# Impact of Mind Mapping on Pediatric Nurses' Performance regarding Peripherally Inserted Central Catheters at Neonatal Intensive Care Units

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Abstract

Background: An essential tool commonly used in neonatal intensive care units for critically ill neonates in need of ongoing monitoring and resuscitation treatments is a peripherally inserted central catheter. One active learning strategy that enhances learning, increases cognitive function and improves memory recall is the mind map. Aim: To evaluate the impact of mind mapping on pediatric nurses' performance regarding peripherally inserted central catheters at neonatal intensive care units. **Design**: To achieve this study's goal, a quasi-experimental research approach was employed. Setting: The study was conducted in neonatal intensive care units, at Sohag University Hospitals. Subjects: The study included all available nurses (50) working in Neonatal intensive care units in the abovementioned study setting. Tools: Three tools were used for data collection: Tool (I): A structured interviewing questionnaire which consisted of two parts; part (1) demographic characteristics of the nurses; and part (2) nurses' opinion regarding the utilization of the mind mapping method in training. Tool (II): Nurses' knowledge about peripherally inserted central catheters and mind mapping method (pre/post), Tool (III): Observational checklist (pre/post). Results: There was a highly statistically significant difference between total knowledge of mind mapping and pediatric nurses' performance regarding peripherally inserted central catheters. Conclusion: The present investigation found that the mind mapping technique improved the performance of pediatric nurses with peripherally inserted central catheters in neonatal intensive care units. Recommendations: According to the study, for pediatric nurse education and training, mind mapping ought to be employed as a teaching method.

Keywords: Mind mapping, Neonatal intensive care units, Pediatric nurses' performance, Peripheral inserted central catheters.

#### Introduction:

An intravenous device called a peripherally inserted central catheter (PICC) is inserted into the central veins through the peripheral veins. It is frequently used for frequent blood draws, long-term intravenous therapy, and the administration of blood and nutrition (Indarwati et al., 2022). Neonatal intensive care units (NICUs) commonly use peripherally inserted central catheters (PICCs) for critically ill neonates, who typically have hemodynamic instability and require ongoing monitoring and resuscitation care. PICCs are essential for improving the care of newborns admitted to the intensive care unit (NICU), especially those who are preterm and critically ill. PICCs are one way to achieve adequate nutrition, hydration, and medical support (Li et al., 2019). Central venous access devices (CVADs) include the sophisticated peripherally inserted central catheter. Using the median, cephalic, or basilic veins, the most typical insertion site is above the antecubital region. The superior vena cava is where the catheter is inserted, either with or without a guide wire. Using ultrasound guidance to place PICCs has emerged as the gold standard for pre-use verification (**Page et al., 2018**).

One of the most widely used techniques in NICUs is the peripherally inserted central catheter. Because infant mortality and co-morbidity directly affect critically ill neonates, it is a crucial life-saving intervention (Mingkun et al., 2019). Although parenteral

nutrition was the initial purpose of peripherally central catheters, their uses have since grown to include frequent blood draws, chemotherapy, antibiotic treatment, and prolonged dehydration (**Khieosanuk et al., 2022**). By reducing the frequent negative effects of small peripheral catheters, such as thrombosis, blockage, and leakage, it also makes it possible to safely infuse drugs with high osmolality or nonphysiological acidity. In the hospital ward, insertions can also be performed. PICCs are comfortable, provide long-term intravascular access, facilitate a seamless transition to home care, and are fairly priced (**Issa et al., 2018**).

According to Bhargava et al. (2020), the peripherally placed central catheter device should be chosen based on the evaluation of the neonates' clinical status and the planned increased treatment plan. An risk of complications such as sepsis, embolism, thrombosis. central line-associated and bloodstream infection (CLABSI)

are linked to PICCs, even though they are generally regarded as safe devices. These complications ultimately result in a longer hospital stay and higher hospital expenses (**Moureau & Chopra, 2019**). Problems that would postpone medication administration and blood collection caused about 30% of PICCs to fail before treatment was completed. Therefore, in addition to knowing the procedure, professionals must also master the technical procedure (**Sudprasert et al., 2019**).

