

## MEASUREMENT OF GENERAL CRITICAL THINKING IN UNDERGRADUATE NURSING STUDENTS: EXPERIMENTAL STUDY

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### ABSTRACT

**Objective:** to compare the levels of general critical thinking and the skills or cognitive attributes involved, individually measured during the training of undergraduate nursing students, through a teaching intervention using Concept Maps.

**Method:** an experimental, randomized, double-blind study with before and after design, conducted with 77 undergraduate nursing students. The research subjects were randomized to the control (38) and experiment (39) groups and both participated in a course on Advanced Life Support in Cardiology for a period of five weeks, when the intervention was the construction of four concept maps. Data collection took place through a sociodemographic questionnaire and the California Critical Thinking Skills Test (CCTST) before and after the course and after in order to measure critical thinking.

**Results:** sociodemographic data confirmed that the groups had similar characteristics. After the intervention using the concept maps, the mean pre-and post-test general critical thinking averages were classified as moderate and showed no statistically significant difference. The t-test for paired samples showed a significantly increased Evaluation skill score (p-value of 0.022) in the posttest for the experiment group.

**Conclusion:** the use of the teaching strategy with construction of the concept maps performed well in the promotion of General Critical Thinking and its abilities. Teaching strategies based on constructivist theories should be encouraged as they play a significant role in improving student learning and critical thinking.

**DESCRIPTORS:** Nursing. Nursing education. Thought. Learning. Educational technology. Advanced life support. Care to prolong life.

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# MENSURAÇÃO DO PENSAMENTO CRÍTICO GERAL EM ESTUDANTES DE CURSOS DE GRADUAÇÃO EM ENFERMAGEM: ESTUDO EXPERIMENTAL

## RESUMO

**Objetivo:** comparar os níveis de pensamento crítico geral e as habilidades ou atributos cognitivos que o constituem, mensurados individualmente durante a formação de estudantes de graduação em Enfermagem, mediante uma intervenção de ensino com uso de Mapas Conceituais.

**Método:** estudo experimental, randomizado, duplo-cego com delineamento antes e depois, realizado com 77 estudantes de graduação em enfermagem. Os sujeitos da pesquisa foram randomizados para os grupos controle (38) e experimento (39) e ambos participaram de um curso de extensão sobre Suporte Avançado de Vida em Cardiologia por um período de cinco semanas, quando a intervenção foi a construção de quatro mapas conceituais. A coleta de dados aconteceu por meio de um questionário sociodemográfico e a resolução do *California Critical Thinking Skills Test* (CCTST) antes do início do curso e após o encerramento, para mensuração do pensamento crítico.

**Resultados:** os dados sociodemográficos confirmaram que os grupos possuíam características similares. Após a intervenção por meio dos mapas conceituais, as médias de pensamento crítico geral no pré e pós-teste foram classificadas como moderadas e não apresentaram diferença estatisticamente significativa. O Teste-*t* para amostras emparelhadas evidenciou a pontuação da habilidade Avaliação aumentada significativamente (*p*-valor de 0,022) no pós-teste para o grupo experimento.

**Conclusão:** a utilização da estratégia de ensino com construção dos mapas conceituais apresentou bom desempenho na promoção do Pensamento Crítico Geral e de suas habilidades. Estratégias de ensino baseadas em teorias construtivistas devem ser incentivadas, pois desempenham um papel significativo na melhoria da aprendizagem e do Pensamento Crítico dos estudantes.

**DESCRITORES:** Enfermagem. Educação em enfermagem. Pensamento. Aprendizagem. Tecnologia educacional. Suporte avançado de vida. Cuidados para prolongar a vida.

# MEDICIÓN DEL PENSAMIENTO CRÍTICO GENERAL EN ESTUDIANTES DE CURSOS DE GRADUACIÓN DE ENFERMERÍA: ESTUDIO EXPERIMENTAL

## RESUMEN

**Objetivo:** comparar los niveles de pensamiento crítico general y las habilidades o características cognitivas que lo constituyen, medidos individualmente durante la formación de estudiantes de grado en Enfermería, a través de una intervención docente utilizando Mapas Conceptuales.

