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THE EFFECT OF MIND MAPPING ON CRITICAL THINKING SKILLS OF UNDERGRADUATE NURSING STUDENTS

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ABSTRACT

Critical thinking is an essential skill that is necessary for identifying client issues and combining strategies to promote successful treatment outcomes. Traditional teaching methods mostly promote memorization, nursing students think critically don`t required assistant, and resolve difficulties in the classroom or clinical situation. The purpose of this study was to evaluate the impact of the mind mapping technique on sensitive critical nursing students' talents. In this study, a quasi-experimental (pre/posttest) design was used to achieve the purpose of the present study. This study was performed on a convenient sample of 100 undergraduate nursing students (females and males) who registered in the second term of Medical-Surgical Nursing in the 2017/2018 academic year at a baccalaureate nursing program at the Faculty of Nursing, Menoufia University. The research tools included three structured interview questionnaire, Yoon's Critical Thinking Disposition Inventory (YCTD), and Nurses' perception Assessment questionnaire toward mind mapping. The results of the present study showed a highly significant variation among pre and post-test regarding student knowledge and critical thinking skills. Also, about half of the students perceived the concept of mapping positively. In conclusion, the nursing students who taught by mind mapping showed better critical thinking skills than the pre-intervention level. Also, students' knowledge improvement and positive attitude toward mind-mapping became apparent. Therefore, this study suggests program managers, deans, and nursing faculties evaluate their prospectuses to integrate conception map teaching strategies into courses to progress and improve students' critical thinking skills.

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Introduction

Critical thinking (CT) is the foundation stone of higher education today. Dr Christine Tanner, in 2006, first described the term "thinking like a nurse" to introduce the concept of critical thinking as a process of higher-level intentional thinking. She recommended using critical intelligence to outline a patient's problem, choosing delivery choices and using evidence-based practice in patient care [1]. The critical thinking process needs the nurses to think inventively, use the image, and involve in analytical thinking [2]. Critical thinking is an essential skill needed to identify patient problems and incorporate strategies to facilitate effective nursing outcomes [3]. An investigation carried by Asselin [4] reported that students develop new practical perspectives on new information. Experiences gained by nurses have contributed to improvements in their work strategies. Serious thoughtful represents a figurative connection to knowledge and practice. Significant thoughtful in nursing entails mind behaviours, which include the incorporation of cognitive skills [5].

Scheffer and Rubenfeld [6] conducted groundbreaking research in which nurses from nine countries identified ten mind practices (affective modules) and 7 critical thinking talents (cognitive components) in nursing. The ten effective constituents are creativity, self-confidence, circumstantial perspective, inquisitiveness, flexibility, intellectual integrity, perseverance, intuition, open-mindedness, and reflection. Seven abilities include information seeking, applying standards, transforming knowledge, discriminating, analyzing, logical reasoning. Lunney and predicting, [7] used cognitive and affective elements to establish the use of critical thoughtful in diagnostic procedures and to describe a precise nursing diagnosis. The research showed that nurses need to use the whole 17 components of critical thought in defining clinical diagnoses.

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Concept mapping is a technique that represents critical thinking using a graphical representation of nonlinear and linear relationships. Concept maps, also recognized as mind mapping, are situation reliant on and can be applied to improve analytical abilities. The characteristics of the idea are intertwined and making sense of the idea they signify. The thought map permits the nurse to map words on the page and concentrate on ideas and relationships. A broad advantage of these maps is that they faster to take note of and focus key concepts [2].

Concept mapping gives a connection among present nursing skills and new evidence for nurses. This education technique promotes significant thoughtful and can help nursing students understand complex ideas [8]. Theory maps supporting health care professionals have gained the knowledge and understanding of principles essential to safe and effective care delivery [9]. This concept map can combine several problems instead of solving a single client problem. This helps the nurses to demonstrate the interrelationships between client problems and evaluate the treatment depending on the severity of those difficulties [10]. Hence, perception mapping can be a useful method to improve critical thinking.

The concept map, a visual representation of key points, uses a body system approach to guide patient attention. Nowadays in the healthcare site, the aptitude of nurses to analytically think they are faced throughout different circumstances is a significant talent. Patients who are hospitalized nowadays are exciting, more complex, and more aware. Inappropriately, newly graduated nurses may suffer from a deficiency in some of the skills regarding critical thinking which required to upkeep for patients safely. Nurse leaders are observing additional operative and effective ways to adjust graduate nurses, particularly in light of the existing nursing lack [11].