Mind mapping and concept mapping are learning strategies that show promise in the context of medical education, according to the constructivist theory of learning. A visual diagram known as a "mind map" is used to record and arrange data in a manner akin to how our brains process memories. Tony Buzan created it in the 1970s. By motivating students to absorb knowledge, comprehend difficult concepts, and identify connections between the basic and clinical sciences, mind mapping can be used as a teaching tool to promote critical thinking (**Indarwati et al., 2022**).

"It is a successful visual aid for enhancing comprehension and thinking clarity. Additionally, it is regarded as a multimodal tool that can help medical students consolidate, integrate, and retain information. In a nonlinear format, mind mapping is a graphic illustration approach that uses words, images, colors, and branches that branch out from a main idea to reveal more precise information and relationships. It highlights the use of images and diagrams to improve memory and foster knowledge. This method improves how relationships and connections between ideas are visualized, which helps with learning and remembering information (Phenwan & Tawanwongsri, 2018; Rosciano, 2020).



#### (Buzan and Buzan (2010): http://www.mindmap, example.com/samples.php)

Buzan provides the following seven steps for creating a mind map: 1) Begin in the middle of a sideways-flipped blank page. 2. Use a picture or image to symbolize the main idea. 3) Make use of color throughout. 4. Attach your secondand third-level branches to the first and second

levels, and attach the main branches to the central image. 5. Curve the branches instead of making them straight. 6. Each line should contain one keyword. 7. Make use of pictures throughout. A useful learning tool for studying, summarizing, remembering, and recalling scientific material is mind mapping, which is a straightforward method of illustrating information in diagrams rather than writing it down in sentences. In addition, mind mapping has gained popularity recently as a tool for memory-improving educational materials. Consequently, the researchers aimed to assess how mind mapping affected the performance of pediatric nurses with peripherally implanted central catheters in neonatal intensive care units (Buzan, 2012; Deka et al., 2019; A Abdel Hamid, 2020)

## Significance of the study:

The prognosis, length of hospital stay, and expenses of critically ill neonates are impacted by several complications that arise from improper PICC care in the NICU, including occlusion. infection. leakage. phlebitis. displacement, pleural effusion, and breaks (Emampholi, 2020). Understanding PICC procedures and results in adults has also advanced significantly, but knowledge of pediatric and neonatal populations has lagged. This results in knowledge gaps about how to care for the smallest and most vulnerable newborns (Bowden & Greenberg, 2019). Recently nurses forced to develop their knowledge and practice by thinking critically, being more working hard in NICU to implement peripherally inserted central catheters so, they need active teaching techniques to develop effective learning that can be achieved by using the mind mapping strategy (A Abdel Hamid, 2020; Deka; 2019). So, this study focused on evaluating the impact of mind mapping on pediatric nurses' performance regarding peripherally inserted central catheters at neonatal intensive care units

#### Aim of the study

The study aimed to evaluate the impact of mind mapping on pediatric nurses' performance regarding peripherally inserted central catheters at neonatal intensive care units.

## **Research hypothesis:**

The use of mind mapping will assist nurses in NICUs in enhancing the performance of their peripherally inserted central catheters.

## Subjects and Method:

#### **Research design:**

This study's goal was accomplished through the use of a quasi-experimental research design.

#### Settings:

The study was conducted in in Neonatal Intensive Care Unit, at Sohag University Hospital.

# Sample:

A convenient sample composed of 50 nurses was included in the study from the previously mentioned settings. They were divided into subgroups of about 4 to 6 nurses.

## Tools of the study:

Three tools were used for data collection:

# Tool (1): A structured Interviewing Questionnaire:

The researchers created it following a review of relevant national and international literature. The two components of this tool were as follows:

Part 1: Data on the demographics of pediatric nurses, such as age, gender, education, and years of experience, were included in this part.