**Método:** estudio experimental, aleatorizado, doble-cego con investigación anterior y posterior, realizado con 77 estudiantes de grado en enfermería. Los sujetos de investigación fueron aleatorizados a los grupos de control (38) y de experimento (39) y ambos participaron en un curso de extensión sobre Soporte vital avanzado en cardiología durante un período de cinco semanas, cuando la intervención consistió en la construcción de cuatro mapas conceptuales. La recopilación de datos se realizó a través de un cuestionario sociodemográfico y la resolución del *California Critical Thinking skills* (CCTST) antes del comienzo del curso y después de la finalización para medición del pensamiento crítico.

**Resultados:** los datos sociodemográficos confirmaron que los grupos tenían características equivalentes. Luego de la intervención a través de los mapas conceptuales, los promedios de pensamiento crítico general antes y después de la prueba se clasificaron como moderados y no presentaron diferencias estadísticamente significativas. La prueba-*t* para muestras emparejadas mostró un puntaje de habilidad de evaluación significativamente mayor (valor *p* de 0.022) en la prueba posterior para el grupo de experimento.

**Conclusión:** el uso de la estrategia de enseñanza con la construcción de los mapas conceptuales tuvo un buen desempeño en la promoción del pensamiento crítico general y sus habilidades. Deben fomentarse las estrategias de enseñanza basadas en teorías constructivistas, ya que desempeñan un papel importante en la mejora del aprendizaje y el pensamiento crítico de los estudiantes

**DESCRITORES:** Enfermería. Educación en enfermería. Pensamiento. Aprendizaje Tecnología educativa. Soporte vital avanzado. Cuidados para prolongar la vida.

## INTRODUCTION

Studies report that nurse education is not always able to prepare its students for the required work demands of nurses. There is also concern that these newly graduated professionals may have poor practical skills and thus compromise patient safety.<sup>1-2</sup>

In addition, the demands of the health care environment, along with the need to know the patient, suggest that the goals of nurse education need to emphasize the development of critical thinking and problem-solving skills.<sup>3</sup>

Critical thinking consists of cognitive skills or attributes that refer to assessment, analysis, inference, induction, and deduction which enable nurses to identify the necessary information, distinguish the problems that require immediate intervention, and consider the possible consequences of each action.<sup>1-5</sup>

In this context, recognizing and encouraging a close relationship between clinical reasoning ability and critical thinking is fundamental to nurse education, since their skills contribute to the ability to interpret and analyze clinical problems, evaluate evidence and make inferences, draw conclusions and then implement effective interventions.<sup>6</sup>

Therefore, the objective of this research was the use of the concept map development strategy as a pedagogical resource for the teaching of Advanced Life Support in Cardiology (SAVC), since emergency care services require health professionals to understand its structure and political link within the other services, as well as their ability to act in specific care, with technical, communication, interaction with other areas of expertise, patients, family members, always guided by scientific basis for the recovery of patients or to reduce their health problems.

Nurses who work in these services are faced with a relatively new practice for traditional nursing standards. Nurses must be able to identify the needs of the victim, set priorities and initiate necessary interventions in order to stabilize them.<sup>7-8</sup>

In prehospital care, the nurse who works in Advanced Cardiac Life Support (ACLS) in conjunction with the rest of the health team is responsible for nursing care, which aims to resuscitate and stabilize the patient where the event occurred and during transportation to the service. This is a practice that requires refined knowledge, ability to handle stressful situations, and a wide range of professional team members that differs from hospital practice.<sup>7-8</sup>

Therefore, in order to acquire this new knowledge and make decisions for quality, safe health care, they need to use cognitive skills that must be developed in their initial training. Nursing students must learn to think like nurses and educational institutions must encourage critical thinkers to self-assess their needs.<sup>9</sup>

In order to train nursing professionals who are competent and who meet the demands of today's society, it is essential that the teaching strategies used are in accordance with this concept and that the pedagogical approaches used by teachers can meet all the students' needs.<sup>3</sup> In this context, concept maps have been used to promote critical thinking and meaningful learning, to allow the students to be actively involved in organizing and interpreting data, comparing and correlating relevant information, and synthesizing ideas.<sup>10</sup>

Therefore, this study aimed to compare the levels of general critical thinking and the skills or cognitive attributes involved, measured individually during undergraduate nursing student training, through a teaching intervention using conceptual maps.

