	18.18	43,47
More than six days	9	81.82	13,16,41,42,45,46,48–50
Group Nature			
Closed group	11	100.00	13,16,41–43,45–50
Open Group	0	-	-
No. of facilitators per group			
2-5 facilitators	5	45.45	13,42,47,49,50
Not reported	6	54.55	16,41,43,45,46,48
The educational program of Group			
1st Year BSc Nursing	3	27.27	43,45,46
2nd Year BSc Nursing	7	63.64	13,16,41,45,46,49,50
3rd Year BSc Nursing	2	18.18	16,42
4th Year BSc Nursing	1	9.09	47
Not specified	1	9.09	48
Conduction of Group Activities			
Yes	6	54.55	16,42,45,47,49,50
No	1	9.09	13
Not specified	4	36.36	41,43,46,48
Countries Conducted			
Iran	4	36.36	16,41,42,47
Turkey	2	18.18	13,46
Taiwan	2	18.18	45,48
USA	2	18.18	43,49
Malaysia	1	9.09	50
Research Approach Used			
Quantitative Research	9	81.82	13,16,41–43,45–47,50
Qualitative Research	1	9.09	48
Mixed-Method Research	1	9.09	49

to assist nursing students in enhancing CT abilities. A concept mapping care plan (CMCP) was utilized by Latif *et al*. (2022)[50] to evaluate the academic performance of fourth-semester students enrolled in the second-year Diploma in Nursing Program in clinical practice. Aein F and Aliakbari F (2017) assessed CT skills by utilizing CM to formulate nursing care plans versus traditional ones.[42] Similarly, Atay S. and Karabacak U. (2012) also used concept maps to formulate a nursing care plan to check its effectiveness on the students' CT skills.[46] Moattari M. *et al*. (2014)[47] conducted a workshop on CM and its application to improve students' CT in care

Table 2: Effect of CM on CT skills among nursing students

Author	Design	Sample Size and Study Groups	Exposure	Measuring parameters	Findings	Quality assessment Instrument	Rating
Latif *et al.* (2022)[50]	Quasi-experimental	Exp Group 109 Con Group 109	CM and lecture method	Academic achievement and CT in clinical	A paired *t*-test with a *P* value of 0.05 revealed that the experimental group scored 65.23 in CMCP during clinical practices, substantially higher than the control group's 59.33.	JBI SUMARI (Quasi-experimental studies)	Include; risk of bias: moderate rate.
Lin C *et al.* (2022)[48]	Qualitative approach	24 students	Simulated concept mapping strategy	CT in clinical practice	Two major themes emerged: changes in learning and thinking and motivation. Image memory and cognition evolved from linear to multidimensional thinking at several levels.	MMAT (Mixed methods of research studies)	Include; risk of bias: low rate.
Bilik *et al* (2020)[13]	Double-blind, randomized, controlled, and experimental design	Exp Group 210 Con Group 209	Web-based CM education	CT of nursing students in practicals, NP writing ability	Web-based CM increased scores (16.45 vs. 12.70, *P*=0.000), and Critical Thinking Motivation differed substantially between groups.	JBI SUMARI (RCT)	Include; risk of bias: low
Roshangar *et al.* (2020)[41]	Quasi-experimental pretest–post-test design	Exp Group 28 Con Group 27	Cased-based learning with CM	Critical thinking, academic self-efficacy	Case-based learning with CM increased critical thinking considerably in the study group (*P*=0.001) and had a comparable impact in the control group (*P*<0.001).	JBI SUMARI (Quasi-experimental studies)	Include; risk of bias: low
Mohammadi *et al.* (2019)[16]	Quasi-experimental case-control study	Exp Group 41 Con Group 40	CM	CT skills.	The mean CT values were not substantially different across the groups (*P*=0.781). However, the intervention group had considerably higher post-intervention mean scores (*P*<0.0001).	JBI SUMARI (Quasi-experimental studies)	Include; risk of bias: low
Aein *et al.* (2017)[42]	Pre- and post-test control group design	Exp Group 30 Con Group 30	Nursing care plan with a concept map	CT skills at the beginning and end of clinical postings	Concept maps considerably enhanced CT abilities compared to the control group (*P*<0.001). Both groups improved on the California CT skill exam (*P*<0.001).	JBI SUMARI (RCT)	Include; risk of bias: low
Kaddoura *et al.* (2016)[43]	Quasi-experimental pretest post-test control group design	Exp Group 42 Con Group 41	Didactic lecturing with concept maps	Critical thinking skills	The intervention group had considerably higher post-test CT scores than the control group (*P*=0.0003). Concept mapping raised HESI results by 84.15 points, outperforming the control group's 25.24-point rise.	JBI SUMARI (Quasi-experimental studies)	Include; risk of bias: low
Moattari *et al.* (2014)[47]	Quasi-experimental (post-test only design)	32	One-day workshop concept mapping for NP with clinical practice for ten weeks using CM	Cognitive CT abilities and habits of mind	Significant differences were noted in both groups—CT, including identification, reasoning, and overall skills in 11 of 17 variables.	JBI SUMARI (Quasi-experimental studies)	Include; risk of bias: low
Samawi *et al* (2014)[49]	Mixed methods quantitative and qualitative	48 nursing students	Simulation and CM	Self-Confidence and CT abilities	This study found substantial associations (*P*=0.000) between self-confidence and simulation and CM. In qualitative analysis improved evaluation skills, CT.	MMAT (Mixed methods of research studies)	Include; risk of bias: moderate rate
Lee *et al.* (2012)[45]	Quasi-experimental design, longitudinal follow-up	Exp Group 47 Con Group 48	CM with lectures	CT abilities	In study group, CT score was higher than control group	JBI SUMARI (Quasi-experimental studies)	Include; risk of bias: low