Part 2: This part sought to evaluate the opinions of pediatric nurses regarding peripherally inserted central catheters following the use of the mind mapping strategy in the training, as well as the pediatric nurses' understanding of mind mapping following a lecture on the new teaching method and its potential applications in peripherally inserted central catheter training, prior use of mind mapping in training, and preferred use of mind mapping in training (Buzan, 2012, A Abdel Hamid, 2020)

#### Scoring system:

• One for excellent, two for very good, three for good, four for accepted, and five for not accepted is the nurse's assessment following the use of mind mapping to explain infection control.

• Previously, mind mapping was used in training; it received a score of 1 for yes and 0 for no.

A 1 indicates yes, and a 0 indicates no, indicating a preference for mind mapping in training.

Tool Nurses' knowledge **(II)**: about peripherally inserted central catheters and mind mapping method (pre/post): After examining relevant national and international literature, the researcher created it (Sudprasert et al., 2019). To evaluate the nurses' understanding of peripherally inserted central catheters (PICs) for neonates, a multiple-choice questionnaire was included, with questions about the procedure both before and after a month. One of the tasks was to define PICCs, along with their purpose, indications, most insertion sites, common and potential complications (10 questions).

2. Prior PICC preparation and evaluation (5 questions).

3. The role of the nurse in PICC care (10 questions).

4. The nurse's responsibility is to avoid PICC complications (5 questions).

## Scorings system

Every right response was worth one point, while every wrong response was worth zero. Two categories were created from the total score for peripherally inserted central catheter knowledge: satisfactory ( $\geq$ 70%) and unsatisfactory (< 70%).

Tool III: Observational Checklist for peripheral central catheter (pre/post-test). This tool was adapted from Bowden & Greenberg (2016) and Emamgholi et al. (2020). Nurses' practices with regard to PICCs were evaluated using the observation checklist, which included six items for assessing and preparing neonates, thirteen items for changing dressings, ten items for flushing PICCs, and eleven items for IV fluids and medications.

#### Scoring system

Every item on the observational checklist used in the nursing practice scoring system was assigned a score between 0 and 1. When completed correctly and completely, the score was (1); when incomplete or not completed, the score was (0). Alfar et al., (2020) divided all nursing practices into two groups: competent and incompetent. A score of less than 70% was considered incompetent practice, and a score of more than 70% was considered competent practice.

## Validity of the tools

Content validity of the tools for clarity, comprehensiveness, appropriateness, and relevance by a board of five expert professors in Neonatology and five expert professors in pediatric nursing with more than ten years of experience in the fields were assessed; the board ascertained the face and content validity of the tools.

## **Reliability of the tools**

Reliability was assessed through Cronbach's alpha reliability test  $\alpha$ =, 886% which revealed that the first tool, consisted of relatively homogenous items as indicated by high reliability, and  $\alpha$ =, 893% which revealed the reliability of the second tool.

#### A pilot study

A pilot study was done on 10% of the sample once the tool was developed (5 nurses). It was done to detect any ambiguity in the tools, verify item transparency, and establish the time required for data gathering. The results of the pilot study were used to develop the final form of the tools, which included the clarification and testing of the practicality of the research process. Nurses included in the pilot study were excluded from the study to prevent sample contamination.

## Administrative and ethical considerations:

Official permission to carry out the study was obtained from the research ethics committee at Sohag University and through an issued letter from the Dean of Faculty of Nursing, Sohag University to conduct this

study. Before beginning the questionnaire, the researcher told the nurses that the study was optional and that they had the right to decline participation at any time and to leave the study at any moment without providing a reason. The nurses' oral consent was acquired. They were also assured that the information they provided would be kept confidential and used only for research.