## METHOD

A quantitative, experimental, randomized, double-blind, pre and post-test assessment study to measure the effectiveness of the concept map as a pedagogical resource for teaching Advanced Cardiac Life Support (ACLS) to students from two public Brazilian schools of nursing.

Undergraduate nursing students regularly enrolled from the third year who agreed to participate after reading the information contained in the informed consent form were considered eligible for the study.

The sample consisted of undergraduate nursing students, one located in the southern region and the other in northeastern Brazil, enrolled between the 3<sup>rd</sup> and 4<sup>th</sup> year. There was a total of 77 students.

Participants were randomized to compose a Control Group (CG) and Experiment Group (EG) according to course year, gender, age, having a technical or technological course in health, as well as a previous ACLS course, type of high school and occupation. The CG had 38 participants and the EG had 39 participants. All students had access to lectures and practical activities on ACLS.

The didactic activities of the study were developed through an extension course and were related to five areas: Basic Life Support (BLS), teamwork, oxygen therapy, cardiac assessment and Advanced Cardiac Life Support (ACLS) which were taught during dialogued lecture and in practical skills laboratories. The course was conducted by the same instructor for a period of 30 days to both groups, which lasted for 60 hours and had nine face-to-face meetings on alternate days, as well as blended learning activities.

An intervention was added to the GE, i.e., the construction of concept maps through the use of Cmap Tools® Software, referring to the guiding questions of each theme discussed in the classroom. Each GE participant created four CMs.

Data on sociodemographic characteristics were collected and critical thinking and individual cognitive skills or attributes were measured using the California Critical Thinking Skills Test (CCTST) Form B. This instrument contains 34 multiple-choice items and was applied twice to each participant, before starting the course as a pretest and after the course. Both the CG and the EG answered the instrument again as a post-test.

The CCTST is marketed by Insight Assessment, which provides full support for analyzing the collected data. Thus, the results allow the analysis of each skill to establish general critical thinking. It can be categorized as Not manifested, Weak, Moderate, Strong, or Superior according to the student's overall critical thinking score. It is worth mentioning the classification provided by the CCTST Handbook (2016) according to the test score for the test, with 34 questions, in which overall critical thinking is rated as Superior (24-34), Strong (19-23), Moderate (13-18), Weak (8-12), and Not manifested (0-7)<sup>4</sup>

Data analysis was performed by using the inferential descriptive statistics and suggested hypothesis test. The socioeconomic data and the results of the critical thinking scores were compiled on a spreadsheet using the statistical program SPSS® version 20.0, coded for their analysis and displayed in tables and graphs.

After data collection, the CCTSTs used by this study were sent to Insight Assessment in the United States of America who was responsible for the descriptive analysis regarding the general critical thinking score and its respective partial cognitive skills or attributes.

In accordance with Resolution no. 466/12 of the National Health Council of the Ministry of Health, this study was submitted to the Research Ethics Committee which deals with research with human beings.

## RESULTS

Demographic data were analyzed with the intention of treating baseline characteristics for direct comparison, while critical thinking differences were assessed by independent sampling.

Seventy-seven undergraduate nursing students participated in the study. Thirty-eight were allocated to the CG and 39 to the EG. The data presented in Table 1 demonstrate the adequate randomization prior to the intervention course, and the sociodemographic data showing that the groups were similar. It can be observed that both were mostly made up of women and had an average age of over 23 years.

**Table 1** – Sociodemographic characterization of nursing students from the two courses participating in the study. Natal, RN, Brazil, 2017. (n = 77)

Category	Control Group(n=38)	Experiment Group(n=39)
	n (%)	n (%)
Sex		
Male	6 (15.78)	2 (5.13)
Female	32 (84.22)	37 (94.87)
Age*	23,57 ( $\pm$ 2.40)	23,05 ( $\pm$ 4.4)
Course year *	6,81 ( $\pm$ 1.03)	6,97 ( $\pm$ 1.02)
High school		
Public	18 (47.36)	15 (38.46)
Private	20 (52.64)	24 (61.54)
Employed		
Yes	4 (10.53)	4 (10.25)
No	34 (89.47)	35 (89.75)
Marital Status		
Married	2 (5.26)	1 (2.57)
Single	34 (89.48)	38 (97.43)
Civil union	2 (5.26)	-

\* Variable expressed as mean and standard deviation.

