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RESEARCH ARTICLE

Effectiveness of Concept Mapping in Enhancing Knowledge Regarding Dengue Among Health Profession Students: A Quasi-Experimental Study

Kumar Abhinav [1], Prakash Shashi [2]*, Biji Biju [3], Verma Akanksha [4], Kumar Akash [5], Shrivastav Kumar Alok [6], Kumar Amit [7], and Singh Amrita [8]

[1] Department of Community Health Officer, Kannauj, Uttar Pradesh, India

[2] Department of Medical-Surgical Nursing, Faculty of Nursing, Govt College of Nursing, S. N. Medical College, Agra, Uttar Pradesh, India

[3] Faculty of Nursing, Uttar Pradesh, University of Medical Sciences, Etawah, Uttar Pradesh, India

[4] Nursing Officer, King George Medical University, Lucknow, Uttar Pradesh, India

[5] Department of Community Health Officer, Mau, Uttar Pradesh, India

[6] Department of Uttar Pradesh Secondary Education, Chandauli, Uttar Pradesh, India

[7] Department of Community Health Officer, Sultanpur, Uttar Pradesh, India

[8] Nursing Officer, Uttar Pradesh University of Medical Sciences, Saifai, Etawah, Uttar Pradesh, India

Corresponding author: Prakash Shashi (e-mail: prakashshashipr@gmail.com).

Abstract: In health profession education, effective instruction is essential, particularly when discussing significant health issues like dengue. Deep knowledge is frequently not fostered by conventional instructional techniques like lectures. Concept mapping, on the other hand, is an active learning technique that fosters critical thinking by assisting students in organizing and integrating their information. In comparison to conventional lecture techniques, the purpose of this study is to assess how well idea mapping enhances nursing students' understanding of dengue. Sixty nursing students from two institutions—Uttar Pradesh's University of Medical Sciences Nursing College (30 students) and J.K. College of General Nursing (30 students)—were chosen by simple random sampling in a quasi-experimental (Pretest-Posttest) design. Concept mapping was used to teach the experimental group (UPUMS), whereas conventional lectures were given to the control group (J.K. College). A self-structured knowledge questionnaire that was given both before and after the intervention was used to gauge participants' knowledge of dengue. Both descriptive and inferential statistics were used to analyze the data. The experimental group's mean pretest knowledge score (concept mapping) was 18.86 (SD=3.43), while the lecture method control groups were 17.03 (SD=4.39). Following the intervention, the experimental group's mean post-test score increased dramatically to 27.46, whereas the control group's score increased somewhat to 20.45. The experimental group exhibited a highly significant difference in knowledge improvement ($t=5.60$, $p<0.001$), while the control group showed no significant difference ($t=2.57$, $p=0.05$), according to a 't' test. When compared to conventional lecture techniques, concept mapping greatly increased nursing students' understanding of dengue. According to the findings, idea mapping is a more successful teaching method that improves comprehension and retention. To improve students' educational experiences, nursing educators should think about introducing concept mapping into their courses.

Keywords: Concept Mapping; Dengue; Health Profession Students; Quasi-Experimental Study; Knowledge Enhancement; Active Learning

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1. Introduction

In the field of health profession education, concept maps are becoming recognized as an excellent teaching and learning tool. Their ability to arrange and visually represent complex information, promote critical thinking, and facilitate deeper understanding has made them popular. As an educational tool, concept maps enable students to exhibit their grasp of the ideas associated with a specific body of information (Choudry et al. 2019). Students create concept maps, which are visual representations of a set of concepts, to show what they understand about them. Concept maps can be a useful learning strategy in health profession education. The purpose of this guide is to provide an understanding of the theoretical basis and instructional use of concept mapping in health professions education (Torre et al. 2023; Radwan et al. 2019). Since concept maps encourage meaningful learning and assist students in connecting ideas and understanding their relationships, they are a helpful tool for tackling this problem. This introduction explores the value and efficacy of concept mapping in health profession education, emphasizing its potential to enhance clinical reasoning, promote long-term memory retention, and fortify cognitive capacities. Students' involvement and internalization of the content, along with the presentation of the information, are now used to evaluate effective teaching (Biggs & Tang, 2019; Brentnall et al. 2022). A key goal of contemporary education is to support self-directed learning, where students take control of their education, evaluate new information critically, and apply it in meaningful ways in a range of contexts (Schunk, 2020; Walvekar et al. 2021).

Health profession education is defined by the breadth of the curriculum and the need for students to apply and integrate their knowledge in a range of situations. Conventional teaching methods like lectures and rote memorization usually do not promote deep knowledge and critical thinking. By establishing and illustrating knowledge connections, active learning strategies like concept mapping encourage students to actively engage with the material rather than passively absorbing it. According to Novak and Cañas (2008), concept maps are diagrammatic representations that organize and arrange information. They are composed of connecting lines that illustrate the relationships between key concepts and nodes that represent those concepts. Cognitive learning theories state that actively creating and organizing knowledge into meaningful patterns is the best way to understand it (Ausubel, 2000). These theories align with this strategy. Active learning techniques like idea mapping have been demonstrated to increase student involvement, retention, and comprehension (Prince, 2004). Concept mapping enables students to link theoretical ideas with useful, real-world applications in nursing education, where the application of information in clinical settings is crucial (Innis et al., 2024).

The capacity of idea maps to promote critical thinking is one of their main benefits in health profession education. Clinical reasoning, which is essential to the conduct of the health profession, entails problem-solving, decision-making, and the analysis of complex data. By teaching students to prioritize important concepts, establish interrelationships, and arrange material hierarchically, concept maps help students develop these abilities. Concept maps have been shown in numerous studies to improve clinical reasoning and decision-making skills in students pursuing health professions (Torre et al., 2017). By helping students make connections between ideas and pinpoint knowledge gaps, concept mapping promotes the meaning-making process and enhances understanding (Novak, 2019). Constructivist learning theory, on which this method is based, contends that knowledge is actively created by students when they interact with new material and connect it to what they have already learned (Vygotsky, 2021). Concept maps help students solve problems in clinical settings by giving them a visual picture of knowledge and showing them how disparate pieces of information fit together.

Concept mapping has also shown great potential in the area of information retention. Students must retain a great deal of material in the context of health profession education, frequently in high-stakes situations. Conventional study techniques like memorizing and passive reading may help with short-term retention but are less successful at long-term memory and application. However, it has been demonstrated that concept maps enhance long-term memory by promoting active involvement with the content (Novak, 2003). Students are compelled to recollect and arrange previously taught content while creating a concept map, which strengthens their comprehension and improves memory retention (Fonseca et al., 2020). Ben-Haddour et al. (2022) investigated the impact of concept mapping on students' recall of health profession knowledge. According to the findings, students who employed concept maps outperformed those who did not in terms of their ability to remember and apply knowledge in clinical settings. Students had to actively combine new information with what they already knew in order to create a map, which led to deeper comprehension and more robust memory traces.

A significant element of health profession education is problem-based learning, which provides an environment that encourages active learning, critical thinking, and the application of the learned information to real practice. Concept mapping is a very useful tool in this type of setting, where students work as a team to solve more challenging problems. PBL often throws complex issues, which require the synthesis of knowledge from multiple fields. Concept maps provide an ideal structure for this knowledge, enabling the student to visualize how various facts relate to one another and why they are relevant to the larger issue in question.