However, approximately 2/3 of the existing nursing graduates worldwide are incapable to clinically motive at the greatest simple level to distinguish a deteriorating variation in patient condition. This phenomenon is commonly referred to as "failure to rescue" and occurs when the nurse does not diagnose styles that imitate a failed situation variation until it is too late and has an adverse outcome or a patient death [12]. Azizi-Fini et al. [13] established that the program of nursing education did not affect the CT talents of its students. Several authors have been suggested to evaluate the critical intelligence of nursing students periodically. Furthermore, a review of the curriculum (C.V.) and organization of nursing teachers suggested the use of innovative and active teaching programs.

Research has shown that CM is useful for students and educators in incorporating nursing procedures, imagining ideas, developing CT skills in nursing students and connecting theory and practice. CM has been established as a useful learning and teaching method for students in a classroom or clinical location to improve CT capabilities [14].

Several Professional and regulatory bodies in nursing education required CT, which is central to all nursing curricula. For example, the National League of Nurses listed CT as an essential requirement for clinical program accreditation. The Joint Commission on Accreditation of Healthcare Organizations included CT among its norms as a key skill of great significance in nursing education and professional practice [15]. The American Nurse Association (ANA) similarly emphasizes that nurses' CTS should be assessed as a principle to influence the consequences of nurse education programs [16].

Significance of the study

Customary teaching methods, which typically encourage memory, do not support thinking of the nursing students significantly and elucidate classroom or clinical difficulties. In Egypt, Mohamed et al. [17], reported findings of a quasi-experimental study conducted at the faculty of nursing Cairo University, the study revealed that students taught using concept mapping presented an elevation in their CT scores relative to those in the control group.

The National Academic Reference Standards (NARS) considers CT one of the main attributes of the graduates of bachelor's degree in nursing science in Egypt [18]. In its update in 2017, NARS changed to be competency-based that emphasized on the integration of knowledge, skills, and professional attitudes utilizing clinical evidence to provide safe and holistic patient care, in addition to displaying cognitive flexibility and reflective functioning, and exhibit creative and adaptive thinking within a changeable scientific social and technological environment as attributes to nursing graduates [19]. These push toward the reshaping of nursing education by introducing a new teaching approach.

The lack of specific previous research related to the effectiveness of concept mapping on the sophomore nursing students' CT abilities in Egypt has prompted this research. Also, the conduction of this study could provide more evidence about the usefulness of CM and if it can be a viable solution for students to obtain creativity and higher-order thinking. In the field of critical thinking, professional nurses entering the workforce today are sometimes missing critical thinking skills.

A definition map for graduate nurses provides an instrument to direct their critical thinking until it is inherent or second nature. Therefore, this study was conducted to evaluate the effect of mind mapping on critical thinking of student nurses'.

Aim of the study:

The purpose of this study was to evaluate the effect of the mind mapping technique on the critical thinking skills of student nurses'.

Research hypothesis:

Nursing students who taught the mind mapping technique will exhibit improved critical thinking skills compared to their pre-intervention level.

Subjects and Methods:

Research design:
Quasi-Experimental research (a group of pre/post design) is employed to achieve this goal. Quasi-experimental research designs examine whether there is a causal relationship between independent and dependent variables. Simply defined, the independent variable is the effect variable and the dependent variable is the variable that is being influenced [20].

Subjects:
A convenience sample of one hundred undergraduate nursing students (females and males) who joined in the Medical-Surgical Nursing course during the second term in the academic year 2017/2018 of a baccalaureate nursing program in a particular college was selected as the study sample. Repeater students, those coming from the technical nursing institute were omitted from the study sample to avoid bias in the sample previously intended for course materials. Also, people previously exposed to concept mapping learning were excluded from the study. Nursing students were classified into ten groups in both classroom education and clinical education. A rotation plan is designed to distribute students between theoretical and practical teaching.

Research setting:
The Second-year classroom of the Menoufia University faculty of nursing was the study setting selected for the conduction of the study. The class capacity was 200-250 students. Also, student clinical setting for using the practical part conducted at the Menoufia teaching hospital in medical word rotation between student groups. The clinic placement had the capacity of a group of ten students at the time.

Data Collection Tools
Three implements were applied to collect information on current work.