#### Fieldwork:

The Sohag University Hospital's director gave his approval. From the start of June 2023 to the end of November 2023, the study was carried out. The researchers greeted each nurse, introduced themselves, and described the purpose and nature of the study before beginning the interview, which took place two days a week from 9:00 a.m. to 12:00 p.m.

Phases of the research: The following four stages were used to carry out the study:

## **I-Assessment Phase**

Prior to completing the application, each nurse was interviewed in order to gather information about their characteristics using a tool (I) part (1).

Utilizing tool (I) part (2), tool II, and tool III, nurses' knowledge, practice, and opinions regarding infection control precautions using the mind mapping strategy were evaluated.

## II. Planning phase:

Based on the results of the previous phase, the goals, priorities, and expected results were established to address the practical requirements and knowledge gaps of the nurses regarding the peripherally inserted central catheter procedure in NICUs.

The researchers organized five sessions (two practical and three theoretical) for the nurses under study to give them practice and information on the peripherally inserted central catheter procedure in NICUs.

## III. Implementation phase:

- Five sessions—three theoretical and two practical—with a duration of approximately 30 to 45 minutes each

- were used to implement the mind mapping strategy with the goal of improving nurses' understanding and practice of the peripherally inserted central catheter procedure in NICUs.
- The researchers began by gathering input regarding the previous session at the start of each one, and they provided a summary at the conclusion.
- The researchers were accessible in the study area from 9 a.m. to 12 p.m., two days a week. The study tools mentioned above were used to conduct individual interviews with each nurse.
- \_ \_
- The nurses under study were split up into smaller groups, each consisting of 4-6 nurses.
- After reviewing the relevant literature and assessing the actual needs of the nurses under study, a simplified booklet covering all aspects of knowledge and practice regarding the peripherally inserted central catheter procedure at NICUs was provided to nurses in Arabic as supportive material.
- There are a variety of teaching techniques that can be used with the mind mapping method, including lectures, small group discussions, brainstorming, pictures, demonstrations, and re-demonstration. A variety of instructional resources were used, including PowerPoint, handouts, figures, flipcharts, and illustrated videos that explained the process of peripherally inserted central catheters.

The following is how the theoretical and practical sessions were conducted:

First session (theoretical): The researchers gave a brief introduction, greeted the nurses, thanked them for participating in the study, and went over the goals of these training sessions. The definition, purpose, indications, most common insertion sites, and complications of PICCs were all covered in the first session. The second session, which was theoretical, addressed topics about the nurse's role in PICC care and in preventing PICC complications.

The third session, which was theoretical in nature, covered topics such as what a mind map is, what materials are needed to use one, how mind mapping can be used to train procedures involving peripherally inserted central catheters, and the benefits of mental mapping.

The fourth session, which was practical, involved clinical demonstrations and redemonstrations of the PICC procedure by one of the studied nurses. The process of peripherally inserted central catheters was explained in these mind-mapping sessions.

During the fifth practical session, the researcher began by soliciting feedback regarding the previous sessions and answering any questions regarding the procedure of peripherally inserted central catheters. The researcher then thanked all of the participant nurses for their participation in the study.

#### **IV-Evaluation phase:**

During this phase, the researchers used the same pretest tools and observational checklist to assess the effectiveness of the mind mapping that was used to enhance nurses' knowledge and practice regarding the peripherally inserted central catheter procedure at NICUs.

## Statistical Design:

After coding, the gathered data was loaded into SPSS Version 23.00, a statistical program for social science. Quality control was done during the coding and data entry phases. Frequencies and percentages were employed as descriptive statistics for categorical variables, while means and standard deviations were employed for continuous quantitative variables. With the assumption that the row and column variables are independent, the chi-square (X2) test was utilized to compare qualitative category data, but it did not disclose the strength or direction of the relationship. Qualitative variables were compared using the F, T, and chi-square tests. When the difference was p0.001 and the P- value was less than 0.05, statistical significance was assessed.