The function of idea maps in PBL contexts has been emphasized in a number of research. Bixler, Brown, Way, Ledford, and Mahan (2015), for example, discovered that concept maps improved students' comprehension and capacity to apply knowledge in clinical settings by assisting them in better organizing and consolidating information in a PBL course. Since making a

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concept map frequently entails discussions and compromises on the connections between concepts, it has also been demonstrated that using concept maps in PBL improves students' collaborative abilities. In addition to reinforcing the content, this collaborative element promotes a deeper comprehension of the subject.

A number of cognitive learning theories explain why idea mapping works so well in health profession education. According to Ausubel's (2000) theory of meaningful learning, it's critical to relate newly learned material to preexisting schemas, or cognitive structures. Students can explicitly connect new and existing information through the use of concept maps, which offer a visual depiction of this process (Choudhari et al. 2021). Students are more likely to remember material and recognize its applicability in various circumstances if they participate in this process. In a similar vein, Piaget's (1976) theory of cognitive development emphasizes the importance of active participation in the learning process, in which students interact with their surroundings to generate knowledge. Concept maps support Piaget's focus on cognitive creation by asking pupils to actively arrange and synthesize material.

Based on Vygotsky's (2021) social constructivist theory, learning is viewed as a process that results from social interaction and teamwork. Such cooperative learning may be fostered by the use of concept mapping, especially in group settings. Students have discussions that improve comprehension and problem-solving abilities when working together to create a collaborative map. As students reflect on their own thought and learning processes during the activity, this collaborative aspect also fosters metacognitive abilities.

One of the important aspects of the practice of the health profession is clinical reasoning, which requires the ability to synthesize and apply knowledge in clinical settings. It has been proven that concept maps enhance clinical reasoning by helping students organize and structure complex clinical information. Examples are conceptual maps, which aid learners to diagrammatically explain the pathophysiology of the illness in addition to how their symptoms are clinically present. One way of using that process of having students recognize and trace how significant ideas are associated to arrive at a correct judgment of clinical situations can assist in better decision-making for such situations.

A study by Daley et al. (2016) examined how idea maps can help students pursuing health professions develop their clinical reasoning skills. According to the findings, students who arranged clinical data using idea maps showed enhanced diagnostic abilities and were more capable of prioritizing important concerns in clinical situations. In the same way, Brondfield et al. (2021) discovered that idea mapping aided students pursuing careers in the health professions in elucidating their clinical reasoning procedures, especially when handling complex cases. Students were able to more effectively solve problems by organizing their ideas visually through the creation of a map.

Beyond cognitive improvement, concept maps are helpful for various applications of health profession education. Student learning evaluation is one such application. Traditional evaluation approaches, such as multiple-choice tests, fail to capture the depth of what a student has understood. However, concept maps present an integral, visual form of what a student comprehends. According to Daley et al. (2016), concept maps can be used as an assessment method to determine how well students understand difficult subjects. Teachers can learn more about how well students comprehend the connections between important ideas and how well they have integrated their knowledge by assessing the accuracy and completeness of a concept map.

Moreover, concept maps can be used as a feedback device. Concept maps can provide students with instant feedback on how well they understand a concept, argues Kinchin (2008). With this feedback, students can enhance their entire learning process, complete comprehension gaps, and perfect their knowledge structures. Moreover, concept maps may be a useful learning device (Sieben et al. 2020). To ensure that the information they have is both accurate and up-to-date, students should study their maps regularly to focus on significant ideas.

Apart from enhancing memory and cognitive ability, there are more benefits associated with concept mapping. For instance, researchers have shown that concept maps can be used by the student to develop motivation and engagement toward learning. According to Schunk (2020), "Motivation is essential for learning, and students are more likely to succeed when they are motivated and engaged in learning.". The interactive and visual nature of concept mapping can increase the engagement of students, making the learning process more enjoyable and less intimidating. In addition, concept maps encourage active participation and self-regulation, as the student must take responsibility for organizing and structuring knowledge. Fink (2013) stated that the traditional lecture approach often relies on rote memory, which fails to support the development of critical thinking and problem-solving skills needed for clinical practice.

The process of making a concept map makes students introspect their knowledge and also where the changes will improve upon these. Therefore, it gives opportunities for their self-directed learning. Because it enables learners to drive their learning process, says the idea map promotes self-regulated learning for Anantharaman et al. (2019), it is in line with metacognition, goal, and self-evaluation according to the principles of the same. Students can monitor their progress and improve on their strategies if needed through continually creating and improving concept maps.

To sum up, idea mapping is an effective teaching method for health professions that has several advantages for both teachers and students. Concept mapping has been shown to be a successful method for raising learning outcomes for students pursuing health professions because of its capacity to foster critical thinking, improve knowledge retention, ease clinical reasoning, and

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assist with problem-solving. Additionally, idea maps give students an interactive and visual way to arrange difficult material, making it simpler to comprehend. Concept mapping's incorporation into curricula and evaluation techniques will surely be crucial in educating the next generation of healthcare workers as health profession education develops.

Concept maps systematically organize and link ideas to make it easier for students to understand challenging concepts. Besides fostering cooperation and debunking myths, they cultivate critical thinking, creativity, and problem-solving skills. They foster a deeper connection with the content in both the creation and analysis of concept maps (Sannathimmappa et al. 2022; Slieman & Camarata, 2019; Maryam et al. 2021).

Therefore, there is much potential for the use of idea mapping in health professions education to enhance individual learning outcomes as well as help create a more thorough and efficient system of health professions education. It is likely that idea mapping will continue to grow in popularity as an essential teaching tool in the health professions as further research is conducted on its effectiveness in other educational settings.

2. Materials and Methods

2.1 Study Design, Setting, and Sample

This quasi-experimental study used a pretest-posttest design to evaluate the effectiveness of concept mapping in enhancing nursing students' knowledge about dengue compared to traditional lecture-based instruction. The study was conducted at two nursing colleges: J.K. College of General Nursing, Etawah, and UPUMS Nursing College, Saifai. These institutions were selected based on feasibility, the availability of sufficient samples, and the investigator's familiarity with the settings.

The study targeted second-year General Nursing and Midwifery (GNM) students from these colleges. A sample of 60 students was chosen, with 30 students selected from each college. Simple random sampling by the lottery method was applied to randomly assign participants from the pool of eligible students who met the inclusion criteria. To ensure unbiased randomization, students were listed by their registration numbers, and each student was assigned a unique identifier. Then, a random number generator was used to select 30 students from each college. This process was closely monitored to avoid selection bias and ensure equal representation. Table 1 lists the sample selection criteria.

TABLE 1. SAMPLE SELECTION CRITERIA.

Inclusion Criteria	Exclusion Criteria
-Nursing students enrolled in the 2nd year of the GNM program.	-Students who were not enrolled in the GNM program.
-Students willing to participate in the study.	-Students with prior exposure to teaching on dengue.
-Students who were available during the data collection period.	-Students who were unavailable during the study period.
-Students who could read and write in English.	