1. A structured interview questionnaire
It developed by the researcher to collect the students' character of age, gender, and marital status. The questionnaire also included forty questions related to the topics of the selected studies. Topics selected included two basic concepts (Fluid and electrolytes, and pain), and two common disorders (Diabetes Millets, and Hypertension). The questionnaire consisted of 20 MCQs and 20 open-ended questions (five correct points in each). The questionnaire used as a pre and posttest.

Scoring system:
The questionnaire corrected against the sample model answer. MCQs were corrected as a mark for the correct answer and 0 for the incorrect answer (total 20 marks). Open-end questions are corrected as a mark for each correct answer point and zero for an incorrect or incomplete answer (100 marks in total). The total questionnaire summed, and the mean score counted for the whole questionnaire.

2. Yoon's Critical Thinking Disposition Inventory (YCTD)
This tool was developed by Yoon [21] to measure student nurses' critical thinking. The inventory included 27 statements assessing seven domains of critical thinking. The domains included critical thinking self-confidence (4 statements) items no. 17, 19, 23, 27; intellectual eagerness /curiosity (5 statements) items no. 13, 15, 20, 21, 22; intellectual fairness (4 statements) items no. 1, 5, 24, 26, objectivity (3 statements) no. 3, 6, 8; prudence (4 statements) item no. 2, 4, 14, 18; healthy skepticism (4 statements) items no. 7, 10, 12, 16; and systematically (3 statements) items no. 9, 11, 25. The tool reliability was tested using the Cronbach alpha coefficient test (0.842) for Korean nursing students and showed high reliability by several previous studies [22-24]. Cronbach's alpha coefficient test in this study was (0.867). This tool is used twice pre and post-intervention.
These statements were rated on a 5-point Likert scale ranging from 1 to 5, indicating (strong disagreement) to 5 (strong agreement), respectively. The score is calculated as the mean and standard deviation for each subscale and total. Minimum and maximum scores were also recorded for each subscale.

3. Nurses' perception Assessment questionnaire toward Mind mapping
The tool was developed by the researcher to assess the perception of nursing students to mind mapping as a teaching approach. It includes 11 statements in the form of positive and negative statements. Responses were tested against a 5-point scale ranging from 5 to 1, which represents strongly agree (5 points) to strongly disagree (1 point), respectively. The score reversed for thee negative statements. Therefore, the higher the score, the more positive the perception toward mind mapping. This tool is used once after using mind mapping. The perception scale has been tested for its internal consistency and has shown good reliability (0.860).

Procedures:

Study tool validated by a panel of 5 professors in nursing education and medical-surgical nursing for coverage, clarity, wording, length, format, completeness, relevance, and the overall appearance. Changes to the tools were made according to the suggestions of the experts.

A pilot study was conducted on a group of ten students (10% of the sample) to evaluate the feasibility of the research process and to test the adequacy and applicability of the study tools. The pilot sample was later excluded from the primary sample.

The official permission was issued from the Dean of Faculty of Nursing at the University of Menoufia. A written agreement was also gained from the Ethics and Research Committee of the College of Nursing, Menoufia University. After explaining the purpose and nature of the study, the researcher obtained consent from each student. Voluntary participation ensured the anonymity of the data was assured. Each student was informed that the test grades will only use for research purposes and will not affect their total academic grade.

The current study was conducted through the phases; Assessment, planning, implementation, and evaluation. The first phase (assessment) consists a set of subjects' contents, its relevant clinical training in medical word, a rotation plan, and study documents to record student grade. A pretest was distributed for all students at the same session before the application of concept mapping to avoid sample contamination. The assessment phase started in September 2017 and ended at the end of October 2017.

The planning phase includes study protocol design, tool validation and testing for internal consistency, and environmental preparation, Clinical setting selection, and classroom preparation. Designing the final form of a handout, designing mind mapping for the four subjects selected in the form of poster presentation, and interactive PowerPoint presentation. The planning phase ongoing from the first of November 2017 to the end of December 2017.

The implementation phase began with a pilot study and general lectures were given to all students on mind mapping. This lecture includes an explanation of mind mapping as a concept, standard forms of mind mapping, advantages, uses, benefits, and applications. The lecture also includes instructions on how to draw a mind map that concentrates the main concept with a keyword and then divides the relevant pieces into a clear pattern. Then smaller branches expanded from the sub-branches with further details regarding the subtopics.