The overall average critical thinking scores were obtained for the pre-test CG of 15 (SD=3.5) and for the GE of 14.1 (SD=3.7), and in the post-test for the CG of 14.6 (SD=3.9) and for the EG of 14.1 (SD=3.4), as presented in Table 2. In addition, the average of the cognitive skills or attributes involved in general critical thinking, which are Analysis, Inference, Evaluation, Induction and Deduction, referring to the CCTST score for the pre and posttests of both groups, as well as the paired comparison of the t-test results.

The result of the paired sample t-test indicated that the rating of the Assessment skill increased significantly (p-value 0.022, to a significance level of 95%) in the post-test for the experiment group.

**Table 2** – Overall average for critical thinking and cognitive skills or attributes of Control and Experiment students with concept mapping. Natal / RN, Brazil, 2017. (n=77)

	Control Group (n=38)		t-test		Experiment Group (n=39)		t-test	
	Pre-test*	Post-test	t	p	Pre-test	Post-test	t	p
General CT†	15.0 (3.5)	14.6 (3.9)	0.804	0.426	14.1 (3.7)	14.1 (3.4)	0.058	0.954
Analysis	4.6 (1.3)	4.4 (1.3)	0.758	0.453	4.4 (1.4)	4.1 (1.3)	1.465	0.151
Inference	4.8 (1.8)	4.8 (2.1)	0.263	0.794	4.6 (1.9)	4.5 (1.7)	1.452	0.155
Evaluation	5.6 (1.9)	5.3 (2.1)	0.076	0.940	5.0 (2.0)	5.6 (1.7)	2.380	<b>0.022</b>
Induction	6.3 (2.1)	5.7 (2.0)	1.982	0.055	5.7 (2.0)	5.8 (2.0)	0.381	0.706
Deduction	6.9 (2.0)	7.3 (2.2)	1.181	0.245	6.9 (2.2)	7.0 (2.2)	0.000	1.000

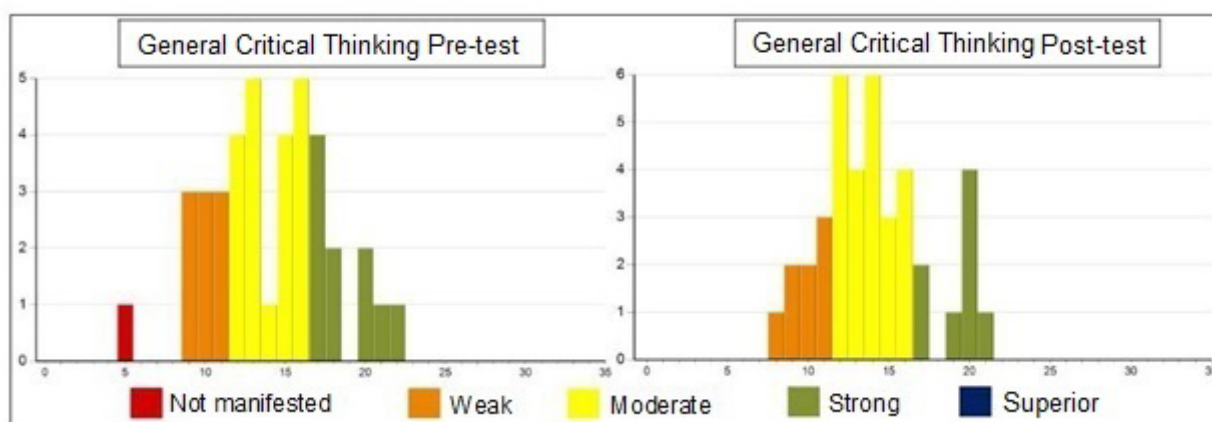
\*Mean and standard deviation; † General Critical Thinking

Although the other critical thinking skills showed no statistical difference after t-test pairing, there was a significant increase in the average induction and deduction skills for the EG. In general, Induction and Deduction skills increased for both groups before and after the course, and the increased Evaluation skill only occurred in EG students. The CG showed a decrease in the Analysis and Evaluation skills and the same value was kept for Inference. The EG showed a reduction in the Analysis and Inference scores.