## **Results:**

**Table 1** indicates that 70% of the nurses in the study were female, and over half (58%) were under 30 years old, with a mean age of  $27.5 \pm 4.3$ . Seventy percent of the nurses in the study had technical nursing credentials. More than half of them (52%) had between five and fifteen years of experience.

According to Figure 1, approximately half (44%) of the nurses in the study expressed positive opinions about the peripherally inserted central catheter procedure following the use of mind maps in training, while only 4% thought it was unacceptable.

Figure (2) makes it clear that every nurse in the study (100%) said they had never used a mind map in their prior training.

The majority of the nurses in the study (90%) favored using mind maps during training, as shown in **Figure (3**).

A highly statistically significant improvement in nurses' knowledge was observed one month before and after the mind mapping application (P<0.001), as shown in **Table (2)**.

Table (3) demonstrates that nurses' pre- and post-application knowledge of mind mapping strategies differed in a highly statistically significant way (P<0.001). Additionally, the same table showed a highly significant improvement in the mean total knowledge score on the post-test (F=30.7, p<0.000).

**Figure 4** demonstrates that while 94% of the nurses in the study had inadequate knowledge of the pretest, 96% of them had satisfactory knowledge after using mind mapping.

According to Table 4, there was a highly significant improvement in the level of practice

and the application of all principles in the various nursing tasks related to the peripherally inserted central catheter procedure before and after the mind mapping application ( $p \le 0.001$ ).

According to **Figure (5)**, 42% of the nurses in the NICU had incompetent practice with peripherally inserted central catheters; this percentage dropped to 6% following the application. However, before the use of the mind map, 58% of the nurses in the study practiced competently; following the application, 94% of nurses saw a statistically significant improvement in their practice scores. The correlation between nurses' knowledge and practice scores before and after mind mapping was displayed in **Table 5**; there was a statistically significant positive correlation between the knowledge and practice scores (p <0.05).

# Table (1): Demographic characteristics of the studied nurses (N = 50)

Demographic characteristics	N0.	%		
Age (Years)				
$\leq$ 30 years	29	58.0		
>30years	21	42.0		
Mean $\pm$ SD	27.5 ± 4.3			
Gender:				
Male	15	30.0		
Female	35	70.0		
Qualification:				
Technical	35	70.0		
High qualified nurse	15	30.0		
Years of experience:				
$\leq$ 5 years	13	26.0		
5–15 years	26	52.0		
15 - ≥ 25 years	11	22.0		



Figure 1: Nurses' opinion after application of mind maps in training, regarding peripherally inserted central catheters procedure (N=50)



Figure 2: The studied nurses' opinion distribution regarding the previous application of mind maps in training (N=50)



Figure 3: Nurses' opinion distribution regarding preferring application of mind maps in training (N=50)

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Table (2): Nurses' knowledge score about the peripherally inserted central catheters procedure pre and post-mind mapping application (N = 50)

Nurses' knowledge regarding peripherally inserted central catheters	Pre ma appl	Pre-mindPost-mindmappingmappingapplicationapplication		Post-mind mapping application		Post-mind mapping application		P-value
	No	%	No	%				
Definition - Correct - Incorrect	30 20	60.0 40.0	50 0	100 0.0	99.5	<0.001**		
Indications						< 0.001**		
- Correct - Incorrect	24 26	48.0 52.0	46 4	92.0 8.0	88.6			
Insertion sites						< 0.001**		
- Correct - Incorrect	26 24	52.0 48.0	45 5	90.0 10.0	77.8			
Preparation and assessment			-			< 0.001**		
- Correct - Incorrect	22 28	44.0 56.0	47.0 3.0	94 6.0	78.4			
Role of the nurse during						< 0.001**		
insertion								
- Correct	19	38.0	46	92.0	67.9			
- Incorrect	31	62.0	4	8.0				
The role of the nurse is to						<0.001**		
<ul> <li>prevent complications</li> <li>Correct</li> <li>Incorrect</li> </ul>	28 22	56.0 44.0	47 3	94.0 6.0	94.6			