Then, the students classified into ten groups of 10 students. Each group had four theoretical teaching sessions for four theoretical subjects and three days of clinical teaching in the word general medical. For each group, the theoretical subject was taught on a Sunday followed by a practical training focusing on the subject taught on next Monday, Tuesday, and Wednesday. Every third day of practical training includes hands-on training in producing mind maps for selected topics.

During this session, student nurses were allowed to ask questions, clarify the mysteries regarding mind mapping and its application, and use it in various specialized subjects. The educational session consumed about 2 hours. Clinical education for each group was 18 hours. Data collection has started from February 2018 to the end of March 2018. These teaching sessions are embedded in course lectures and clinical education.

The evaluation phase includes the posttest distribution at the end of teaching for all groups' at the same time for all participating students. It was a one-hour test. The student perception questionnaires were distributed after the posttest to value the student perception for the mind mapping experience.

Data analysis:

Data entry and statistical analysis were performed using SPSS 24.0 statistical software package. Cronbach alpha coefficient was planned to assess the internal consistency of the developed tools'. Descriptive statistics were computed for some data including age, gender, marital status, and students' perception of mind mapping using frequency, percentage, mean, and standard deviation. The sample paired t-test is a statistical method to determine whether the mean-variance among two sets of observations is zero. Student t-test for comparing two independent groups (here we compare the critical thinking of male and female students'). Pearson correlation indicates the linear relationship between the two variables. Statistical significance was considered at the p-value ≤ 0.05.

Results:

Table 1 demonstrates the personal character of the studied nursing students. It was observed that the student nurses' mean age was 18.18±0.36, 80% of students were females, and 98% were singles.

Table 1: Demographic characteristics of nursing students' (N=100).

Demographic characteristics	**Min.**	**Max.**	**Mean**	**SD**
Age	17.11	19.00	18.18	0.36
	N		**%**	
Gender				
male	20		20.0%	

female	80	80.0%
Marital status		
single	98	98.0%
married	2	2.0%

Table 2 reveals a highly statistically significant difference between the total score of student's mean knowledge before and after using mind mapping.

Table 2: Student total knowledge score from before and after mind map application.

Student knowledge marks	**Min.**	**Max.**	**Mean**	**SD**	**t***	**P value**
Pre-test marks	55.00	88.00	70.50	6.90	13.02	<0.001
Post-test marks	58.00	95.00	84.29	9.06		

*Paired samples t-test

Table 3 shows the highly statistically significant differences between pre and post-application of mind mapping regarding all the critical thinking domains.

Table 4 shows the highly statistically significant negative correlation between intellectual fairness and age (P<0.001). The table also shows a statistically significant correlation between healthy skepticism and student age (p<0.05).

Table 5 demonstrates a highly statistically significant difference between the domain of intellectual fairness and student gender (for the sake of female students). The table also shows a statistically significant difference between the systematization and gender of students' (for the sake of female students).

Table 6 shows that 69% of student nurses agreed about the mind mapping as valuable when learning concepts, 61% agreed with mind mapping to improve understanding of topics, 53%, and 52% were strongly agreed that it helps recall information and agrees that it helps to organize information respectively. Also, 44% of them agreed with mind mapping, encouraging them to read and outline the chapters and helped to clear the concept. Finally, 50% disagreed about it is not their style, and 48% of them disagreed that mind mapping is not helped them with retention of the material.

Table 3: Students' critical thinking subscales before and after mind map application.

Critical thinking domains	**Min.**	**Max.**	**Mean**	**SD**	**t***	**P-value**
Critical thinking self-confidence (pre) (4 statements)	11.00	17.00	14.66	1.64	17.06	<0.001
Critical thinking self-confidence (post)	13.00	18.00	15.97	1.00		
Intellectual eagerness /curiosity (pre) (5 statements)	17.00	24.00	20.71	2.06	18.75	<0.001
Intellectual eagerness /curiosity (post)	20.00	24.00	22.34	1.25		
Intellectual fairness (pre) (4 statements)	9.00	15.00	11.86	1.58	23.97	<0.001
Intellectual fairness (post)	11.00	15.00	13.20	.89		
Objectivity (pre) (3 statements)	9.00	15.00	11.11	1.14	6.95	<0.001
Objectivity (post)	9.00	14.00	10.67	1.19		
Prudence (pre) (4 statements)	10.00	17.00	13.50	1.62	11.95	<0.001
Prudence (post)	11.00	17.00	14.58	1.20		
Healthy skepticism (pre) (4 statements)	12.00	18.00	14.66	1.64	17.67	<0.001
Healthy skepticism (post)	13.00	18.00	15.97	1.00		
Systematicity (pre) (3 statements)	3.00	5.00	3.52	.56	24.00	<0.001
Systematicity (post)	3.00	5.00	4.00	.35		
Total score (pre)	85.00	113.00	98.17	7.80	34.50	<0.001
Total score (post)	93.00	113.00	105.21	3.77		

*Paired samples t-test

Table 4: Correlation between critical thinking domains and student age before the intervention.