Contd...

Table 2: Contd...

Author	Design	Sample Size and Study Groups	Exposure	Measuring parameters	Findings	Quality assessment Instrument	Rating
Atay *et al.* (2012)[46]	Pretest post-test control group experimental design	Exp Group 40 Con Group 40	Care plan using concept maps	CT abilities	The experimental group had higher post-test mean overall CT disposition scores (247±16.4) than the control group (225±19.2), with significant differences (t=5.37, P<0.05).	JBI SUMARI (RCT)	Include; risk of bias: low

planning. This involved creating concept maps that included patient health information, history, risk factors, causes, investigative methods, and management under related nursing diagnoses.

A study by Lin C *et al.* (2022)[48] investigated the effect of CT as a teaching and learning technique for assisting students in integrating their knowledge into practice and developing CT abilities. A course on evaluation and analysis using 24 simulated patients in adult health nursing was taught using CM. Likewise, Mohammadi F. *et al.* (2019)[16,45] and Lee W. *et al.* (2012)[16,45] used CT to teach various medical-surgical nursing topics to nursing students to assess its effectiveness on the student's CT.

However, Bilik O. *et al.* (2020)[13] included web-based CM education using PowerPoint presentations that provided information about concept maps and their significance, types, principles, samples, videos, and other sources to advance nursing students' CT.

Case-based learning, either with or without CM, was employed by Roshangar F. *et al.* (2020)[41] to assess nursing students' CT and academic competence. Students were asked to focus on medical diagnosis, followed by clinical findings, methods of diagnosing disease, nurses' diagnosis, and so on. Students were also encouraged to identify the relationship between the subjects and to determine the connections between concepts. Likewise, Kaddoura M. *et al.* (2022)[43] also used concept maps paired with traditional didactic lectures to teach concepts related to pathophysiology and pharmacology related to disease conditions.

In addition, Samawi Z., Miller T., and Haras MS. (2014) employed high-fidelity simulation and CM to foster self-confidence in nursing students attending a pediatric clinical rotation. At the conclusion, informal focus groups were conducted to determine how the students felt about CM and how it affected their CT abilities.[49]

Critical thinking outcomes

The study in which web-based CT teaching was employed to the nursing program students showed that CM scores were higher in the experimental group (16.45 ± 10.91) than in the control group (12.7 ± 09.31). The expectancy,

attainment, and utility subscales of the Critical Thinking Motivational Scale also demonstrated a significant difference between the two groups.[13]