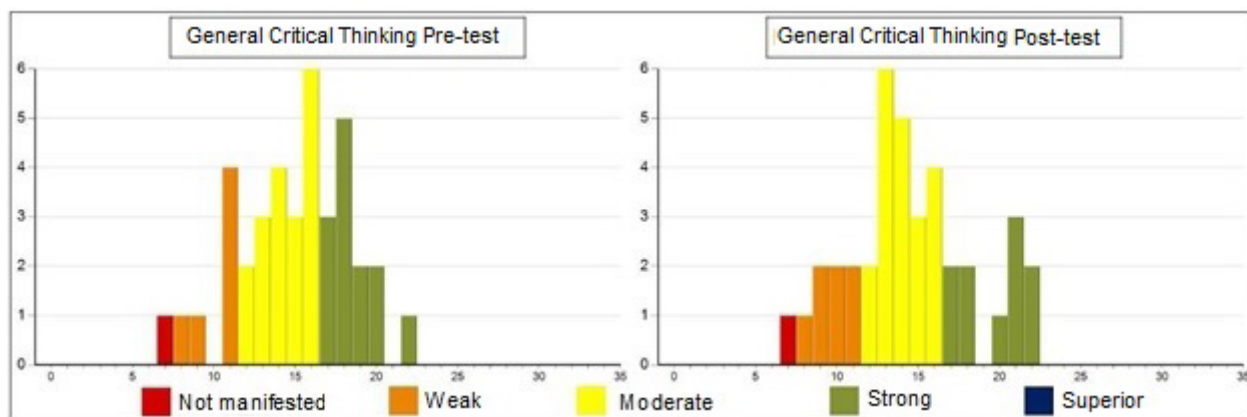
Despite the statistical results only presenting differences between the group averages, this does not mean that the use of the teaching strategy based on the construction of the concept maps did not contribute to the development of these skills.

After analyzing the skills for establishing general critical thinking, it can be categorized as Not manifested, Weak, Moderate, Strong, or Superior, according to the student's overall critical thinking score. Figure 1 and 2 show the overall critical thinking score for the EG and CG, respectively. According to Figure 1 and 2, most EG students started the study with moderate level of critical thinking and remained in this classification.

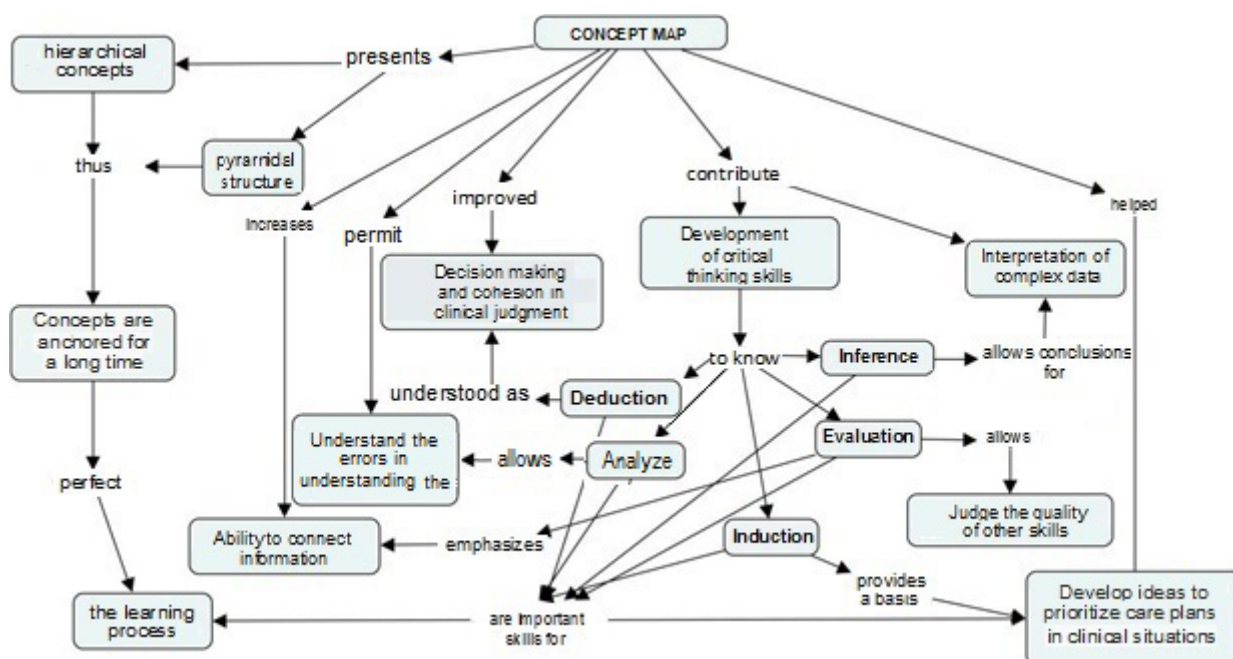
Based on theoretical deepening and data analysis, a concept map was constructed to present the interrelationship between the concept map teaching strategy, its contribution to the learning process and to the development of critical thinking skills in undergraduate students, as shown in Figure 3.