Critical thinking domains	**Age**	
	Pearson's correlation	**P-value**
Critical thinking self-confidence	0.11	0.28

Intellectual eagerness /curiosity	0.04	0.68
Intellectual fairness	-0.37	<0.001
Objectivity	-0.18	0.07
Prudence	-0.08	0.44
Healthy skepticism	0.21	0.03
Systematicity	0.04	0.69
Total score pre	-0.05	0.64

Table 5: Relationship between critical thinking domains and student gender before the intervention.

Critical thinking domains	Gender				t*	P-value
	Male		Female			
	Mean	SD	Mean	SD		
Critical thinking self-confidence	21.10	1.48	21.20	1.32	0.30	0.77
Intellectual eagerness /curiosity	18.90	1.12	19.12	1.30	0.71	0.48
Intellectual fairness	9.75	.55	10.71	.68	5.87	<0.001
Objectivity	11.40	.68	11.58	.96	0.76	0.45
Prudence	12.75	.79	12.34	1.29	1.36	0.18
Healthy skepticism	13.70	.92	13.26	.96	1.83	0.07
Systematicity	3.00	.00	3.05	.22	2.04	0.05
Total score pre	90.60	1.43	91.26	3.04	1.42	0.16

*Student t-test

Table 6: Student perception regarding mind map after intervention

Student's perception	Strongly disagree		Disagree		Unsure		Agree		Strongly agree	
	N	%	N	%	N	%	N	%	N	%
Valuable when learning concepts	0	0.0%	0	0.0%	13	13.0%	69	**69.0%**	18	18.0%
Improving understanding of topics	2	2.0%	0	0.0%	9	9.0%	61	**61.0%**	28	28.0%
Helpful in recall information	3	3.0%	0	0.0%	21	21.0%	23	23.0%	53	**53.0%**
Helpful in organizing information	2	2.0%	4	4.0%	11	11.0%	52	**52.0%**	31	31.0%
Encouraged us to read & outline the chapters	4	4.0%	4	4.0%	9	9.0%	42	**42.0%**	41	41.0%
Helped to clear concepts	2	2.0%	4	4.0%	11	11.0%	42	**42.0%**	41	41.0%
Good self-study tool	5	5.0%	3	3.0%	9	9.0%	38	38.0%	45	45.0%
Helpful for rapid revision	5	5.0%	2	2.0%	11	11.0%	37	37.0%	45	45.0%
Enjoyed learning nursing with this method	4	4.0%	3	3.0%	11	11.0%	39	39.0%	43	43.0%
Not my learning style	32	32.0%	**50**	**50.0%**	15	15.0%	2	2.0%	1	1.0%
I do not think it helped with retention of material	33	33.0%	**48**	**48.0%**	16	16.0%	1	1.0%	2	2.0%

Discussion

American Association of Colleges of Nursing [25]; the Korean Accreditation Board of Nursing Education [26], reported that critical thinking (CT) is recognized as a high energy outcome for nursing education. Facilitating CT remains a challenge, faced by both nurse educators and student nurses. However, the challenge facing them is the gap that exists between knowing the concepts of CT and being able to consistently using the critical-thinking process to real-clinical situations [27, 28]. So, this work aimed to estimate the impact of mind mapping on critical thinking of student nurses'.