To ensure that the assignment of students to the experimental and control groups was unbiased and randomized, the following systematic process was employed:

1. Preparation of the Sample Pool: After obtaining consent from all eligible students, the complete list of second-year GNM students who met the inclusion criteria was compiled. Each student was assigned a unique identifier. This ensured that each participant had an equal chance of being selected for either group, and it also protected their anonymity.

2. Simple Random Sampling via Lottery Method:

Step 1: The list of eligible students was separated into two groups based on the college they attended: J.K. College of Nursing (Etawah) and UPUMS Nursing College (Saifai).

Step 2: Within each college, a random selection was performed to allocate students to either the experimental group (receiving concept mapping) or the control group (receiving traditional lecture-based instruction).

Step 3: Using the lottery method, each student's unique identifier was placed in a container. The researcher then drew numbers randomly to assign 30 students to the experimental group (from UPUMS Nursing College) and 30 students to the control group (from J.K. College of Nursing). This process was repeated independently for each group of students from each college.

Step 4: Once all the students had been assigned, their group assignment was documented, and the process was verified to ensure the randomization was done without bias or influence.

3. Ensuring Equal Representation: Since the study involved two different colleges (J.K. College of Nursing and UPUMS Nursing College), the randomization ensured that each college was represented fairly. The 30 students from each college were randomly split between the experimental and control groups, making sure that both groups had an equal number of participants and were comparable in terms of baseline knowledge.

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4. No Prior Knowledge of Group Allocation: The randomization process was done without prior knowledge of the student's individual characteristics, such as prior exposure to dengue-related content, previous academic performance, or other factors that could influence their knowledge level. This approach minimized selection bias and ensured that the groups were comparable at the outset of the study.

5. Monitoring of Randomization: To further ensure the integrity of the randomization process, it was overseen by the research team to confirm that the procedure was followed correctly and that each student was assigned solely based on chance. This rigorous randomization process helped guarantee that the students assigned to each group were similar in all respects except for the intervention they received. It helped reduce the potential for confounding variables to influence the study's outcomes, thereby improving the validity and reliability of the study's findings.

2.2 Operational Definitions

1. Assess: In this study, "assess" refers to the measurement of nursing students' knowledge of dengue based on their correct responses in a structured questionnaire.

2. Effectiveness: In this study, effectiveness refers to the improvement in nursing students' knowledge of dengue after the implementation of concept mapping, as measured by the structured questionnaire.

3. Concept Mapping: In this study, concept mapping refers to the use of visual diagrams by nursing students to organize and represent knowledge related to the care of dengue patients.

4. Care of Dengue Patient: This study refers to the nursing care provided to a patient diagnosed with dengue, including the administration of fluids, monitoring of vital signs, and patient education on prevention and treatment.

2.3 Instruments

The data collection for this study was carried out using a structured questionnaire that assessed nursing students' knowledge regarding dengue. The structured questionnaire was selected as it is the most effective tool for gathering specific information from a large group of participants. It consisted of two sections: 1) Section A: Demographic variables such as age, gender, previous educational status, religion, residence, and knowledge of dengue care (including sources of information, medical history, and family history of dengue). 2) Section B: A set of 29 multiple-choice questions assessing knowledge in 9 key areas related to dengue, including introduction (1 question), causes of dengue (3 questions), incubation period (1 question), clinical manifestations (10 questions), complications (2 questions), prevention (2 questions), treatment (7 questions), nursing care (2 questions), and home care (1 question).

2.4 Development of the Tool

This structured questionnaire was developed after a review of relevant literature, expert consultation, and identification of key areas of knowledge to be known by nursing students in the context of dengue care. The tool was designed to elicit responses that would allow for a clear measurement of students' knowledge in specific domains.

Steps involved in the development process include: 1) Literature Review: A review of literature that has already been written regarding dengue, care in nursing, and learning strategies has been undertaken to establish the frame of the questionnaire. 2) Expert Consultation: Sessions with experts on the subjects of medical-surgical nursing, nursing education, and public health helped outline the contents and framework of the questionnaire. 3) Blueprint Design: A blueprint was developed to ensure the questionnaire addressed all relevant aspects of dengue knowledge from symptoms to nursing care and treatment. 4) Pilot Testing: The tool was pre-tested on a small sample of students to determine any ambiguities or difficulties in understanding the questions.

2.5 Validity and Reliability

Content validity was ensured when the structured questionnaire was sought from 7 experts who were nurses and medical practitioners. After taking the feedback and revising appropriately, the final tool was developed. They checked whether the questions developed were clear, relevant, and comprehensive regarding the learning objective. In applying the Cronbach Alpha method, it was determined to test the reliability of the tool in terms of its internal consistency. The calculated reliability score was $r = 0.87$. This showed that there is a high consistency in measuring knowledge. This positive correlation suggests that the tool used was reliable and consistent to be used in the study.

2.6 Study Procedure

The research ethics obtained an ethical approval committee. Formal permission was obtained from concerned authorities at both J.K. College of Nursing, Etawah, and UPUMS Nursing College, Saifai. Informed consent was obtained from all participants, explaining the study's purpose, procedures, and their right to confidentiality.

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The study was conducted with a sample of 60 nursing students (30 students from each college). Data collection was initiated with the help of a pretest or knowledge assessment using the structured questionnaire to assess the baseline knowledge about dengue. After the pretest, the students in the experimental group (UPUMS) were taught using concept mapping to organize and visualize the care of dengue patients. Students in the control group (J.K. College) were given traditional lecture-based instruction on dengue care. A post-test was conducted after the intervention to assess changes in knowledge levels. The total time allocated for data collection was approximately 20-25 minutes per participant.

Any missing data from participants who could not complete the questionnaire were addressed by removing those specific responses from the analysis. Outliers were identified through statistical methods (e.g., box plots or z-scores) and were excluded if they significantly deviated from the expected range. This ensured the accuracy and integrity of the data analysis.

Data were analysed using descriptive statistics (e.g., mean, standard deviation) to summarize the pretest and post-test scores and inferential statistics (e.g., paired t-tests) to compare the knowledge improvement between the experimental and control groups. The scores were coded as correct response: 1 point, incorrect response: 0 points. The total possible score was 29. Knowledge levels were categorized as: 1) Inadequate: < 50%, 2) Moderately adequate: 50-75%, Adequate: > 75%.

The researchers handled all data confidentially. The identities of the students were not known, and aggregate data were reported in the study. By employing a structured and systematic approach to the development of the tool, data collection, and analysis, the study aimed to establish valid and reliable results about the effectiveness of concept mapping in improving nursing students' knowledge about dengue.

3. Major Findings, Analysis and Interpretation

This study analysed the knowledge of nursing students prior and post-intervention, which had been done by the researcher through concept mapping and the lecture method. The mean and standard deviation scores of both groups are provided with some statistical comparisons to evaluate how effective both teaching methods were. Table 2 shows the knowledge scores for concept mapping and lecture method. The t-test for the concept mapping was at 5.60, which means that it is significant on the $p < 0.001$ level. In a comparative sense, the t-test for the lecture method is 2.57, which is not significant on the $p = 0.05$ level. The outcome, therefore, provides a significant difference as far as knowledge improvement for the concept mapping is concerned than that for the lecture method.

TABLE 2. KNOWLEDGE SCORES.