Cased-based learning with CM also has higher students' CT capabilities than those who received education using only case-based learning. However, the study found that the experimental and control groups had increased CT findings after receiving case-based education with and without CM.[41] In another study, after the intervention, mean CT abilities increased ($P < 0.0001$) in the experimental group, who received education on various disease conditions using CM, compared to the control group, who received teaching using group discussion, conference, and lecture. The study also showed that post-intervention mean CT scores increased in both groups ($P = 0.781$).[16] Comparably, the results of another study demonstrated that nursing students' mean CCTST critical thinking scores increased in both groups before and after the intervention ($P < 0.001$). On the other hand, the experimental group, which created nursing care plans using concept maps, had considerably higher scores for CT than the students in the control group, which created nursing care plans using the conventional linear method ($P < 0.001$).[42]

Similarly, another study showed that after the intervention, CT scores increased in participants who received education with traditional didactic lectures with concept maps ($P = 0.0003$) compared to the control group, which received teaching using only the traditional lecture method.[43] Similar results were also seen in another study when post-test CT ratings for identification, justification, and response quality were much higher in the experimental group. Likewise, regarding cognitive CT skills, the study participants outdid the observation group's logical reasoning, discrimination, applying standards, and knowledge transformation. The experimental group saw improvements in habit, persistence, background perspective, self-confidence, instinct abilities, and cognitive integrity.[47]

Another study found that both groups' mean CT scores declined with time. The study's results, however, showed that study participants had higher CT ratings than the observational group after controlling individual characteristics.[45] The experimental group's post-test

CT disposition and its subscales showed statistical improvement in the study, including implementing a nursing care plan based on CM (t = 5.37, $P < 0.05$). For the second, third, and fourth care plans, the experimental group's scores in the concept map evaluation criteria increased (f = 90.73, $P < 0.05$).[46]

The qualitative study findings suggested that the use of CM assisted nursing students in shifting their learning style from traditional rote learning to visualizing knowledge in image format. The thinking process was improved from linear to complex thinking. Furthermore, using CM and simulated instances aided in developing mental security and increased learning capacity.[48] Similarly, another qualitative study's findings revealed three themes from the focus group discussions: enhanced assessment of abilities, higher CT, and more assurance after high-fidelity simulations and CM as a teaching–learning technique.[49]

Key gaps in literature

Examining articles on the instruction of CT in nursing learners using idea mapping identified the following key gaps:

1. Lack of RCTs: Only one publication in the current scoping review used a randomized controlled research methodology.[13] Future researchers are advised to perform studies on the application of CT in CT using randomized control experiments to improve the generalization of the findings.
2. Only two of the 11 studies had a greater sample size (more than 100).[13,50] The present review has a maximum sample size of 419[13] and a minimum sample size of 24.[48] Therefore, subsequent studies should prioritize the effective use of larger sample figures.
3. Only one (9.09%)[13] of the 11 studies used modern technology (web-based concept mapping) to offer the intervention in concept-based education, which intended to improve nursing students' CT abilities. This emphasizes the necessity for future researchers to investigate the usage of mobile, online, social media, and app-based concept maps. Since technology is well-versed in the nursing domain, it makes it easier for students to grasp and may be used in patient care whenever necessary.
4. The frequency of similar studies is notably low, with no studies conducted in 2023, only two in 2022,[48,50] and the remaining nine conducted between 2012 and 2021. Thus, there is a lot of scope for further study on the effect of CM-based teaching on CT in nursing students.
5. While most studies have focused on using concept maps with BSc nursing students, it is as important to include them in the curriculum for MSc nursing students. This inclusion is crucial since MSc Nursing students may pass on this information to their junior classmates and employ improved CT abilities in real-world clinical decision-making settings.
6. Lack of studies providing training interventions to faculty to evaluate the concept maps on critical care thinking.
7. There is a lack of studies on the inability to request expert opinions about the content of CM to keep the interactions between the students under control during discussions.
8. Studies also suggest the assessment of student satisfaction with the use of concept maps.

Discussion

Evidence supporting the effectiveness of CM on nursing students' CT was presented in this scoping review. Among the various scales used to evaluate CT in this scoping review, the most commonly used were CCTST, CTMS, CCTDI, HESI CT, and CTS. Concept Map Evaluation Keys and Concept Map Care Plan Evaluation were also used to evaluate nursing care plans prepared using concept maps.

Our findings suggest that concept map-based and traditional nursing care plans have successfully enhanced CT skills among nursing students. Nonetheless, the study group's CT was statistically greater than the control group's.[42,46,47] Hence, nursing students can utilize concept maps to formulate a nursing care plan and enhance CT. However, careful evaluation and feedback should be given for concept maps prepared by students so that proper identification of relationships between concepts can be assessed.

