

## Effect of Concept Mapping Program on Pediatric Nurses' Knowledge Acquisition Regarding Congenital Heart Diseases

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### Abstract

**Background:** Understanding Congenital Heart diseases is crucial for pediatric nurses as they play a significant role in saving a child's life. Concept maps serve as effective tools to assist nurses in easily recalling these important topics, thereby aiding in informed clinical decisions for the patient's condition. **Aim:** To evaluate the effect of the concept mapping program on pediatric nurses' satisfaction and knowledge acquisition regarding congenital heart diseases. **Design:** A quasi-experimental study. **Settings:** The study was conducted in the neonatal intensive care unit, pediatric intensive care unit, and pediatric ward at Suez Canal University Hospitals. **Sampling:** A convenience sampling method was employed, consisting of 48 pediatric nurses in the pre-test group and 46 nurses in the post-test group. **Instruments:** Three instruments were employed for data collection in the study: a knowledge assessment questionnaire on concept mapping, a knowledge assessment questionnaire on congenital heart diseases, and a nurses' satisfaction questionnaire. **Results:** The total mean score for nurses' knowledge about concept maps and congenital heart diseases after implementing the program showed a statistically significant improvement ( $p < 0.01$ ). Additionally, nurses expressed high satisfaction with the training program (mean score  $48.22 \pm 1.89$ ). **Conclusion:** The study offers evidence that the effective use of concept mapping training improves pediatric nurses' understanding of congenital heart diseases and enhances their satisfaction with the implemented program. **Recommendation:** Adoption of concept mapping as an educational strategy for delivering various training programs that hold significant importance for pediatric nurses, including those related to respiratory, renal, neurological, or congenital diseases.

**Keywords:** Concept Map, Congenital Heart Diseases, Pediatric Nurses, Satisfaction.

### Introduction

Nurses face complicated difficulties and decisions that need critical thinking to assess patient needs and apply best practices. The concept map is an active technique for teaching nurses to think critically (Kaddoura, Van-Dyke, & Yang, 2016). It acts as a comprehensive key to unlock the brain's capabilities and encourage critical thought. Complex nursing education topics are extremely difficult for nurse educators to educate. Innovative techniques like concept maps can help people think critically, grasp difficult problems, make the right decisions for patient care (Ramasubramaniam, Nair, & Chaudhary 2021), enhance learners' enthusiasm and problem-

solving skills (Abd El-Hay et al., 2018; Sari et al., 2021; Wu & Wu, 2020).

A concept map visually portrays concepts as nodes and their relationships as connecting links (Schroeder et al., 2018). It takes varied forms, such as a spider/web design having a central subject surrounded by connecting words like a spider's web. Hierarchical design organizes information by significance, often in descending order. A flowchart visually represents information in a linear format. A conceptual approach is similar to a flowchart, allowing flexibility to add or remove ideas. Landscape structure presents information in a landscape-style framework. Multidirectional structure is a 3D representation

using depth to convey complex relationships. Mandalas use geometric shapes to convey information (Gomes et al., 2011).

Concept mapping is an effective tool that aids cognitive development in educators and learners. It facilitates easier comprehension of subject matter, encourages group discussions, and demonstrates positive effects on learning across various subjects and teaching environments (Kandula & Wake, 2021). It is a brainstorming approach that enables users to break down large subjects into their subtopics and related themes (Kernan, Basch, & Cadorett, 2018).

Cardiac malformations are one of the most prominent birth defects occurring in newborns and are considered an essential cause of perinatal and immediate post-natal mortality (Kovalenko et al., 2018). Congenital septal defects are the most prevailing type of congenital heart defects (CHDs) in children (Rao & Harris, 2018). CHDs can be classified into cyanotic and acyanotic (Rohit & Shrivastava, 2018). The majority of CHDs are multifactorial and occur due to a combination of non-modifiable genetic factors and other environmental causes. According to the updated reports released by the American Heart Association, Atrial Septal Defect (ASD), Ventricular Septal Defect (VSD), Tetralogy of Fallot, Patent Ductus Arteriosus, pulmonary stenosis, and aortic stenosis account for 85% of all CHDs (Meshram & Gajimwar, 2018).