(\*\*) highly statistical significance at p < 0.001

Table (3): Mean score Differences between the studied nurses according to their knowledge about mind mapping strategy pre and post-application (N = 50)

Nurses' knowledge of mind mapping	Pre-mind mapping application		Post-mind mapping application		X2	P-
	No	%	No	%		value
Mean Knowledgetotal score	6.5±2.3		10.3±1.5		F=30.7 P=0.000HS	



Figure (4): Total knowledge level of the studied nurses pre and post-mind mapping application (N = 50)

Table (4): Differences in the nurses'	practice regarding peripherally	y inserted central catheters
pre and post-mind mapping applicati	on (n=50)	

Nurses' practice	Pre-mind mapping application		Post-mind mapping application							
Frank Pranting	Not	done	ne Done		Not done		Done		F	P
	No	%	No	%	No	%	No	%		
Assessment and preparation	23	46.0	27	54.0	0	0.0	50	100.0	123.33	0.000**
Dressing change	26	52.0	24	48.0	2	4.0	48	96.0	115.12	0.000**
Flushing	32	64.0	18	36.0	1	2.0	49	98.0	116.44	0.000**
IV fluids and medications	33	66.0	17	34.0	2	4.0	48	96.0	99.22	0.000**

(\*\*) Highly significant at P<0.001



Figure (5): Total practices level the studied nurses about the peripherally inserted central catheters procedure pre and post-mind mapping application, (N = 50)

Table (5): Correlation Co-efficient between the knowledge scor	res and practice scores pre
and post-application of mind mapping	

Practice scores				
R	Р			
0.165	0.379			
0.362	0.047*			
	Practice scores R 0.165 0.362			

Correlation is significant at the 0.05 level\*\*.

#### **Discussion:**

In intensive care units (NICUs), peripherally inserted central catheters are used to provide feeding and long-term medication to newborns (Sharpe et al., 2020). Peripherally implanted central catheters are becoming more and more necessary to provide parenteral nutrition, intravenous fluids, and medications as more critically ill and extremely low birth weight neonates survive (Chopra et al., 2019). This implies that nurses are always challenged to improve the way they provide safe and reliable vascular access to neonates who are at risk (Nobre et al., 2019). Because nurses in NICUs must constantly receive educational training to comprehend and apply the peripherally inserted central catheter procedure when providing nursing care, mind mapping is used as a teaching tool to help nurses integrate information and comprehend the connection between clinical skills and basic knowledge. The purpose of this study was to evaluate the impact of mind mapping on pediatric nurses' performance regarding peripherally inserted central catheter procedures at neonatal intensive care units.

According to the study's findings, the majority of the nurses were female, and over half were under 30 years old, with a mean age of  $27.5 \pm$ 4.3. The study "Impact of Structured Education on knowledge and practice regarding venous access device care among nurses," which was carried out in India by **Deshmukh and Shinde** s(2024), also revealed that most of the participants were female and between the ages of 21 and 30. The results of this study are in line with those of **Se & LS (2019)**, who discovered that nurses between the ages of 21 and 26.

Additionally, in the study "Nurses' information regarding peripheral central catheter nursing care and its impacts on keeping it patent, China: a cross-sectional survey," **Xu et al. (2020)** found that the group's average age was 25.

**Belal et al. (2019)** found that all of the nurses in their study who worked in the NICU were female, which contrasts with these findings.

In terms of the nurses' qualifications, fewer than three-quarters were technical nurses. The majority of the participants had the same level of nursing education, according to Se & LS (2019), which was in conflict with these findings. It may help to clarify the results of this study that nursing was previously only offered to girls in Egyptian institutions until a few years ago; this fact may explain the high number of females.