Our review results also show that even when the experimental group uses concept maps to improve CT, an alternate learning pedagogy for the control group still increases the CT of the control group students. However, the study group has significantly higher postintervention CT scores than the control group.[41–43] Additionally, our review findings indicate that integrating concept maps with other teaching–learning strategies, such as didactic lectures and case-based learning, can provide more benefits in terms of reflection on the thinking process of individuals.[41,43,45] Therefore, CM can be integrated with other teaching–learning strategies to enhance CT skills.

In comparison, the results of our study are consistent with the findings of a review study conducted by Garwood JK, Ahamed AH., and McComb (2018) regarding the impact of CM on the CT of nursing students. The findings concluded that CM effectively increased the nursing students' CT.[33] Likewise, Yue M. *et al.* (2017)[29] found that CM effectively increased CT and its subscales in a systematic literature review and meta-analysis. The results of our study, however, indicated that while CT successfully enhanced the

overall CT scores, some subscales did not alter or remain the same for the experimental and control groups.

The review also highlights that CM-based education can be delivered online or web-based.[47] Hence, CM can also be used in online education to enhance CT skills.

Conclusion

CT, which entails the fast production of ideas for problem resolution, is critical for nurses who frequently encounter medical and surgical situations. The review findings revealed that using instruments such as CCTST, CTMS, CCTDI, HESI CT, and CTS, CM benefits CT and its subcomponents. Apart from CT, improvements are shown in clinical decision-making, self-efficacy, confidence, student satisfaction, and other critical areas. The results support and recommend the policy makers of nursing fraternity and nursing managers regarding the utilization of concept maps in nursing curriculum in the Indian context either as a stand-alone approach or in conjunction with additional strategies including lectures and simulations to develop students' CT skills. Furthermore, it promotes additional research and the use of standardized assessment methods to confirm the efficacy of CM in nursing education. This scoping review found just 11 original publications accessible to the public across several databases, underlining the need for a stronger body of evidence to support the advantages of CM in the nursing curriculum.

Conflicts of interest
There are no conflicts of interest.