Concept Mapping	**Lecture Method**
- Mean: 18.86	- Mean: 17.03
- Standard Deviation: 3.43	- Standard Deviation: 4.39

3.1 Demographic Profile of the Sample

Figure 1 provides the sociodemographic characteristics of study participants. The sample included 60 nursing students from two institutions, 30 each from J.K. College and UPUMS Nursing College. The majority of students in the age group 18-26 years have been reported by both J.K. College and UPUMS Nursing College: 90% from J.K. College and 83.3% from UPUMS Nursing College, respectively. Thus, this sample is primarily comprised of young students. For the gender, the majority of participants were female, with 83.33% of the students from J.K. College and 70% from UPUMS Nursing College being female. The highest percentage of previous educational qualification was Intermediate level (60% in J.K. College and 46.67% in UPUMS Nursing College). Notably, more students from UPUMS Nursing College had passed the degree compared to that in J.K. College, 43.33% versus 10%. The residence distribution was relatively balanced for J.K. College, with 50% residing in urban and rural areas. However, UPUMS Nursing College had a higher percentage of urban residents at 56.66%. About 73.33% of students at J.K. College and 30% at UPUMS Nursing College had prior knowledge about how to care for dengue clients. Again, the source of that previous knowledge was mostly hospitals and books, though the pattern shows variations in both colleges. Among medical history, a personal history of dengue was more common in J.K. College (43.33%), whereas UPUMS Nursing College had the lowest rate of personal past medical history (6.66%). However, a considerable number of students from both colleges reported having a family history of dengue (53.33% in J.K. College and 93.33% in UPUMS Nursing College).

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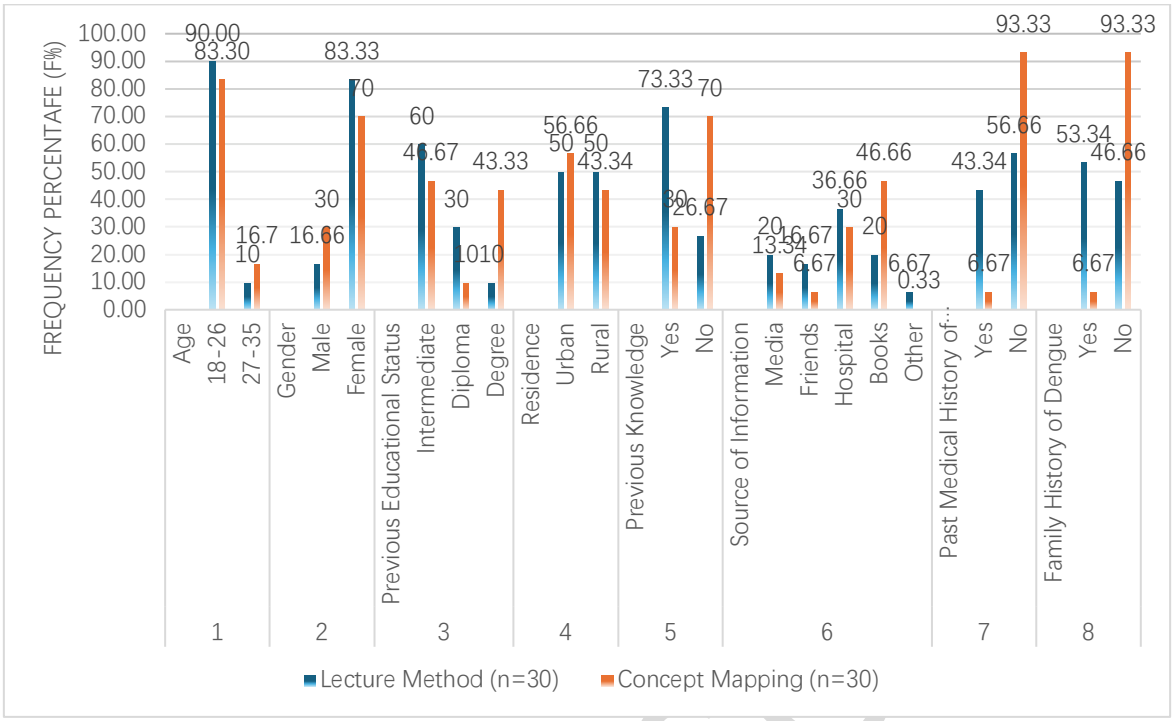

Figure 1. Sociodemographic characteristics of the studied samples (N=60).

3.2 Comparison of Pretest and Post-test Knowledge Scores

Figure 2 Comparison of the knowledge scores of both groups before and after the intervention. The knowledge scores levels were categorized as inadequate, moderate, and adequate. For the lecture method, before the intervention (pre-test), most of the students (53.33%) had inadequate knowledge, that is, less than 50% and 46.67% had moderate knowledge, that is, 51-75%. After the intervention (post-test), most of the students, that is, 60%, had moderate knowledge, that is, 51-75%. This implies that even though the lecture approach had improved things to a certain extent, the number of students with adequate knowledge still remained very low as compared to the concept mapping group. For the concept mapping, before the intervention, it was found that 56.67% of the students had poor knowledge, and 43.33% of the students had moderate knowledge. After the intervention of concept mapping, an improvement was observed, wherein 70% of students possessed moderate knowledge. Unlike the lecture method, it was seen that the percentage of students with moderate and adequate knowledge was more in the post-test after the concept mapping approach. Figure 2 shows that concept mapping has been the more effective tool for learning as compared to the lecture method.

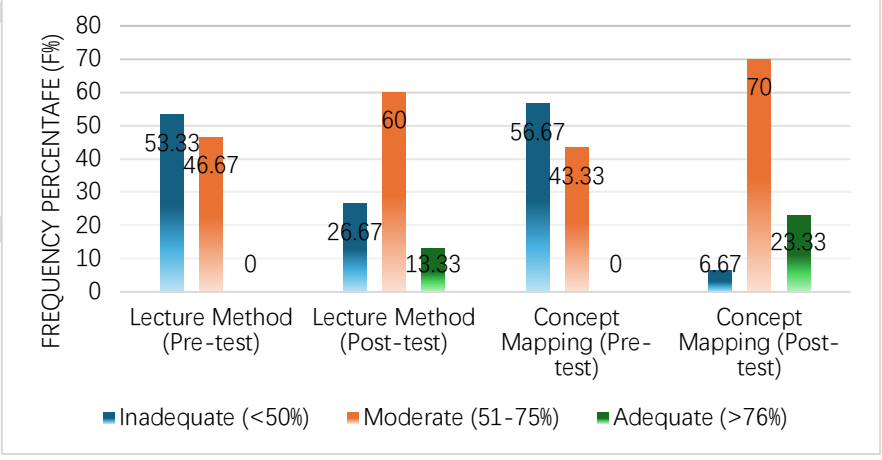

Figure 2. Frequency & Percentage Distribution of Pre-test and Post-test Knowledge Scores of Lecture Method and Concept Mapping.