**Figure 1** – General Critical Thinking of Experiment Group students before and after the extension course. Natal / RN, Brazil, 2017. (n=39)



**Figure 2** – General critical thinking of Control Group students before and after the extension course. Natal, RN, Brazil, 2017. (n = 38)



**Figure 3** – Conceptual map regarding the learning process of undergraduate nursing students and the development of critical thinking skills. Natal, RN, Brazil, 2017

## DISCUSSION

This study examined the effectiveness of the concept map teaching strategy during an ACLS-themed extension course, on the average of critical thinking and its cognitive skills or attributes in undergraduate nursing students from two regions of Brazil. Based on the results, an average of critical thinking in the pre and post-test classified as Moderate in both groups was evidenced, without major changes in the general scores, when the adopted strategy also contributed to the development or improvement of Evaluation, Induction and Deduction skills.

Higher frequencies of general critical thinking classified as Moderate and Strong after the intervention were perceived. When analyzing the same data in the CG, it is possible to notice that

the student with not manifested general critical thinking remained the same after the course, which highlights the importance of promoting critical thinking. In this same group there was also a decrease in the number of results in the Strong classification, with a higher concentration in the Moderate classification.

When considering the theme selected for the extension course that served as the basis for controlling the entire study, the American Heart Association suggests the use of alternative teaching modalities for Basic and Advanced Life Support. Student outcomes are considered more important than the course format. Acquisition and retention of knowledge and skills, and ultimately clinical performance and patient outcomes, should guide resuscitation education and learning. It is recommended that education and training activities are universally available.<sup>11</sup>

Regarding critical thinking skills, improvements in the averages for Evaluation, Induction and Deduction were observed. However, when performing the student's t-test, statistical significance was only found for the Evaluation skill. Therefore, EG students performed better on the Evaluation skill after the concept map intervention.

For the analysis of these results, it is important to highlight the specificity of the course content offered and the experience of clinical practice as conditions for the development of the mentioned skills. These skills are considered as a high-level target in training and require a long period of time to develop. Research on nursing students in Turkey showed that the willingness of students for critical thinking is low at the beginning and the end of the school year. The authors expected these results as the study was conducted with first year nursing students and because critical thinking takes a long time to acquire.<sup>12</sup>

Another study conducted at the University of Ohio, in the United States, which lasted for four weeks, also used the construction of concept maps based on four neonatal concepts and did not obtain significant results for CCTST scores. They found that the results, while not statistically significant, were associated with a gain in knowledge and potential advantages of providing an active learning approach with the material.<sup>13</sup>

Although no significant change in CCTST total scores was found, this study is an important starting point to improve understanding regarding the development of critical thinking and its skills in undergraduate nursing students in Brazil. The study involved a relatively short intervention and the results allow us ask important questions about the optimal duration of teaching activities with the aim of teaching content while improving critical thinking skills.

Students perceive the process of creating concept maps as easy to learn and apply. However, they recognize that it takes a long time to start, but that practice facilitates this process. Professors need to carefully select topics for concept mapping and devote adequate time to this activity in order to increase perceived and real learning.<sup>13</sup>

Thus, the evolution of students in the mentioned skills is understandable, the identification of signs and symptoms, assessment and decision making are encouraged at all times during ACLS education.