An atrial septal defect is one of the most prevailing CHDs in children. These malformations allow the shunting of blood in a reversed way between the pulmonary and systemic circulations. Early diagnosis during childhood often prevents complications such as atrial dysrhythmias, Pulmonary Artery Hypertension (PAH), or right or left ventricular dysfunction (Alkashkari, Albugami, & Hijazi, 2020). Surgical closure of an ASD is a non-risky and successful operation with little or even no morbidity or mortality. Efforts to decrease the trauma that may result from the surgery are focused on current approaches targeting less or non-invasive surgical procedures rather than performing the classic intracardiac surgical repair (Liava'a & Kalfa, 2018).

Ventricular septal defect (VSD) is the most

common type of congenital heart anomaly in children. An abnormally situated opening between the right and left ventricles or shunt formation is the main form of hemodynamic compromise in VSD. Despite many VSDs closing spontaneously, large-size defects may cause devastating complications such as PAH, ventricular hypertrophy and arrhythmias (Ghosh et al., 2018; Hopkins et al., 2018 & Kenny, 2018).

### Significance of the study:

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With an approximate prevalence of 1 in every 250 live births, ventricular septal defects are the most common type of heart defects in children, and nearly 10% of heart defect cases are due to atrial septal defects, and their prevalence at birth ranges from about 1–2 in every 1000 live births. (Dakkak and Oliver, 2021), and depending on the fact that utilizing concept maps as an active learning tool presents a new approach to assist nurses in acquiring, retaining, and simplifying complex information, aiding in clinical decision-making and enhancing patient safety. Focused attention on congenital heart disease is imperative to reduce preventable child mortality in the era of sustainable development goals (Zheleva & Atwood, 2017).

### Aim of the study:

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The present study aimed to evaluate the effect of a concept mapping program on pediatric nurses' satisfaction and knowledge acquisition regarding CHDs. So, the following research hypotheses were formulated:

H0: The application of a concept mapping program has no effect on pediatric nurses' satisfaction and knowledge acquisition regarding CHDs.

H1: The application of a concept mapping program enhances pediatric nurses' knowledge acquisition concerning CHDs.

H2: The application of a concept mapping program enhances the satisfaction of pediatric nurses with the program.

**Operational definitions:**

Congenital Heart diseases: represent atrial and ventricular septal defects, which are the most prevalent forms commonly seen in pediatric patients.

Concept mapping: is a visual representation method for organizing knowledge, using circles or boxes to denote concepts and connecting lines with words to illustrate relationships between them.

**Subjects and methods:****Study type:**

A quasi-experimental design was used.

**Target population:**

Pediatric nurses in the previously mentioned setting.

**Type of sample:**

A convenience sample technique was used, which resulted in 48 nurses in the pre-test group and 46 nurses in the post-test group.

**Study setting:**

The study was carried out in neonatal intensive care unit (NICU), pediatric intensive care unit (PICU) and pediatric ward at Suez Canal University Hospitals.

**Study Instruments:**

Three instruments were used to collect data:

**Instrument I: A Knowledge Assessment Questionnaire on Concept Mapping:**

Self-administrated questionnaire that the researcher developed. It was divided into two parts as the following:

- Part 1. It was designated for gathering data about pediatric nurses, encompassing age,

department, educational level, years of experience, and attendance at prior training courses related to concept maps or CHDs.

- Part 2. It was developed based on a literature review (Abd El-Hay et al., 2018; Gomes et al., 2011) to assess the pediatric nurses' prior knowledge of concept maps regarding definition, purpose, benefits, and components, steps. It was scored as follows: one mark for each correct answer and zero for each incorrect answer or I do not know. The total test score was 15 points. Accordingly, a nurse's total knowledge level was rated poor if the total score was less than 60%, fair for 60 % to less than 75%, and good for 75% or higher.