Table 3 The pre-test and post-test means and standard deviations for both lecture method and concept mapping. For the Lecture Method, the pre-test mean score was 14.1 (SD = 4.43) and increased to 17.03 (SD = 4.39) with the post-test mean score. The mean difference was 2.93, t = 2.57, and p = 0.0126, meaning the difference between the pretest and the post-test knowledge scores is statistically significant, though the effect size was modest. For the Concept Mapping group, the pre-test mean score was 13.83 (SD = 3.52), while the post-test mean score increased significantly to 18.86 (SD = 3.43). The mean difference was 5.03, with a t-value of 5.60 and a highly significant p-value of < 0.001. This suggests that concept mapping had a much more substantial effect on students' knowledge improvement compared to the lecture method. These results highlight the superior effectiveness of concept mapping in enhancing students' understanding and knowledge retention compared to traditional lecture-based teaching.

TABLE 3. THE MEAN AND STANDARD DEVIATION OF KNOWLEDGE SCORES OF LECTURE METHOD AND CONCEPT MAPPING.

Group	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Mean Difference	t-Value	p-value
Lecture Method	14.1	4.43	17.03	4.39	2.93	2.57	0.0126
Concept Mapping	13.83	3.52	18.86	3.43	5.03	5.60	<0.001

Note. Concept Mapping has a p-value of less than 0.001, indicating significant improvement in knowledge as compared to the lecture method.

3.3 Association Between Post-test Knowledge Scores and Demographic Variables

Table 4 examines the relationship between the post-test knowledge score for the lecture method and other demographic variables, such as age, gender, educational status, etc. The Chi-square (X^2) test was used to determine the significance of these relationships.

TABLE 4. ASSOCIATION BETWEEN POST-TEST KNOWLEDGE SCORE OF LECTURE METHOD AND DEMOGRAPHIC PROFILE

S.No	Variable	Group	Inadequate	Moderate	Adequate	Total	X^2 (Value)	df	p-Value
1	Age	18-21	4	6	2	12	$X^2 = 5.48$	6	p = 0.48
		22-25	4	8	1	13			
		26-29	0	3	0	3			
		>30	0	1	1	2			
2	Gender	Male	1	3	1	5	$X^2 = 0.15$	2	p = 0.93
		Female	7	14	4	25			
3	Previous Educational Status	Intermediate	6	10	2	18	$X^2 = 8.61$	4	p = 0.07
		Diploma	0	8	1	9			
		Degree	2	0	1	3			
4	Residence	Urban	7	7	1	15	$X^2 = 6.39$	2	p = 0.04
		Rural	1	11	3	15			
5	Previous Knowledge Regarding Care of Dengue	Yes	6	15	4	25	$X^2 = 1.20$	2	p = 0.55
		No	2	3	0	5			
6	Source of Information (If yes)	Media	1	3	2	6	$X^2 = 9.09$	4	p = 0.33
		Friends	1	4	0	5			
		Hospital	5	6	0	11			
		Books	1	4	1	6			
		Other	0	1	1	2			
7	Any Personal Past Medical History of Dengue	Yes	3	7	3	13	$X^2 = 1.89$	2	p = 0.39
		No	5	11	1	17			
8	Any Family History of Dengue	Yes	5	8	3	16	$X^2 = 1.59$	2	p = 0.45
		No	3	10	1	14			

Note. Residency was significant with regard to post-test knowledge scores for the concept mapping methodology as it correlates with a significance value of p = 0.04.

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Residency was significantly associated with the post-test knowledge scores ($p = 0.04$). This would mean that the improvement of the knowledge of students after the lecture intervention differed based on the residency, whether it is urban or rural. Maybe the students who are residents in the urban areas are accessing better resources or educational support. Other variables such as age, gender, previous educational status, and previous knowledge about dengue care didn't show any significant associations with the post-test scores, meaning that these factors did not influence the effectiveness of the lecture method.

Table 5 analyses of the relationship between the post-test knowledge score of concept mapping and various demographic factors. The Chi-square test is also used for those analyses. Personal past medical history of dengue had a highly significant association with post-test knowledge scores for the concept mapping group ($p = 0.03$). It implies that the students having a personal past medical history of dengue were more likely to do better in the post-test because of the personal experience or heightened awareness due to that experience. Other variables such as age, gender, previous educational status, and family history of dengue did not show any significant associations with the post-test scores, suggesting these demographic factors did not significantly affect the outcomes of the concept mapping intervention.

TABLE 5. ASSOCIATION BETWEEN POST-TEST KNOWLEDGE SCORE OF CONCEPT MAPPING AND DEMOGRAPHIC PROFILE

S.No	Variable	Group	Inadequate	Moderate	Adequate	Total	X^2 (Value)	df	p-Value
1	Age	18-21	2	9	4	14	$X^2 = 2.10$	6	$p = 0.90$
		22-25	1	5	2	8			
		26-29	0	6	1	7			
		>30	0	1	0	1			
2	Gender	Male	1	7	1	9	$X^2 = 0.92$	2	$p = 0.63$
		Female	1	15	5	21			
3	Previous Educational Status	Intermediate	1	9	4	14	$X^2 = 5.21$	4	$p = 0.27$
		Diploma	0	1	2	3			
		Degree	1	11	1	13			
4	Residence	Urban	2	11	4	17	$X^2 = 1.69$	2	$p = 0.43$
		Rural	0	10	3	13			
5	Previous Knowledge Regarding Care of Dengue	Yes	0	8	1	9	$X^2 = 2.34$	2	$p = 0.31$
		No	2	13	6	21			
6	Source of Information (If Yes)	Media	1	2	1	4	$X^2 = 4.25$	8	$p = 0.83$
		Friends	0	1	1	2			
		Hospital	0	7	2	9			
		Books	1	10	3	14			
		Other	0	1	0	1			
7	Any Personal Past Medical History of Dengue	Yes	0	0	2	2	$X^2 = 7.04$	2	$p = 0.03$
		No	2	21	5	28			
8	Any Family History of Dengue	Yes	0	2	1	3	$X^2 = 0.37$	2	$p = 0.83$
		No	2	19	6	27			

Note. The personal past medical history of dengue showed a significant association with the post-test knowledge score for concept mapping ($p = 0.03$).

The study found that concept mapping was significantly more effective than the lecture method in enhancing nursing students' knowledge of caring for clients with dengue. Students taught through concept mapping demonstrated a substantial improvement in knowledge, with a mean post-test score of 18.86 and a highly significant t-value of 5.60. The lecture method showed moderate improvement, but it was less effective. Demographic factors like residence (for the lecture method) and a personal past medical history of dengue (for concept mapping) were significantly associated with post-test knowledge scores, while other factors like age, gender, educational status, and family history of dengue showed no significant impact. These findings suggest that concept mapping is a more impactful teaching strategy for this topic compared to traditional lectures.

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4. Discussion

There is a lot of promise to enhance students' cognitive growth, clinical reasoning, and retention of memory when concept mapping is included in health professions education. The effectiveness of the tool in different conditions is considered as this discussion compares the findings of idea mapping in health profession education with previous studies. In the course of this discussion, a synthesis of the literature body that would evaluate the general utility of idea mapping and its implications for the future of health profession pedagogy shall be undertaken.