The present study conducted on a convenient sample of one hundred year student nurses enrolled in the second year Medical-Surgical course, eighty percent of them were females, and most of them were single, and their mean age was 18.18±036. It should be noted that females comprised 90% of females account for 78% of registered nursing personnel in Egypt, while males comprised 9.22% [29]. This finding is similar to Jaafarpour et al. [30], who described that the average

age of participants in the study was 19 ± 1.2 years. This result is consistent with a report by Mohamed et al. [17] in a study entitled "effect of concept mapping on critical thinking skills of baccalaureate nursing students." They reported that the participants were ranged from 19-20 years old with a mean of 19.26±0.4. This finding is also consistent with Abd El-Hay et al. [31] in studying the impact of thought mapping on difficulty-solving skills, ability in clinical location and knowledge between undergraduate nursing students." The sample revealed a mean age of 20.07 ± 1.12, more than half of them were females, half of the student was in the second year, and the other half was in the fourth year.

The present study demonstrated a highly statistically significant difference between the mean score of students total knowledge before and after application of mind mapping. This finding may be due to the illustrative nature of concept mapping as well as the impact of teaching in small groups besides the complementary nature of practice in the real clinical setting. Hu and Wu [32] had a different explanation for this improvement. It was that concept mapping could help reduce students' intellectual load by assisting them to combine curriculum information.

Dhindsa and Anderson [33] suggested that teaching by mind mapping tactic had an additional positive effect on the superiority of the structure of cognitive information than students educated with the traditional teaching system. Adopting a concept mapping approach in nursing learning can considerably improve the knowledge attainment of Youssef and Mansour students [34]. Also, some authors recorded similar findings that mind mapping enhances students' learning successes, critical and creative thinking skills [35].

These results are consistent with Abd El-Hay et al., [31], who reported a statistically significant variation between pre and post-test information scores after using concept mapping in the clinical setting. Also, Abd El-Fattah, [36] reported the overall academic performance of student nurses in a study entitled "Improving 'nursing student disposition towards critical thinking and academic performance through the utilization of mind-mapping." Pre-and post-test mean scores in the experimental group revealed a statistically significant difference (t= -3.653, Sig=0.001) between the mean of the experimental pre-test (6.10 ±3.84) and post-test (9.73 ± 3.85).

The present study also reveals highly statistically significant differences between pre and post-application of mind mapping regarding all of the critical thinking domains. These results may reflect the effect of mind mapping as a new approach in teaching, which was attractive to student nurses. Likewise, these findings were also supported by Mostafa and Elmolla [37], who established that the study reported low scores of critical thinking before the intervention and added that low scores of critical thinking among their study subjects could undoubtedly be returned to the educational structure given in secondary schools in Egypt. Most of this with the traditional teacher-centered relatively than student-centered learning, where the student is generally the passive recipient. Such traditional educational systems do not authorize students to be self-confident and progress in thinking.

A similar study conducted by Atay and Karabacak [38], with 80 freshman and sophomore nursing students, found that concept mapping improved their critical thinking skills, upon concept mapping training and implementation over time. Along the same line, Tiruneh et al. [39], showed that the study revealed that the existing evidence specifies that the level of CT demonstrated by most students is insufficient, and they discussed that classroom education is frequently ineffective to support students obtain thoughtful skills which they can use to explain significant difficulties inside corrective zones and in routine life.

Besides, several authors have shown that concept mapping is an operative method to increase students' capability to critical thinking [40-42]. Similarly, with the findings of the present study, numerous researchers have displayed a positive outcome in critical thinking scores and concluded that concept mapping can promote critical thinking and enable students to conceptualize treatment strategies in both classroom and clinical practice settings [43-46]. Moreover, Tiruneh et al. [39] conducted a systematic review about the effectiveness of critical thinking instruction in higher education, which showed that out of 27 studies, sixty percent of studies yielded significant CT improvement after using mind mapping.

Sadeghi et al. [47] reported a significant improvement in the total pre-test and post-test mean score in the experimental group who had been trained using the mapping from 9.71 ± 2.66 pre-intervention to 15.20 ± 2.71. The study also concluded that using concept mapping strategies in nursing students learning may lead to developing critical thinking skills as one of the crucial missions of higher-level education.

Mohamed et al. [31] reported a statistically significant difference between pre-test and post-test in the critical thinking mean scores of students in the experimental group (t= 5.106, P= 0.000) after using concept mapping. Also, Farrag [48] conducted a study on the use of concept mapping strategy for enhancing maternity nursing students' attainment and yielded the same results and argued that these results clarified by the fact that contact to learning via the customary learning system resulted in dualistic thinking, concrete, and superficial learning, while, the concept map strategy enhances the capability of the students to manage and organize the information by inspiring students to procedure evidence intensely for understanding. These findings were supported by the research hypothesis.