**Instrument II: A Knowledge Assessment Questionnaire on CHDs:**

A self-administered questionnaire was developed by the researchers after reviewing the relevant literature (Lopez et al., 2018; Dakkak & Oliver, 2017; Menillo, Lee, & Pearson-Shaver, 2018) to assess pediatric nurses' knowledge and information acquisition on CHDs. The instrument, comprising a total of 16 questions, was divided into two sections. The first set of questions pertained to ASD, covering aspects such as definition, signs and symptoms, complications, and management. The second set addressed VSD, encompassing definition, signs and symptoms, complications, management, and digoxin toxicity. For each question, one mark was given for a valid response and zero for a wrong answer, or I do not know. The total test score was 16 points, with the following categories: poor if the score is less than 60%, fair if the score is between 60% and less than 75%, and good if the score is 75% or above.

**Instrument III: A Nurses' Satisfaction Questionnaire:**

The researchers developed it based on a literature review (Ahmed & Mohamed, 2019; Buldu & Buldu, 2010) to determine pediatric nurses' satisfaction with the concept mapping program. It consisted of 10 items, scored on a five-point Likert-type scale ranging from 5 for strongly agree to 1 for strongly disagree. The overall questionnaire score was 50, with the

following categories: satisfied (positive opinion) if their grade was 60% or higher, or unsatisfied (negative opinion) if their grade was less than 60%.

#### **Validity:**

A panel of five bilingual experts evaluated content and face validity to ensure instrument validity. The panel included two experts from the nursing administration department, two from the pediatric nursing department, and one from the medical-surgical nursing department. They assessed relevance, clarity, comprehensiveness, simplicity, question length, order, bias, and redundancy. Feedback from the panel guided adjustments and question removal, resulting in the final valid versions of the instruments, which the experts approved.

#### **Reliability:**

The instruments were highly reliable, as evidenced by high internal consistency coefficients. Cronbach's alpha for the Knowledge Assessment Questionnaire on Concept Mapping was 0.79, 0.86 for the Knowledge Assessment Questionnaire on CHDs, and 0.82 for the Nurses' Satisfaction Questionnaire.

#### **Pilot study:**

After the experts reviewed the instruments, a pilot study involving 10% of the total sample was conducted to assess instrument clarity applicability and identify potential data collection challenges. It also assisted in determining a time range for questionnaire completion. No modifications were made to the instruments based on the pilot study. However, the participants from the pilot study were excluded from the final sample.

#### **Fieldwork**

##### **I. Pre-Implementation of the program:**

The data collection phase took place throughout the entire month of November 2021. During this period, researchers conducted scheduled sessions with the nurses in a

dedicated training room designed for educational purposes. The room was equipped with essential tools, including a data projector for visual aids, a computer device for interactive elements, and a whiteboard to facilitate discussions and illustrate concepts. These sessions were meticulously arranged to align with the availability of the nurses and to create an optimal learning environment. The designated training room, conveniently situated in the same building as the three previously mentioned settings, accommodated nurses during their early, afternoon, and night shifts. Prior to the commencement of the program, the study's objectives were described, and informed consent was secured from the participants. Subsequently, participants within each department were divided into two groups, each consisting of 6-11 nurses, to facilitate the application of the program.

During the initial pre-test phase, study tools were distributed to the participants within the training rooms before the program implementation. Nurses' understanding of concept maps and CHDs was assessed through self-administered concept mapping knowledge assessment questionnaires and CHD knowledge assessment questionnaires, and the approximate time required to complete both questionnaires ranged from 15 to 20 minutes.

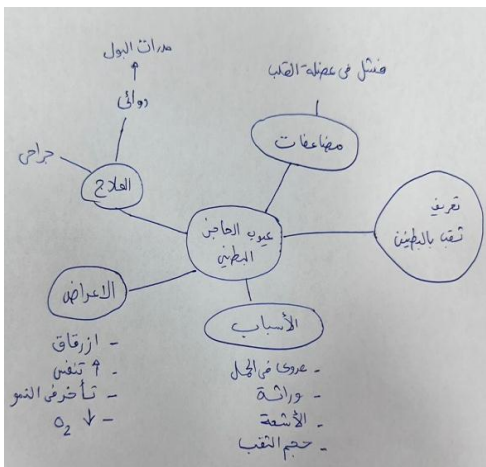
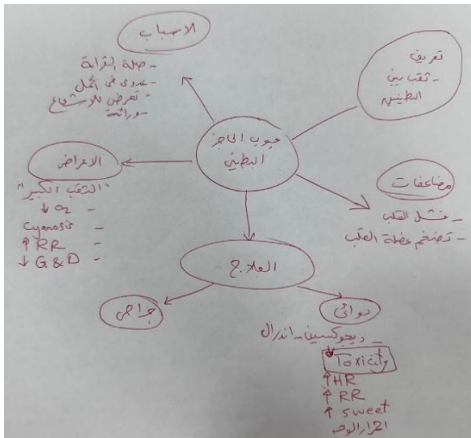
##### **II. Implementation of the program:**