The study's findings suggest that concept maps play a major role in helping people remember and apply the knowledge of the health profession. Students who used concept mapping showed improved retention, deeper comprehension, and recall of the health-related material. Idea maps have been shown to enhance long-term memory retention in previous studies (Ben-Haddour et al., 2022; Novak, 2003). These findings support that theory. For example, Ben-Haddour et al. (2022) discovered that concept maps strengthened the cognitive structures required for long-term memory by making it easier to integrate newly learned information with previously remembered data. This conclusion is further supported by Fonseca et al. (2020), who found that students actively created thought maps rather than using passive study strategies like rote memorization, which resulted in a more thorough engagement with the content. The act of creating and refining concept maps encourages the students to visualize and categorize knowledge hierarchically, which reinforces neural connections associated with memory. Studies by Novak (2003) and Miele et al. (2020) also suggest that concept mapping encourages a higher level of cognitive engagement, prompting students to make explicit connections between concepts and organize their knowledge in ways that align with cognitive development theories, such as Ausubel's (2000) theory of meaningful learning.

Furthermore, these results align with research that highlights the value of active learning in the training of health professionals. According to Torre et al. (2017) and Brondfield et al. (2021), for instance, students who participate in idea mapping exercises not only improve their memory of material but also get a deeper comprehension of intricate health profession subjects. The foundation for knowledge retention is strengthened when students actively participate in the subject because they are more dedicated to their education. The work of Daley et al. (2016), who looked at the function of concept maps in enhancing the recall and application of clinical knowledge, is consistent with the retention enhancement seen in the current study. They demonstrated that students who employed concept maps had better outcomes in subsequent examinations that tested their retention of both factual knowledge and clinical reasoning skills. This implies that the advantages of concept mapping go beyond simple memory and include using knowledge in situations that are pertinent to clinical practice.

Using Concept Mapping to Enhance Clinical Reasoning Clinical reasoning is a core competency in health profession education, and the capacity to integrate and apply knowledge in clinical contexts is essential. According to the study's findings, idea mapping helps students arrange complex health profession information in a way that makes decision-making and problem-solving easier, which helps them build greater clinical reasoning abilities. This result supports the findings of Daley, Durning, and Torre (2016), who discovered that by enabling students to produce visual representations of clinical circumstances, idea maps enhance clinical reasoning. By assisting students in breaking down intricate clinical problems and improving their comprehension of the connections between various pieces of information, this visual aid speeds up the decision-making process. Brondfield et al. (2021) discovered that when students were presented with real-world case scenarios, concept maps improved their capacity to arrange and apply clinical knowledge. They found that students who constructed concept maps had an improved understanding of the diagnostic process, enabling them to prioritize relevant information and draw connections between symptoms, pathophysiology, diagnostic tests, and treatment options. This is in line with research by Miele et al. (2020), who found that by graphically representing the connections between many facets of patient care, idea maps can be utilized as a tool to enhance clinical decision-making.

These results are supported by Bixler et al. (2015), who note that concept maps offered a more full visual framework of patient situations, hence promoting a more in-depth understanding of clinical contexts. Students can identify important concepts and their relationships by organizing their thoughts around critical topics through concept mapping, which is a skill necessary for clinical reasoning.

The act of developing concept maps itself calls for students to actively interact with the content, recognizing key ideas, drawing connections, and taking into account many viewpoints in order to promote critical thinking. Clinical reasoning necessitates both the use of information and the capacity to critically evaluate that knowledge in light of novel circumstances, as noted by Torre et al. (2017). This type of critical evaluation is encouraged by the interactive nature of concept maps, which require students to assess and update their conceptual understandings in light of fresh information or revelations.

It has been extensively studied how concept mapping can improve the efficacy of problem-based learning (PBL), and the results of this study support the usefulness of concept mapping in PBL contexts. PBL is a teaching strategy that prioritizes student-centered learning and focuses on resolving challenging, real-world issues. According to the study's findings, idea maps can greatly help in structuring and organizing the data needed for effective problem-solving in PBL settings. Students can prioritize important information, understand the connections between various concepts, and deconstruct difficult scenarios with the aid of concept maps (Nicolaou et al. 2022). Similar results were found by Bixler et al. (2015), who observed that students in

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PBL classes who utilized concept maps were more adept at organizing and combining knowledge, which resulted in a more methodical approach to problem-solving. By enabling students to integrate information from many fields, idea maps promote deeper learning in PBL situations. Students can see how their many knowledge areas are connected by graphically mapping the important ideas and connections in a clinical case, which eventually results in more thorough solutions. According to research by Kinchin (2008), PBL participants who were asked to make concept maps showed gains in their capacity to connect newly learned material to previously acquired information, which is a crucial component of effective problem-solving. Schunk's (2020) work supports this, emphasizing that concept maps encourage students to think reflectively, which helps them assimilate the information and use it in a problem-solving setting. As students collaborate to produce a common visual depiction of the issue at hand, PBL fosters teamwork, and idea maps can help foster collaborative learning (Vygotsky, 2021). Torre et al. (2017) further emphasized the collaborative nature of PBL and concept mapping, pointing out that concept maps promote communication and cooperative problem-solving, which results in more reliable and successful learning outcomes. In this sense, concept maps can be seen as a tool for promoting teamwork and group problem-solving, which are essential components of the PBL approach, in addition to being a tool for planning individual learning.

The cognitive theories that underpin the effectiveness of concept mapping in health profession education have been thoroughly explored in the literature. This study's findings align with Ausubel's (2000) theory of meaningful learning, which posits that students learn best when new information is integrated into their existing cognitive structures. Students recognize these links between previously learned material and new information because of the hierarchical structure of concept maps, which promotes greater understanding and memory. According to Novak (2003), the explicit form of concept maps helps students create a cohesive mental image of the subject matter by highlighting the links between ideas. In health profession education, where students must make connections between difficult ideas from several disciplines, this visual aid to learning is quite helpful.

The application of concept mapping in health profession education is also supported by Piaget's (1976) cognitive developmental theory. Concept mapping encourages students to actively arrange and structure information, which helps them create new knowledge structures through active interaction with the subject, according to Piaget. By assisting students in bridging the gap between tangible facts and abstract ideas, concept maps enhance the dynamic and interactive nature of the learning process. Students pursuing health professions demonstrate this by using concept maps to illustrate clinical scenarios, combine fundamental scientific knowledge with clinical applications, and eventually gain a greater comprehension of the subject matter. This way, Vygotsky's (2021) social constructivist theory also asserts the importance of collaborative learning. The results of this research support Vygotsky's assertion that knowledge should be constructed socially. During health profession education, it is common for students to create a group of learners where there exists mutual help among them while creating concept maps. This cooperative approach not only improves the understanding of students but also facilitates the development of their cooperation and communication skills, both of which are very vital for successful practice in the health profession.

Both teaching and learning are significantly impacted by the application of idea mapping in health profession education. Concept maps assist students in organizing complicated health profession knowledge, integrating it into a coherent framework, and successfully applying it in clinical settings, as demonstrated by this study. Beyond improving memory and recall of information, idea mapping also improves critical thinking, clinical reasoning, and problem-solving skills. Additionally, concept maps encourage self-regulated learning, teamwork, and active learning—all of which are critical abilities for success in health profession education (Dehghanzadeh & Moaddab 2021).