Regarding years of experience, it was discovered that over half of the nurses in the study had worked in the NICU for more than five and less than fifteen years. This was consistent with the findings of another study by Ibeid et al. (2021), which showed that twofifths of the nurses in the study had six to fourteen years of experience. The majority of the participants had less than five years of clinical experience, according to Deshmukh and Shinde (2024), which contradicted the results. Not in Likewise, Issa et al. (2018) found in their study, of the nurses under investigation, almost one-third had one to five years of experience. Additionally, over half of the participants had one to five years of experience, according to Mohammed & Abdel Fattah (2018).

According to the results of the current study, none of the nurses who were surveyed had ever used mind maps in their prior training. The researchers claim that this proved that mind mapping is a useful tool in nursing education.

When mind maps were used in training for the peripherally inserted central catheter procedure, almost half of the nurses in the study expressed excellent opinions, according to the current study. **Wu & Wu (2020)**, who conducted a study to ascertain the effect of mind mapping on clinical nursing students' critical thinking skills and its use as a teaching tool, found that the majority of nursing students enjoyed learning mind mapping and were willing to use it in their work. This finding was consistent with the current findings.

. Additionally, Atia G (2019) supported the current findings by reporting that, in a study titled "Effectiveness of Mind Maps as a Learning Tool for Nursing Students," students had a high degree of satisfaction and a favorable opinion of mind mapping as a teaching method. The researchers claim that this highlights the significance of the study and the benefits of employing a mind-mapping technique in this investigation. Since mind maps are especially rich in pictures, drawings, and shapes with a variety of eye-catching colors, they are considered the best tool for learning and retention. The brain has an innate sensitivity to symbols and images, and 90% of its inputs are visual has a significant influence on concept retention.

The results of the current study showed that most nurses who were studied preferred using mind maps during training. From the perspective of the researchers, it demonstrated the advantages of using mind mapping in training.

As per the researchers, this might be the result of a shortage of nurses and outdated information regarding the process of peripherally inserted central catheters. Thus, mind mapping is a new teaching method that nurses need to use to help them retain more information, and this study validates its use.

One month before and after the mind mapping application, nurses' knowledge improved, with a highly statistically significant difference between the pre and post-study results. From the perspective of researchers, it demonstrated the effectiveness of mind mapping as a training tool that aids in knowledge enhancement. Furthermore, the results are consistent with

those of Kun et al. (2020), who discovered that the nurses' knowledge, attitude, and skills regarding PICC had improved very little before training. This suggests that the nurses' knowledge of PICC was inadequate before training, but that their knowledge of the PICC's physical structure improved significantly after training. This conclusion is further corroborated by Deshmukh and Shinde (2024), who discovered that less than half of the participants' knowledge was inadequate before the intervention and improved following the post-test. Additionally, compared to the pre-test, the post-test mean knowledge score improved.

According to the current study's findings, nurses' pre- and post-application knowledge of mind-mapping techniques differed in a highly statistically significant way. The benefits of employing mind mapping in nursing education and training regarding the procedure for peripherally inserted central catheters are demonstrated by this. In order to enhance nurses' knowledge and practice, the results of the current study backed the inclusion of mind maps in continuing education for peripherally inserted central catheter procedures.

According to the results of the current study, the majority of the nurses under investigation had unsatisfactory knowledge of the pretest, but nearly all of them had satisfactory knowledge after using mind mapping. According to a study on "Mind Maps as a Novel Teaching Approach for medical students" by Abdel Hamid (2020), mind maps help students better organize and assimilate medical information in education. Consequently, knowledge is easier to recall. According to the researchers, mind mapping's use of various images and colors helps information move from short-term to long-term memory, enhances recall, speeds up access to information, and ultimately boosts creativity. (Antonio, 2019)

Confirming earlier research by Chin, (2019), who investigated and came to the conclusion that mind maps made it simpler for cancer patients to categorize and arrange information visually by combining words and images.