One week later, the researchers initiated an educational program to address areas of knowledge deficits that were discovered from nurses' knowledge assessments. The program began with an hour-long session on concept maps, covering aspects such as definition, purpose, components, benefits, and application methods. Using the concept mapping approach, the researchers then conducted a learning session focusing on ASDs. Following this, an additional hour-long lecture was provided about VSDs.

After the theoretical sessions, nurses were tasked with applying the concept mapping technique they had learned by creating various

types of concept maps summarizing information about VSDs, as illustrated in Figure 1. Following this practical session, the researchers meticulously assessed the quality of the concept maps crafted by the participating nurses, considering criteria such as comprehensiveness, organization, and correctness. Subsequently, detailed feedback on their concept maps was provided to the nurses by the researchers.

**Figure1. Examples of concept maps implemented by participating nurses.**



**III. Post-implementation of the program:**

Following the sessions, the participants were requested to complete a knowledge assessment questionnaire on concept mapping and a knowledge assessment questionnaire on CHDs, using the same approach as in the pre-implementation phase. Additionally, the

participants were asked to complete a nurses' satisfaction questionnaire.

**Ethical considerations:**

Every participant received comprehensive information regarding the study's aim, emphasizing the voluntary nature of participation and the right to withdraw from participation at any point. Those who opted to participate were requested to provide their consent. Furthermore, data privacy and confidentiality were protected by data coding processes. The study received approval from the Research and Ethics Committees at the Faculty of Nursing, Suez Canal University.

**Statistical design:**

The data analysis utilized IBM SPSS (version 26). The socio-demographic characteristics of participants were represented through frequencies and percentages. Mean and standard deviation were employed to summarize participants' satisfaction and knowledge levels concerning concept mapping and congenital heart disease. The students' t-test was conducted for data analysis, with a significance level set at 0.05 and a 95% confidence interval.

**Results:**

Table 1. depicts that 70.83% of the study participants were 20 < 30 years old. 45.8% of them were employed in the NICU. Among the participants, 58.3% had graduated from the Technical Institute of Nursing, and 43.7% possessed less than 5 years of professional experience. Notably, 91.7% had yet to participate in training courses on concept maps or CHDs.

Table 2 demonstrates an increase in the mean scores of nurses' knowledge across all concept mapping questions in the post-test compared to their pre-test scores.

Table 3. illustrates a significant improvement in the total mean scores of nurses' knowledge in the post-test compared to its' pre-test scores. In the post-test group, the mean scores for nurses' knowledge showed a

significant increase ( $9.72 \pm 1.75$ ) compared to their knowledge pre-test scores ( $4.95 \pm 3.2$ ). The differences in scores between the pre-test and post-test were statistically significant ( $P < 0.01$ ).

Figure 2. illustrates that 91.7% of the participating nurses needed a better knowledge of concept maps before the program implementation. However, 71.7% of the nurses showed a fair level of knowledge after the program.

Table 4 illustrates an improvement in the mean scores of nurses' knowledge within the ASD domain during the post-test compared to the pre-test scores, excluding the definition of ASD. Moreover, there was a significant enhancement in their mean knowledge scores for all questions related to VSD in the post-test compared to the pre-test scores.

Table 5. shows a significant improvement in the total mean scores of nurses' knowledge in the post-test compared to its' pre-

test scores. In the post-test group, the mean scores for nurses' knowledge showed a significant increase ( $13.3 \pm 1.31$ ) compared to their knowledge pre-test scores ( $8.25 \pm 4.46$ ). The differences in scores between the pre-test and post-test were statistically significant ( $P < 0.01$ ).