References

1. Dewey J. How We Think. D.C.Heath and CO., Publishers; 1910 [cited 2022 Nov 15]. Available from: http://archive.org/details/howwethink000838mbp.
2. Papathanasiou IV, Kleisiaris CF, Fradelos EC, Kakou K, Kourkouta L. Critical Thinking: The Development of an Essential Skill for Nursing Students. Acta Informatica Medica. 2014 Aug; 22(4):283–286.
3. Özkahraman Ş, Yildirim B. An Overview of Critical Thinking in Nursing and Education. American International Journal of Contemporary Research. 2011 Sep; 1(2):190–196.
4. Scheffer BK, Rubenfeld MG. A consensus statement on critical thinking in nursing. Journal of Nursing Education. 2000 Nov; 39(8):352–359.
5. Raesi R, Farajzadeh Z, Saadatjoo SA. The effect of development program of leadership style based on concept mapping on the components of nurses' leadership style. Journal of Nursing Education. Journal of Nursing Education; 2018 Apr 10;7(1):10–16.
6. Karkada S, Cherian S. A Review on Leadership in Nursing. International Journal of Nursing Research and Practice. 2017 Jun 1;4:2017.
7. Simpson E, Courtney M. Critical thinking in nursing education: Literature Review. International Journal of Nursing Practice. 2002;8:89–98.
8. Hawks JH. Organizational Culture and Faculty Use of Empowering Teaching Behaviors in Selected Schools of Nursing. Nursing Outlook. 1999 Apr; 47:67–73.
9. Banning M. Nursing research: perspectives on critical thinking. British Journal of Nursing. 2006 Apr; 15(8):458–461.
10. Sun Y, Yin Y, Wang J, Ding Z, Wang D, Zhang Y, Zhang J, Wang Y. Critical thinking abilities among newly graduated nurses: A cross-sectional survey study in China. Nursing Open. 2023;10:1383-92.
11. Urhan E, Zuriguel-Perez E, Harmancı Seren AK. Critical thinking among clinical nurses and related factors: A survey study in public hospitals. Journal of Clinical Nursing. 2022;31 (21–22):3155–3164.
12. Zarzycka D, Gesek M. The factors affecting the critical thinking skills among nursing students-An integrative literature review. Pielegniarstwo XXI Wieku. 2022;21:174-180
13. Bilik Ö, Kankaya EA, Deveci Z. Effects of web-based concept mapping education on students' concept mapping and critical thinking skills: A double blind, randomized, controlled study. Nurse Education Today. 2020 Mar; 86:104312.
14. Eisenmann N. An innovative clinical concept map to promote clinical judgment in nursing students. Journal of Nursing Education. 2021;60(3):143–149.
15. Khrais H, Saleh AM. The Effect of Concept Mapping on Critical Thinking of Jordanian Nursing Students. Creative Nursing. 2020;26(1):e19–e24.
16. Mohammadi F, Momennasab M, Rostambeygi P, Ghaderi S, Mousazadeh S. The effect of education through conceptual mapping on critical thinking of nursing students. Journal of Pakistan Medical Association 2019. 2019 Aug; 69(8):1094–1098.
17. O'halloran B. Strengthening Critical Thinking Skills in Associate Degree Nursing Students Through Combined Pedagogies of Concept Mapping Using the Nursing Process and Simulation. Nursing Education Perspectives. 2022;43(3):E10–E12.
18. Choi YJ, Um YJ. The effects of a home-visit nursing simulation for older people with dementia on nursing students' communication skills, self-efficacy, and critical thinking propensity: Quantitative research. Nurse Education Today. 2022;119:105564
19. Rezapour-Nasrabad R. Mind map learning technique: An educational interactive approach. International Journal of Pharmaceutical Research. 2019;11(1):1593–1597.
20. Rosciano A. The effectiveness of mind mapping as an active learning strategy among associate degree nursing students. Teaching and Learning in Nursing. 2015;10(2):93–99.
21. Yang KH, Chen H, Liu CJ, Zhang FF, Jiang XL. Effects of reflective learning based on visual mind mapping in the fundamentals of nursing course: A quasi-experimental study. Nurse Education Today. 2022;11:105566.
22. Choi YR, Lee YN, Kim D, Park WH, Kwon DY, Chang SO. An e-Problem-Based Learning Program for Infection Control in Nursing Homes: A Quasi-Experimental Study. International Journal of Environmental Research and Public Health. 2022;19(20):13371
23. Gunahariati NN, Sutajaya IM, Arnyana IBP, Sudirtha IG. Development of patient safety learning module based on problem based learning for nursing students at the College of Health Sciences. Bali Medical Journal. 2022;11(1):174–183.
24. Arisudhana GAB, Martini NMDA. Implementation of the Blended Learning Method to enhance Clinical Reasoning among nursing students. Jurnal Keperawatan Soedirman. 2022;17(2):57–62.
25. Cao W, Hu L, Li X, Li X, Chen C, Zhang Q, Cao S. Massive Open Online Courses-based blended versus face-to-face classroom teaching methods for fundamental nursing course. Medicine.

2021;100(9):e24829.

26. Tavares N. The use and impact of game-based learning on the learning experience and knowledge retention of nursing undergraduate students: A systematic literature review. Nurse Education Today. 2022;117:105484.

27. Lee KE. Effects of Team-Based Learning on the Core Competencies of Nursing Students: A Quasi-Experimental Study. Journal of Nursing Research. 2018;26(2):88–96.

28. Zeb MA, Mahboob U, Shaheen N. Effect of team-based learning on critical thinking: A quasi-experimental study. Pakistan Journal of Medical Sciences. 2022;38(8):1–5.

29. Yue M, Zhang M, Zhang C, Jin C. The effectiveness of concept mapping on development of critical thinking in nursing education: A systematic review and meta-analysis. Nurse Education Today. 2017;52:87–94.

30. Daley BJ, Morgan S, Black SB. Concept Maps in Nursing Education: A Historical Literature Review and Research Directions. J Nurs Educ. 2016 Nov; 55(11):631–639.

31. Schmehl P. Introduction to Concept Mapping in Nursing-Critical Thinking In Action. United States of America: Jones and Bartlett Learning; 2014.:25-28.

32. All AC, Huycke LI, Fisher MJ. Instructional tools for nursing education: Concept Maps. Nursing Education Perspectives. 2003;24(6):311–317.

33. Garwood JK. Millennial students' preferred methods for learning concepts in psychaiatric nursing. Journal of Psychosocial Nursing and Mental Health Services. 2015;53(9):38–43.