On the other hand, the findings of the current study are inconsistent with Carson-Davis [49], who conducted a study about the association among critical thinking skills and concept mapping of vocational nursing students and found that there was no significant marked increase in critical thinking for subjects before application of the teaching strategy of concept mapping. The results also showed that there was no significant increase in the mean of CCTST scores from pre-test to post-test. In the same line, Sinatra-Wilhelm [50] compared the procedure of nursing care strategies and concept mapping to improve critical thinking skills as measured by CCTST in sophomore-level baccalaureate students. Findings demonstrated

no significant difference in the total score of critical thinking. Despite this finding, the faculty feedback indicated they felt that the concept mapping students were better at connecting medical diagnoses, assessment data, and nursing interventions.

Also, Maldonado [51], in his study about belongings of concept mapping on critical thinking skills of baccalaureate nursing students, found that after implementing concept mapping teaching strategy, no statistically significant difference were observed in the CCTST. Maldonado argued that perhaps one semester of using concept mapping might be not enough to measure the impact of concept mapping on students the critical thinking skill of entry-level.

Sirisom et al. [52] reported non-significant variation among the mean scores of critical thinking capability before and after applying for the CSCM program. The mean scores of overall critical thinking ability both before (24.49±3.46) and after (24.08±3.36) the program was found no significant differences between the two values.

The difference between the findings of the current study and the contradicting findings may be related to the introducing of concept mapping early in the student level before they established a preferable study method may be beneficial to improve their critical thinking which was the case in the current study as our sample was in the fourth semester of their education. This interpretation is supported by Romanko [14] in his quantitative meta-analysis to discover the impact of concept mapping as a learning system on developing critical intelligent skills among nursing students. Romanko [14] clarified that the results of this study were related to the time when the involvement of concept mapping was presented to the nurses. The most valuable period for presenting concept mapping to nursing students early in the program is before they firmly know their favorite methods suggested by many documents. In addition, Bixler et al. [53] found that there was no significant increase in CT as determined by the CCTST from pre-test to post-test when students were learned by applying a concept mapping method. They established that while the variance of CT scores was non-significant, the study could help as an essential start point in the expansion of a curriculum dedicated to enhancing CT.

Furthermore, Wahl and Thompson [40]; and Zarifsanaiey et al. [54] Almost similar results were obtained and determined that a training course alone is not correlated significantly related to critical thinking, attaining critical intelligent skills requires a long time and persistent learning. The lack of a significant elevation of inclusive critical thinking post-test scores may be resultant from many factors connected to the situations in performing the study, importance in compelling tests, the participants' perceptions and relief level with participating in the study, participants' developmental stages and the shortness of the experiment [55].

Over two-thirds of student nurses agreed about the mind mapping as valuable when learning concepts, nearly two-thirds, agreed about the mind mapping to improve understanding of topics, more than half were strongly agreed that it helped recall information and agreed that it helps organize information respectively. Also, about half of them agreed with mind mapping to persuade them to read and outline the chapters and helped to clear the concept. This positive perception may be referred to the proper use of student for the mind mapping under supervision and facilitation of the researcher for several sessions in a small group.

Similar findings were reported by Nirmala and Shakuntala [56], who showed that students touched that the concept map was fascinating, and encouraged them to think better. An insufficient number of students have reported that it is primarily difficult and capable to draw the maps late. Besides, Wahl and Thompson [40] showed that nursing students in their study had a feeling pleased and undergoing positive attitudes to clinical scenarios and simulations after consuming concept maps in their clinical training. Besides, Moahmed [57], who stressed that CM is an appropriate education program in several locations of education. Intervention group students in this study reported a positive approach to the use of CM in clinical courses.

This finding is consistent with Sirisom et al. [52] in describing the content analysis of student understanding of the case study and concept map program on 84 medical surgical students. This study has shown two intermediate topics, the progress in the thinking and the active student progress. The CSCM program are assistances students to advance their thinking process throughout data collection, data analysis, and finally writing the summary or conclusion. The program is capable of enhancing students' analytical and critical thinking and improving the process of accessing data and information. Students reproduced on how they educated to overcome problems throughout thinking. The largest number of students participating in the program informed that the CSCM program stimulated they are keenly study.

They had to modify themselves to pay attention and raise a concern about access to new information. They were excited to learn from different bases other than teachers and textbooks. The program also motivated the participants to involve more in education and direct learning events. Teachers play an important role as initiator and guides.