Figure 3. illustrates that 54.2% of participating nurses had poor knowledge about CHDs before the program's implementation. However, after the program, 84.8% of nurses showed good knowledge regarding CHDs.

Table 6. illustrates the total mean scores of nurses' satisfaction with the concept mapping program was ( $48.22 \pm 1.89$ ), indicating that they were all satisfied with the program.

**Table 1:** Distribution of the studied nurses according to their characteristics (n=48).

Nurses' characteristics	(n= 48)	
	No.	%
<b>Age in years:</b>		
20 < 30	34	70.83
30 < 40	12	25
40 ≤ 50	2	4.17
<b>μ ± SD= 28 ±5.55</b>		
<b>Department:</b>		
Pediatric ward	13	27.1
PICU	13	27.1
NICU	22	45.8
<b>Level of education:</b>		
Diploma of Nursing	12	25
Technical Institute of Nursing	28	58.3
Bachelor's Degree in Nursing	8	16.7
<b>Years of experience:</b>		
< 5 years	21	43.7
5 < 10	13	27.1
10 < 15	8	16.7
More than 15	6	12.5
<b>μ ± SD= 6.85 ±5.75</b>		
<b>Previous training courses about concept maps:</b>		
Yes	4	8.3
No	44	91.7
<b>Previous training courses about CHDs:</b>		
Yes	4	8.3
No	44	91.7

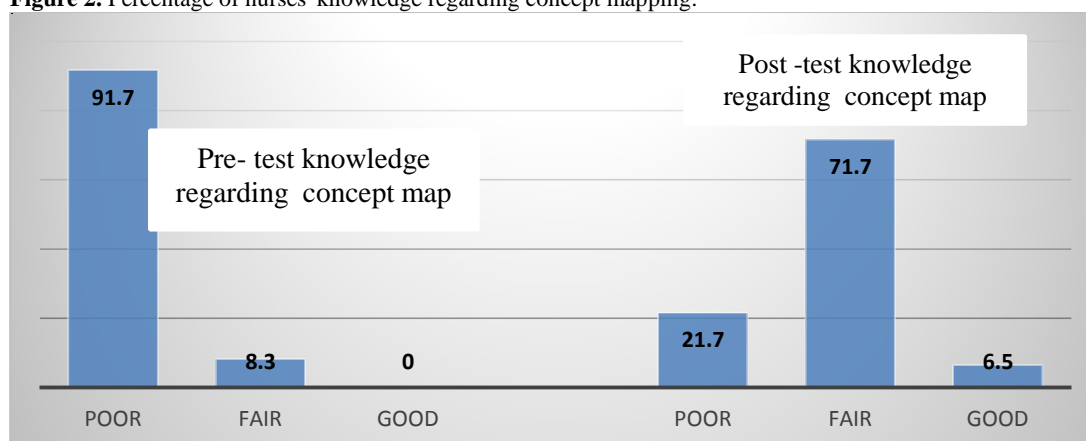
**Table 2:** Mean and Standard Deviation of Nurses' knowledge of concept mapping.

Items	No. of Questions	Pre-test (n= 48)		Post-test (n= 46)	
		$\bar{x}$	SD	$\bar{x}$	SD
Definition of concept mapping	2	.270 ± .449		.326 ± .473	
Purpose of concept mapping	2	.750 ± .564		1.69 ± .465	
Benefits of concept mapping	5	2.50 ± 1.762		3.93 ± .533	
Components of concept map	2	.437 ± .580		.717 ± .455	
Steps of creating a concept map	4	1.00 ± 1.010		3.04 ± 1.153	

**Table 3:** The mean scores of nurses' knowledge regarding concept mapping.

Items	Pre-test (n= 48)		Post-test (n= 46)		t-test	P-value
	$\bar{x}$	SD	$\bar{x}$	SD		
Nurses' knowledge of concept mapping	4.95 ± 3.2		9.72 ± 1.75		9.1	<0.01

\*The maximum total score of nurses' knowledge regarding concept mapping was 15.