According to the conclusion of the study, the concept mapping should be part of health profession curriculum as a core instructional component and assessment. Concept maps may be used as tools to assess students' knowledge but also the ability of those students to synthesize and apply that information to real life, as Kinchin (2008) reports. Moreover, a group setting helps build up a more dynamic, and therefore interesting, environment. by being in line with the concepts of collaborative education and active learning. Concept mapping is likely to play a critical role in preparing students for the complexities of current healthcare as the discipline of health profession education evolves. Concept mapping provides students with cognitive and metacognitive skills needed for lifelong learning, which is very important in this constantly evolving health profession. The findings suggest that concept mapping's active learning approach can foster deeper engagement and understanding compared to passive methods, such as traditional lectures. This has implications beyond nursing education and can potentially be applied to other disciplines that require the retention and application of complex concepts. For example, in fields such as medicine, public health, and allied health, where concept understanding is crucial for clinical practice, concept mapping could serve as an effective pedagogical tool (Alfayoumi, 2018; Innis et al., 2024).

We have strengthened the theoretical framework by incorporating a more thorough discussion of existing literature on concept mapping in nursing education. Previous research has highlighted the benefits of concept mapping in promoting active learning and enhancing student understanding (Alfayoumi, 2018; Innis et al., 2024). For instance, Alfayoumi (2018) found that concept mapping significantly improved nursing students' ability to retain and apply clinical knowledge, a finding that supports

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the present study's conclusion that concept mapping can improve knowledge retention compared to traditional teaching methods. Similarly, Innis et al., 2024 noted that concept maps encourage students to actively engage with the material, which enhances cognitive processing and retention. By aligning our findings with these studies, we provide a stronger theoretical foundation for the use of concept mapping in nursing education.

In conclusion, the current study provides evidence for the effectiveness of concept mapping in enhancing nursing students' knowledge of dengue, with implications for its use in other areas of nursing and health education. However, further research with larger, more diverse samples and long-term follow-up is needed to fully understand its potential. The integration of concept mapping into nursing curricula could foster more active learning and deeper understanding, which is essential for preparing students for real-world clinical practice.

5. Limitations

While this study provides valuable insights into the role of concept mapping in nursing education, several limitations must be considered. Specifically, the small sample size of 60 students limits the generalizability of the findings, the results may not apply to larger, more diverse populations of nursing students across different regions or institutions. Cultural or regional differences may influence the effectiveness of concept mapping as a teaching strategy, so research across different contexts would provide further insights into its applicability (SadatHoseini et al. 2023). Future research should aim to include larger, more diverse samples to explore the effectiveness of concept mapping across different populations and educational contexts. This would help determine whether the observed benefits apply universally to all nursing students or are specific to the sample in this study.

Another limitation is the potential influence of covariates such as prior knowledge and learning motivation on the results. Students' prior understanding of the material and their level of motivation could have affected their ability to engage with the concept mapping process. Future studies should consider controlling for these factors by including baseline assessments of students' prior knowledge and motivation to better isolate the effects of concept mapping. The study also did not fully explore how missing data and outliers were handled in the analysis, and future research should provide more transparency regarding data management techniques to ensure robust and reliable results. The study only examined the immediate effects of the concept mapping intervention, which limits our understanding of its long-term benefits. It would be valuable for future studies to explore long-term knowledge retention and the ability to apply learned concepts over time, as this would offer a more complete picture of the effectiveness of concept mapping in nursing education (Ghezzi et al. 2021).

Finally, while this study offers important insights into the cognitive mechanisms that make concept mapping effective, further qualitative research is needed to explore these processes in more detail. Future studies could investigate how students' cognitive engagement and memory retention are influenced by the process of creating concept maps, providing a deeper understanding of the underlying mechanisms that contribute to its success as a learning tool.

6. Conclusion

This study contributes to the growing body of evidence supporting the effectiveness of concept mapping as an active learning strategy in health profession education. The findings demonstrate that concept mapping enhances students' comprehension, memory, and application of knowledge, particularly in clinical decision-making and critical thinking. Given its positive impact on learning outcomes, concept mapping should be incorporated into nursing curricula as part of a hybrid teaching approach that combines traditional lectures with active learning techniques. This will not only improve students' memory recall but also prepare them for the demands of clinical practice. Future research should address the limitations of this study by using larger, more diverse samples and controlling for covariates like prior knowledge and motivation. By doing so, we can better understand the full potential of concept mapping in nursing education and its role in preparing students for a successful career in healthcare.

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Ethical Statement

Compliance with ethical guidelines Before the study, official permission was granted by the Institutional Ethics Committee, Uttar Pradesh, University of Medical Sciences. The protocol received ethical approval from the Institutional Review Board Services (IRB) as UPUMS/NSG/295/17-18, College of Nursing Ethics Committee, Uttar Pradesh, University of Medical Sciences, Etawah. Informed consent was obtained from all participants, explaining the study's purpose, procedures, and their right to confidentiality and they were assured of the confidentiality of their information.

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Conflicts of Interest

The authors declare that they have no conflicts of interest in this work.

Author Contribution Statement

Data collection: All authors; Writing the original draft, review, and editing: Shashi Prakash, Biji Biju; Conceptualization, study design, data analysis, data interpretation, and final approval: All authors.

Data Availability Statement

Not applicable.