34. Fontenot J. Clinical touch points: Using the PREP framework to improve critical thinking among pre-licensure nursing students. Teaching and Learning in Nursing. 2021;16(4):418–422.

35. Raesi R, Bakhtiari E, Abbasi Z, Saghari S, Bokaie S, Hushmandi K, Gholizadeh H, Raei M. Selected Leadership Style of Nursing Manager from the Perspective of Nurses Caring for Patients COVID-19. Journal of Military Health Promotion. 2021 May 10;2(1):277–285.

36. The Joanna Briggs Institute. Joanna Briggs Institute Reviewers' Manual: 2015 Methodology for JBI Scoping Reviews. [2015th edition]. Australia: The Joanna Briggs Institute; 2015: 6-23

37. Peters MDJ, Godfrey CM, Khalil H, McInerney P, Parker D, Soares CB. Guidance for conducting systematic scoping reviews. International Journal of Evidence-Based Healthcare. 2015 Sep; 13(3):141–146.

38. Munn Z, Peters M, Stern C, Tufanaru C, McArthur A, Aromataris E. Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. BMC Medical Research Methodology. 2018;18(1):143.

39. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, Moher D, Peters MDJ, Horsley T, Weeks L, Hempel S, Akl EA, Chang C, McGowan J, Stewart L, Hartling L, Aldcroft A, Wilson MG, Garritty C, Lewin S, Godfrey CM, Macdonald MT, Langlois EV, Soares-Weiser K, Moriarty J, Clifford T, Tunçalp Ö, Straus SE. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. Annals of Internal Medicine. 2018 Oct 2;169(7):467–473.

40. Hong QN, Pluye P, Fàbregues S, Bartlett G, Boardman F, Cargo M, Dagenais P, Gagnon MP, Griffiths F, Nicolau B, O'Cathain A, Rousseau MC, Vedel I. Improving the content validity of the mixed methods appraisal tool: a modified e-Delphi study. Journal of Clinical Epidemiology. 2019 Jul; 111:49-59.e1.

41. Roshangar F, Azar E, Sarbakhsh P, Azarmi R. The Effect of Case-Based Learning with or without Conceptual Mapping Method on Critical Thinking and Academic Self-Efficacy of Nursing Students. Journal of Biochemical Technology. 2020;11(1):37–44.

42. Aein F, Aliakbari F. Effectiveness of concept mapping and traditional linear nursing care plans on critical thinking skills in clinical pediatric nursing course. Journal of Education and Health Promotion. 2017;6:13.

43. Kaddoura M, Van-Dyke O, Yang Q. Impact of a concept map teaching approach on nursing students' critical thinking skills. Nursing and Health Sciences. 2016 Sep; 18(3):350–354.

44. Cheng YY, Wang WC, Wu JJ, Hwang CK. A preliminary report on the construction of the critical thinking scale (in Chinese). Psychological Testing. 1996;43:213–226.

45. Lee W, Chiang C, Liao I, Lee M, Chen S, Liang T. The longitudinal effect of concept map teaching on critical thinking of nursing students. Nurse Education Today. 2013 Oct; 33(10):1219–1223.

46. Atay S, Karabacak U. Care plans using concept maps and their effects on the critical thinking dispositions of nursing students. International Journal of Nursing Practice. 2012 Jun; 18(3):233–239.

47. Moattari M, Soleimani S, Moghaddam NJ, Mehbodi F. Clinical concept mapping: Does it improve discipline-based critical thinking of nursing students? Iranian Journal of Nursing and Midwifery Research. 2014 Jan; 19(1):70–76.

48. Lin C, Han C, Huang Y, Chen L, Su CC. Effectiveness of the use of concept maps and simulated cases as a teaching-learning strategy in enhancing the learning confidence of baccalaureate nursing students: A qualitative approach. Nurse Education Today. 2022;115.

49. Samawi Z, Miller T, Haras MS. Using high-fidelity simulation and concept mapping to cultivate self-confidence in nursing students. Nursing Education Perspectives. 2014;35(6):408–409.

50. Latif RA, Dahlan A, Nor MZM. The Effectiveness of a Concept Mapping Care Plan in Evaluating Nursing Students' Achievement in Clinical Practice. Malaysian Journal of Medicine and Health Sciences. 2022;18(8):50–58.