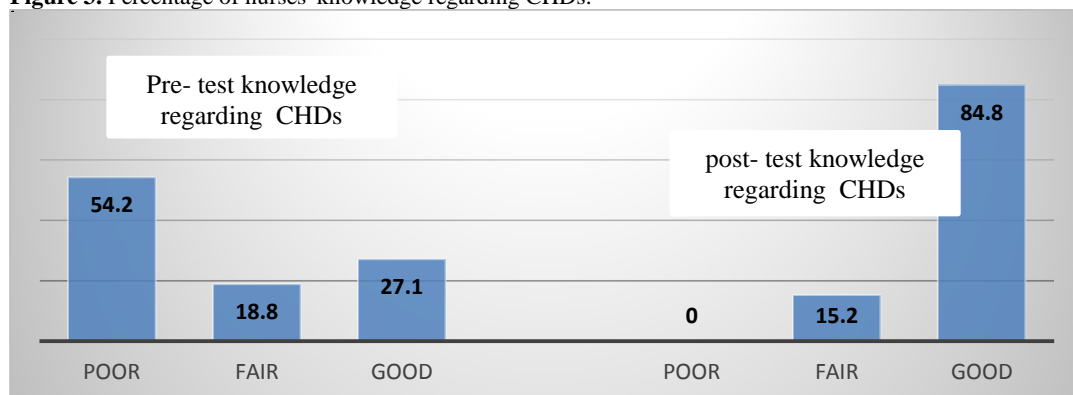
**Figure 2.** Percentage of nurses' knowledge regarding concept mapping.**Table 4.** Mean and Standard Deviation of Nurses' Knowledge about CHDs.

Items	No. of Questions	Pre-test (n= 48)		Post-test (n= 46)	
		$\bar{x}$	SD	$\bar{x}$	SD
<b>Knowledge about ASD</b>					
Definition of ASD	1	.60 ± .494		.30 ± .465	
Signs and symptoms of ASD	3	1.68 ± 1.20		2.17 ± .383	
Complications of ASD	1	.67 ± .476		.91 ± .285	
Management of ASD	2	1.02 ± .75		1.76 ± .431	
<b>Knowledge about VSD</b>					
Definition of VSD	1	.62 ± .489		.93 ± .250	
Signs and symptoms of VSD	5	2.14 ± 1.33		4.30 ± 1.07	
Complications of VSD	1	.54 ± .504		.98 ± .147	
Management of VSD	1	.44 ± .501		.93 ± .250	
Digoxin toxicity of VSD	1	.52 ± .505		1.00 ± .000	

**Table 5.** The mean scores of nurses' knowledge regarding CHDs.

Items	Pre-test (n= 48)		Post-test (n= 46)		t-test	P-value
	$\bar{x}$	SD	$\bar{x}$	SD		
Nurses' knowledge regarding CHDs	8.25 ± 4.46		13.3 ± 1.31		9.1	< 0.01

\*The maximum total score of nurses' knowledge regarding CHDs was 16.

**Figure 3.** Percentage of nurses' knowledge regarding CHDs.**Table 6.** The mean scores of nurses' satisfaction with the concept mapping program (n= 46).

Departments	Satisfaction scores		
	N	Mean	SD
Pediatric ward	13	48.92 ± 0.86	
PICU	13	46.85 ± 2.38	
NICU	20	48.65 ± 1.63	
Total satisfaction	46	48.22 ± 1.89	

\* The total score of the nurses' satisfaction questionnaire was 50

## Discussion:

The utilization of concept maps is regarded as a superior method for transferring and retaining information and knowledge. According to **Kalyanasundaram et al. (2017)**, it has been determined to be an innovative and efficient technique for better retention than conventional methods. As a result, continuous educational training is essential for nurses in pediatric wards, NICUs and PICUs to comprehend and implement practices concerning CHDs. Concept mapping is a teaching tool to facilitate information integration and understanding of the correlation between fundamental knowledge and clinical skills.