The findings of a study titled "Use of technology-assisted techniques of mind mapping and concept mapping in science education: a constructivist study" were contradicted by Balim (2023), who found that students who used the technology-assisted technique of concept mapping expressed favorable opinions and said that learning through concept maps was more beneficial and interesting than learning through the technology-assisted technique mind of mapping.

According to the findings of the current study, there was a highly statistically significant improvement in the level of practices and the application of all principles in multiple nursing tasks in the NICU about the procedure for peripherally inserted central catheters before and after mind mapping. According to the researcher, it is essential to enhance nurses' abilities to meet the unique needs of neonates when using peripheral vein catheters, which will subsequently lower the incidence of adverse events during hospitalization and demonstrate the efficacy of simulated-based education implementation before, right after, and two months after." This result is in line with **Woody and Davis's (2019)** study, which concluded that PICC insertion and maintenance are critical nursing skills that all practicing nurses need to develop.

About the practical level of the nurses, the current study found that before the use of mind mapping, over two-fifths of the nurses practiced incompetently in the NICU. Additionally, following the use of mind mapping, the majority of the nurses in the study demonstrated competent practices. In the same vein, **Hus et al. (2020)** found that in a comparative study, mean nursing competency scores in both groups increased significantly from the pre-test to the post-test.

The current findings are consistent with Ibeid et al. (2021), who reported that all nurses in the study had satisfactory levels of practice following the implementation of a teaching program using mind maps. This shows how effective mind maps are at improving nurses' knowledge and, in turn, their performance regarding the procedure of peripherally inserted central catheters. Additionally, the outcome is comparable to that of Sharpe (2023), who discovered a wide range of PICC performance in numerous PICC placement and care aspects. Additionally, this result is in line with the findings of Deshmukh and Shinde (2024), who discovered that most people performed between average on the pre-test before structured education and improved after it.

Mind maps are also useful for organizing connections and relationships between concepts and data. This facilitates the study's sample's ability to remember concepts and information for both short-term success and long-term retention. Thus, mind maps assist people with poor memory in recalling the specifics of visual images. According to Kalyanasundaram et al. (2019), it is also a

novel and efficient technique for improving memory compared to the traditional method of reading texts. The same study by Spoorthi et al. (2023) found that mind maps help students integrate information, which in turn helps them organize and retain it. Additionally, mind maps are top-notch teaching aids that improve students' capacity to connect ideas, evaluate information, and comprehend the connections between them. Alsuraihi (2022) notes that it is simpler to follow and interact with than written and spoken scripts and entails the reconstruction of visual knowledge.

The present study demonstrated that, following the use of mind mapping, there were statistically significant differences and a significant positive correlation between the knowledge and practice scores. This correlation demonstrates the relationship between increased practice and knowledge. Additionally, after acquiring adequate knowledge, the study's nurses were able to practice efficiently. The use of mind mapping was found to be more successful than traditional teaching techniques. Encouraging all parts of the brain to function in unison and starting from a central point, enhances key components of the content with codes and images of different hues and sizes, which improves recall (Spencer et al., 2023). Eshwar et al. (2019) concluded that mind mapping is a popular learning technique that enhances information organization and retrieval when needed. The findings align with the findings of Abd Elbaky's (2018) study, which discovered a favorable correlation between knowledge, overall performance, and procedural intervention after the educational program.

# **Conclusion:**

Based on the current study's findings, it can be said that the mind-mapping method improved the performance of pediatric nurses in newborn critical care units with regard to peripherally inserted central catheters.

## Recommendations

Based on the current study findings, it can be recommended that:

• The mind mapping method is a useful teaching technique for pediatric nurse

education and training.

- For both normal and preterm infants, written rules, administrative policies, and procedures pertaining to nursing measures for a peripherally implanted central catheter must be established and evaluated on a regular basis.
- Continuous education regarding the latest developments regarding peripherally implanted central catheters is advised for nurses working in the intensive care unit.
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- For the results to be generalizable, more research and replication of the current study with a broader sample of nurses in various situations are needed.

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