References

1. Anantharaman, L. T., Shankar, N., Rao, M., Pauline, M., Nithyanandam, S., Lewin, S., & Stephen, J. (2019). Effect of two-month problem-based learning course on self-directed and conceptual learning among second-year students in an Indian health profession college. *Journal of Clinical and Diagnostic Research*, 13(5), 5–10. https://doi.org/10.7860/JCDR/2019/40969.12874
2. Ausubel, D. P. (2000). The acquisition and retention of knowledge: A cognitive view. Kluwer Academic. https://doi.org/10.1007/978-94-015-9454-7
3. Ben-Haddour, M., Roussel, M., & Demeester, A. (2022). Etude Exploratoire De L'Utilisation Des Cartes Conceptuelles Pour Le Développement Du Raisonnement Clinique Des Étudiants De Deuxième Cycle En Stage Dans Un Service D'Urgence. *Annales Françaises de Médecine d'Urgence*, 12(5), 285–293. https://doi.org/10.3166/afmu-2022-0423
4. Bixler, G. M., Brown, A., Way, D., Ledford, C., & Mahan, J. D. (2015). Collaborative concept mapping and critical thinking in fourth-year health profession students. *Clinical Pediatrics*, 54(9), 833–839. https://doi.org/10.1177/0009922815590223
5. Brondfield, S., Seol, A., Hyland, K., Teherani, A., & Hsu, G. (2021). Integrating concept maps into a health profession student oncology curriculum. Journal of Cancer Education, 36(1), 85–91. https://doi.org/10.1007/s13187-019-01601-7
6. Daley, B. J., Durning, S. J., & Torre, D. M. (2016). Using concept maps to create meaningful learning in health profession education. MedEdPublish, 5(1), 19. https://doi.org/10.15694/mep.2016.000019
7. Fonseca, M., Oliveira, B., Carreiro-Martins, P., Neuparth, N., & Rendas, A. (2020). Revisiting the role of concept mapping in teaching and learning pathophysiology for health profession students. Advances in Physiology Education, 44(3), 475–481. https://doi.org/10.1152/advan.00020.2020
8. Kinchin, I. M. & King's College London. (2008). THE QUALITATIVE ANALYSIS OF CONCEPT MAPS: SOME UNFORESEEN CONSEQENCES AND EMERGING OPPORTUNITIES. In Proc. Of the Third Int. Conference on Concept Mapping. https://cmc.ihmc.us/cmc2008papers/cmc2008-p500.pdf
9. Novak, J. D. (2003). The promise of new ideas and new technology for improving teaching and learning. Cell Biology Education, 2(2), 122–132. https://doi.org/10.1187/cbe.02-11-0059
10. Novak, J. D., & Cañas, A. J. (2008). The theory underlying concept maps and how to construct and use them. Technical Report IHMC CmapTools. Retrieved from https://cmap.ihmc.us/docs/theory-of-concept-maps
11. Piaget, J. (1976). The grasp of consciousness: Action and concept in the young child (pp. 124–130). Routledge. ISBN: 978-0415254585
12. Schunk, D. H. (2020). Learning theories: An educational perspective (8th ed., p. 80). Pearson.
13. Torre, D. M., Daley, B. J., Picho, K., & Durning, S. J. (2017). Group concept mapping: An approach to explore group knowledge organization and collaborative learning in senior health profession students. Health profession Teacher, 39(10), 1051–1056. https://doi.org/10.1080/0142159X.2017.1342030
14. Torre, D. M., Durning, S. J., & Daley, B. J. (2017). Concept maps: Definition, structure, and scoring. Academic Medicine, 92(12), 1802–1802. https://doi.org/10.1097/ACM.0000000000001969
15. Vygotsky, L. S. (2021). Mind in society: The development of higher psychological processes (p. 45). Harvard University Press.
16. World Health Organization (WHO). (2021). Dengue and severe dengue. Retrieved from https://www.who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue
17. Novak, J. D. (2019). Learning, creating, and using knowledge: Concept maps as facilitative tools in schools and corporations (2nd ed., p. 15). Routledge.
18. Biggs, J., & Tang, C. (2019). Teaching for quality learning at university (5th ed., p. 72). Open University Press.
19. Prince, M. (2004). Does active learning work? A review of the research. Journal of Engineering Education, 93(3), 223-231. DOI: 10.1002/j.2168-9830.2004.tb00809.x
20. Fink, L. D. (2013). Creating significant learning experiences: An integrated approach to designing college courses (p. 72). Jossey-Bass.
21. Walvekar, P., Baliga, S., & Mahantshetti, G. (2021). Concept map as a teaching and learning tool for health profession students. Journal of Education and Health Promotion, 10(1), 35. https://doi.org/10.4103/jehp.jehp_146_20
22. Torre, D., German, D., Daley, B., & Taylor, D. (2023). Concept mapping: An aid to teaching and learning: AMEE Guide No. 157. Health profession Teacher, 45(5), 455–463. https://doi.org/10.1080/0142159x.2023.2182176

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23. Radwan, A., Nasser, A. A., Araby, S. E., & Talaat, W. (2019). Correlation between Assessment of Concept Maps Construction and the Clinical Reasoning Ability of Final Year Health profession Students at the Faculty of Medicine, Suez Canal University, Egypt. Education in Medicine Journal, 10(4), 43–51. https://doi.org/10.21315/eimj2018.10.4.5
24. Nicolaou, N., Loizou, S., Papageorgiou, A., Pincus, B. A., & McCrorie, P. (2022). Concept maps as a novel assessment tool in health profession education. MedEdPublish, 12, 21. https://doi.org/10.12688/mep.19036.3
25. Choudhari, S. G., Gaidhane, A. M., Desai, P., Srivastava, T., Mishra, V., & Zahiruddin, S. Q. (2021). Applying visual mapping techniques to promote learning in community-based health profession education activities. BMC Health profession Education, 21(1). https://doi.org/10.1186/s12909-021-02646-3
26. Choudry, A., Shukr, I., & Sabir, S. (2019, October 23). DO CONCEPT MAPS ENHANCE DEEP LEARNING IN HEALTH PROFESSION STUDENTS STUDYING PUBERTY DISORDERS? https://pafmj.org/PAFMJ/article/view/3395
27. Brentnall, J., Thackray, D., & Judd, B. (2022). Evaluating the clinical reasoning of student health professionals in placement and simulation settings: A Systematic review. International Journal of Environmental Research and Public Health, 19(2), 936. https://doi.org/10.3390/ijerph19020936
28. Innis, J., Johnston, S., & Cambly, E. (2024). Concept Mapping in Simulation within Nursing Education: A Scoping Literature Review. Teaching and Learning in Nursing, 19(3), e518–e525. https://doi.org/10.1016/j.teln.2024.03.004
29. Dehghanzadeh, S., & Moaddab, F. (2021). The effect of concept mapping on nursing students' critical thinking skills and nursing care plan design. Research in Health profession Education, 13(2), 26–35. https://doi.org/10.52547/rme.13.2.26
30. Sieben, J. M., Heeneman, S., Verheggen, M. M., & Driessen, E. W. (2020). Can concept mapping support the quality of reflections made by undergraduate medical students? A mixed method study. Medical Teacher, 43(4), 388–396. https://doi.org/10.1080/0142159x.2020.1834081
31. Maryam, N. A., Mohammadreza, N. D., Abdolhussein, N. S., Ghobad, N. R., & Javad, N. K. (2021). Effect of concept mapping education on critical thinking skills of medical students: a quasi-experimental study. Ethiopian Journal of Health Sciences, 31(2). https://doi.org/10.4314/ejhs.v31i2.24
32. Slieman, T. A., & Camarata, T. (2019). Case-Based group learning using concept maps to achieve multiple educational objectives and behavioral outcomes. Journal of Medical Education and Curricular Development, 6. https://doi.org/10.1177/2382120519872510
33. Sannathimmappa, M. B., Nambiar, V., & Aravindakshan, R. (2022). Concept maps in immunology: A metacognitive tool to promote collaborative and meaningful learning among undergraduate medical students. PubMed, 10(3), 172–178. https://doi.org/10.30476/jamp.2022.94275.1576
34. Alfayoumi I. The impact of combining concept-based learning and concept-mapping pedagogies on nursing students' clinical reasoning abilities. Nurse Educ Today. 2019 Jan;72:40-46. doi: https://doi.org/10.1016/j.nedt.2018.10.009. Epub 2018 Nov 6. PMID: 30419419.
35. Innis, J., Johnston, S., & Cambly, E. (2024). Concept Mapping in Simulation within Nursing Education: A Scoping Literature Review. Teaching and Learning in Nursing, 19(3), e518–e525. https://doi.org/10.1016/j.teln.2024.03.004
36. Ghezzi JFSA, Higa EFR, Lemes MA, Marin MJS. Strategies of active learning methodologies in nursing education: an integrative literature review. Rev Bras Enferm. 2021 Mar 24;74(1):e20200130. English, Portuguese. doi: https://doi.org/10.1590/0034-7167-2020-0130. PMID: 33787786.
37. SadatHoseini, A., Shareinia, H., Pashaeypoor, S., & Mohammadi, M. (2023). A cross-cultural concept analysis of healing in nursing: a hybrid model. BMC Nursing, 22(1). https://doi.org/10.1186/s12912-023-01404-8

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