Regarding the participants' knowledge of concept maps, most participating nurses needed better knowledge before the program implementation. However, after the program, approximately three-fourths of the nurses

demonstrated a fair level of knowledge. From the researchers' point of view, this improvement can be attributed to concept mapping being new for them, and they showed interest in applying it. The results improved to a moderate level as they were more interested in applying the concept practically rather than solely focusing on theoretical information.

Similarly, a study conducted by **Abd El-Hay et al. (2018)** showed significant improvement among nursing students in their general knowledge of concept mapping (including its definition, importance, benefits, and characteristics) after applying concept maps. Before the application, three-fourths of the students exhibited a poor level of knowledge, and this proportion shifted to approximately two-thirds demonstrating a good level of knowledge after the integration of concept maps.



The present study revealed a significant improvement in nurses' knowledge of CHDs. Before the program implementation, more than half of the nurses needed better knowledge in this area. However, after the program, most nurses demonstrated good knowledge regarding CHDs. According to the researchers, this improvement can be attributed to concept mapping, a new technique that stimulates information retention and facilitates easy recall. By incorporating congenital heart disease with concept mapping, which focuses on one of the most common and critical topics that nurses encounter daily, the nurses enhanced their understanding and knowledge in this area.

In a study by **Mora et al. (2020)**, it was observed that young individuals with CHDs often had a lack of disease-related knowledge and self-management skills. The study found that utilizing intervention mapping facilitates the creation of personalized interventions, potentially empowering these individuals to assume greater responsibility for their care. The study by **Pishgooie et al. (2019)** concluded that the teaching method based on concept maps was more effective in enhancing nursing students' learning in Basic Life Support than lecture-based teaching methods.

Similarly, **Baliga, Walvekar, and Mahantshetti (2021)** concluded that concept maps are an effective tool for teaching and learning among medical students. These maps can enhance meaningful learning and can be utilized to improve students' understanding of complex concepts. The authors suggest incorporating concept maps more frequently in medical education to facilitate better comprehension among students. Additionally, **Jaafarpour, Aazami, and Mozafari (2016)** determined that concept mapping positively impacted the participants' achievement. **Kaddoura et al. (2016)** demonstrated that employing concept mapping served as an interactive method to cultivate the development of clinical judgment skills in nursing students.

Regarding nurses' satisfaction, all participants expressed satisfaction with the concept mapping program. According to the researchers, the participants found it to be an effective way of delivering information, as it

presented complex topics in a simplified manner that was easy to understand and remember and ultimately increased creativity. The concept map approach received positive feedback from all participants, highlighting its ability to facilitate learning and comprehension.

Similarly, **Hsu, Pan, and Hsieh (2016)** found that the mean satisfaction scores of the nursing students were higher in the concept mapping group, which was used to teach neurological care, compared to the objective-based lectures. Similarly, **Hinck et al. (2006)** concluded that most participants expressed satisfaction with using concept mapping for developing care plans.

### Conclusion:

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The study concluded that:

Prior to the program's implementation, the majority of nurses had poor understanding of concept maps, but after the program's implementation, around two-thirds of them had fair knowledge. Prior to the program's implementation, more than half of nurses had a poor understanding of CHDs; however, following the program's adoption, the majority of them had a good knowledge. Pediatric nurses' knowledge of CHDs has been enhanced as a result of the concept mapping training program. Nurses expressed a high degree of satisfaction with the concept mapping program.

### Recommendations:

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- Implementation of CHD educational programs for pediatric nurses in order to provide them with the critical knowledge required for delivering optimal nursing care and thereby lowering overall morbidity and death rates among those children.

- Adoption of concept mapping as an educational strategy for delivering various training programs that hold significant importance for pediatric nurses, including those related to respiratory, renal, neurological, or congenital diseases.

- Replicate the study on a broader,

representative sample in diverse pediatric healthcare settings, employing an experimental design with randomization.

#### Study Limitations:

- The nurses' level of cooperation was a little decreased due to the high workload. To address this, the program was implemented multiple times with smaller groups of nurses within the same shift.

- A few nurses faced challenges in creating their own concept maps, particularly as the concept was novel to most of them. Researchers closely monitored the nurses, offering assistance while considering not to jeopardize the results of the post-test.

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