The development of critical thinking skills can be favored mainly because the CMs promote the internalization of concepts and understanding the relationships between them. Thus, graphical integrations of key concepts guide case problem solving, i.e. CMs enable students to modify their learning styles in order to become critical thinkers and active learners, and to have greater self-confidence in learning.<sup>6,14</sup>

Concept maps enhance students' ability to focus on the most important information and provide a more effective evidence-based care plan.<sup>10</sup> Concept maps contributed to evaluation development in this study, which is considered a reasoning skill that allows you to assess the credibility of information sources and the claims they make. Widely used to determine the strength or weakness of arguments.



By applying this ability, one can judge the quality of analyzes, interpretations, explanations, inferences, options, beliefs, ideas, proposals, and decisions.

Concept mapping also allows students to develop analytical skills by enabling them to understand errors in their concept understanding process and then to increase the reasons for correcting such errors.<sup>15</sup> Analysis allows students to identify assumptions, reasons, claims, and examine how they interact in the formation of arguments and how they interact with each other.<sup>4</sup>

Regarding deduction and induction skills, two experimental studies concluded that concept maps improve decision-making and cohesion skills in clinical judgment competence, as well as assisting in the development of ideas that prioritize care plans for clinical situations.<sup>1,10</sup> These skills are understood by the assessment instrument itself as decision making in precisely defined contexts (deductive reasoning) where rules, operating conditions, fundamental beliefs, principles, procedures, and terminology determine outcome and decision making in uncertain contexts or from inferences about what is thought to be true based on analogies, case studies, previous experiences, respectively.<sup>4</sup>

The results of work with students in Sweden for both assessment and learning development show that the use of concept maps can provide rich, multidimensional information about content, inform the interpretation of complex data and reveal the structure and order that can be used with further planning, development, and decision making.<sup>16</sup> This way, it is also able to encourage the development of the Inference skill, which allows conclusions to be drawn from reasons and evidence, recommendations, or decisions.<sup>4</sup>

In this context, it is worth noting that, in a previous study conducted in Brazil with undergraduate nursing students at a public university, the construction of CMs as a teaching strategy proved to be important as a sign of improvement in the teaching-learning process.<sup>17</sup> In addition, using the concept map strategy has contributed to integrating difficult concepts, making relationships, and helping students think critically about how each concept is interrelated.<sup>15,18</sup>

Thus, regardless of the school of thought that underpins the concept of critical thinking, it is understood that this is an essential element for planning nursing actions. Understanding critical thinking as a skill and application in clinical practice is a determining factor in the construction of nursing diagnoses. In other words, critical thinking can be trained to improve clinical thinking regarding the health-disease process.<sup>19</sup>

However, the nature of each course, mastery and characteristics of the instructor, and the teaching method selection can affect the development of critical thinking skills. Therefore, professors of undergraduate nursing courses are encouraged to accept this challenge, to use new educational strategies and technologies, and to be encouraging agents by stimulating the process of teaching student learning.

Regarding the limitations for the development of the study, the short intervention period of 30 days is mentioned as it was associated with the development of a doctoral thesis.

## CONCLUSION

The use of the concept map teaching strategy in the ACLS course performed well in the promotion of critical thinking, as the average score of evaluation, induction and deduction skills increased according to the CCTST.

The overall post-test critical thinking score for EG did not show a statistically significant difference, however, the results show that the application of CMs as a teaching strategy was effectively positive, since the CG evolved minimally from Weak or Moderate, which did not happen to CG students. Therefore, it is a valid strategy as an effective intervention for the development of critical thinking.

Based on the results found, this study can be considered as a starting point to guide future research in the search for the best moment, duration, content and strategies that can improve critical

thinking in undergraduate nursing students. Further research is suggested in order to investigate factors and teaching strategies that may influence the development of critical thinking, as well as the need to conduct an evaluation of undergraduate nursing curricula for critical thinking domains and their skills. In this context, developing a high level of thinking skills as one of the main challenges of nursing education today requires appropriate pedagogical approaches.

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## NOTES

### CONTRIBUTION OF AUTHORITY

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Analysis and interpretation of the data: Carvalho DPSRP, Ferreira Júnior MA.

Discussion of results: Carvalho DPSRP, Ferreira Júnior MA.

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### CONFLICT OF INTEREST

There is no conflict of interest.

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