Abd El-Hay et al. [31] reported similar findings that 65.0%, 43.3%, 73.2%, 46.7%, and 43.3% of them were disagreed about: using concept-mapping was beneficial to reduce worry in clinical settings; enjoy more when use concept map in clinical settings; The concept map is an operative teaching/ learning/assessment tool; concept map consumed time that is needed to complete management and find concept map challenging to express thoughts and convert it to care for patient respectively.

The contradicting findings are reported by Zipp and D'Antoni [58], in a study entitled "mind maps: a useful schematic tool for integrating and organizing concepts of complex patient care in the clinic and classroom." The student nurses' perception of mind mapping revealed that they did not agree that mind mapping improved communication skills. This finding does not positively support mind mapping in the development and retention of student knowledge.

When reviewing responses to the surveys open-ended questions, the following were noted; Mapping the mind encouraged us to read and outline chapters, useful self-study tools, forced the students to read the chapter thoroughly, sit down and study

well long before exams. It helped the students to organize information and useful to outline, made me go through the chapters and keep up on reading, I liked the fact that I was able to open the neuro book and truly examine the chapter in a timely efficient manner, Mind mapping is not my learning style, I do not think it helped with retention of material, Not my type of learning, but I'm sure it would help if I had spent more time with it, I wouldn't really utilize it during studying since, it is not my way of learning, and they were unorganized for my style of learning and after doing them, I never looked back at them.

One of the significant findings in this study is a highly statistically significant negative correlation between intellectual fairness and age ($P<0.001$), and a statistically significant correlation between healthy skepticism, and student age ($p<0.05$). This finding is inconsistent with Dwyer, [59] finding, who reported that there was no statistically significant difference between the study sample age groups.

Also, there was a highly statistically significant difference between the domain of intellectual fairness and student gender (for the sake of female students), and a statistically significant difference between systematicity and gender of students' (for the sake of female students). Shubina and Kulalll [60] in the study of critical thinking, creativity, and gender differences for knowledge generation in education. Findings showed that gender had a significant effect on critical thinking skills and creativity. Therefore, it ensures knowledge creation and sharing in the modern educational era. Aliakbari and Sadeghdaghighi [61] reported such a gender difference, but contrary to the findings of the current study, males were higher in comparison with female counterparts. Another contradiction to the findings of the present study is the findings of Salahshoor and Rafiee, [62], who reported a non-significant difference between males and females in a study regarding the relationship between critical thinking and gender: a case of Iranian EFL learner. This contradiction may be attributed to the difference in the domains of learning, as these studied tested critical thinking among linguistic student learners.

Conclusion:

The findings of the current study concluded that nursing students who taught by mind mapping exhibited better critical thinking skills compared to their pre-intervention level. Also, an improvement in knowledge level was demonstrated in the students. The study also showed a positive perception of student nurses mind mapping and a statistically significant relationship between age and intellectual fairness, healthy skepticism, and systematicity. In addition, a statistically significant difference was revealed between gender and intellectual fairness.

Recommendation

- Based on the findings of the present study, the following recommendations are recommended
- Deans, program directors, and nursing faculties assess their curricula to integrate teaching strategies into concept maps in courses to develop and improve the critical thinking skills of their students.
- Train and encourage the students to use mind maps as a note-taking strategy during lectures, and in clinical practice sessions. Also, encourage them to show their maps to their teacher to benefit the most from their advice. Encourage them also to use the concept of mapping during their case presentation and to use the collaborative mapping software and post their maps on the website links. Encourage them to utilize concept mapping in all courses until it becomes a part of their personal learning experience rather than random assignments.
- The orientation of the faculty staff regarding the utilization of concept mapping to widening the utilization in different nursing courses is also recommended.
- Encouraging the academician to formulate new teaching strategies that can potentiate the students' critical thinking.
- Graduate nurses use this tool to focus on increasing care organizations, prioritizing problems that need to be addressed, and increasing their critical thinking skills.
- Replicate the current study on a larger probability sample to achieve generalization in different nursing faculties. Also, replicate the current study with a recruiting of a control group.
- Further researches to test the effect of various novel teaching strategies on the development and improvement of critical thinking skills of student nurses.
- Further studies to investigate the long-term effect of using mind mapping on critical thinking of nursing students'. Also, study the effect of electronic mind mapping on the nursing students' critical thinking.

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