

# Effectiveness of Mind Maps as a Learning Tool for Nursing Students

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**Abstract:** Critical thinking is increasingly gaining importance in nursing education, and various teaching strategies have been identified to apply it. Mind mapping is one of these innovative learning approaches. This study was aimed at examining the effectiveness of Mind Mapping Learning Technique (MMLT) in enhancing nursing students' learning. The study was conducted at the Technical Institute of Nursing affiliated to Menoufyia University in Egypt using a quasi-experimental design with control group and pre-post assessment. It involved a convenience sample of 200 new entry students equally divided into intervention or control groups. Data collection tools included a written test administered to both groups before and after the intervention, and an evaluation sheet to assess students' perception in the intervention group about the Mind Map. The results showed that the control group had a slightly lower pass rate (42.0%) compared with the intervention group (51.0%) before the intervention, but with no statistically significant difference. After the intervention, the pass rate was 89.0% in the intervention group and 57.0% in the control group ( $p < 0.001$ ). They had a higher median score (87.0) compared to 71.0 in the control group ( $p < 0.001$ ). Moreover, the median post-pre difference in their score was 17.0 compared to only 4.0 in the control group ( $p < 0.001$ ). The perception of mind mapping technique in the intervention group was very high, and it correlated positively with the improvements in their scores ( $r = 0.617$ ,  $p < 0.01$ ). In multivariate analysis, the mind mapping technique was the main significant positive independent predictor of the post-intervention score, in addition to female gender. The improvement in the scores of the intervention group was predicted by their perception score. Hence, mind mapping is an effective and acceptable educational technique that can help nursing students. Further studies are needed to examine its effectiveness in long-term retention of information, and its impact on the utilization of the acquired information in practice.

**Keywords:** mind map, student achievement, students' perception, nursing education.

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## 1. INTRODUCTION

Worldwide, the educational programs and teaching strategies in nursing and medical schools have witnessed changes aimed at increasing students' active participation and responsibility for own learning, with more tendency towards self-directed learning to ensure lifelong continuing education (Buzan, 2010). These changes emerged from educators' concerns that students tend to memorize facts "rote learning" rather than understand and apply concepts "meaningful learning" (Buzan and Buzan, 2010). Problem-based learning incorporates techniques of brainstorming, organizing ideas, taking notes, learning collaboratively, presenting, and studying (West et al., 2000). Moreover, critical thinking is increasingly gaining importance in nursing education (Spencer et al., 2013), and various teaching strategies have been identified to apply it (Julie et al., 2013). Such innovative approaches would promote students' ability in developing care plans and health promotion activities, as well as synthesizing disease processes, and forming differential diagnoses (Rendas et al., 2006, Rosciano, 2015). Nonetheless, this requires active teaching and learning strategies, which would constitute a new challenge to nurse educators (Zipp and Maher, 2013).

Nurse educators should create learning experiences that enable students to think and to be better learners (Christensen et al., 2008). Mind mapping is a creative way for students to engage in a unique method of learning that can expand memory recall and help create a new environment for processing information (Ifenthaler et al., 2011). This strategy was created in the early 1980s (Daley et al, 2016) for assisting students to order their thinking through mentally mapping words or notions (Nettleship, 1992), and clarify their thinking (Kotcherlakota et al, 2013). A mind map can be expressed as a diagrammatic representation of words, ideas, tasks or other items associated with a study topic arranged around a central key word or idea (Ambrose et al., 2012). The main study topic is drawn at the center with keywords corresponding to subtopics branching out in a divergent pattern (Ryan and Deci, 2000). Smaller branches project from the subtopics with further details regarding the subject being included in a progressively branching pattern (Alamsyah et al., 2009, Ahangari2011). Artistic arrangements are not only allowed but also desired as advantageous for more creativity and pleasure (Jones et al., 2012).

Mind maps (Mms) are considered a powerful metacognitive tool that can facilitate the acquisition of knowledge through meaningful learning, and can thus be used to promote and evaluate critical thinking (Edwards and Cooper, 2010). By using mind maps, learners make a link between unknown and known information that leads to deeper understanding (Kyoko and Hiroko, 2011). It is an extremely effective method of taking notes, and it aids recalling of existing memories. This teaching-learning method does not teach students to think, but helps them to actively acquire information (Sarhangi et al., 2010). It enables students to link stories through patterns, keywords, or symbols (Mento et al., 2009). Moreover, mind mapping can be used in self-learning; it facilitates the achievement of a conceptual understanding of a huge amount of information, integrating concepts together (All and Havens, 1997), as well as promoting inquiry and reflection (Eppler, 2006), and helps bridging the gap between theory and clinical competence (Jamison and Lis, 2014). It can be integrated in problem-based learning (Thomas et al, 2016). It was even recently used in the conduction of systematic reviews (Pombo et al, 2017) and in biomedical research as well (Jiang et al, 2016) with related software programs (Mammen, 2016; Wilson et al, 2016).

### 1.2 Significance of the study:

Nurse educators are under pressure to prepare graduates who are able to think critically and solve problems in a variety of clinical practice settings. They require active teaching strategies to promote meaningful learning, instead of relying on traditional methods that promote recall and memorization. A review of the current state of the science with regard to concept mapping demonstrates that this teaching-learning method can assist nurse educators to prepare students to think critically in the complex health care environment. Therefore, the researcher was motivated to examine the effectiveness of this technique in a medical-surgical course for nursing students.

### 1.3 Aim of the study:

This study was aimed at examining the effectiveness of Mind Mapping Learning Technique (MMLT) in enhancing nursing students' learning. It was hypothesized that the nursing students exposed to the MMLT will have significantly higher test scores compared to those exposed to traditional methods of learning.

## 2. SUBJECTS AND METHODS

**2.1 Research design and setting:** A quasi-experimental design with control group and pre-post assessment was utilized to conduct this study at the Technical Institute of Nursing affiliated to Menoufyia University in Egypt.

**2.2 Subjects:** Two equal groups of new entry students in the study setting from the academic year 2014- 2015 were recruited by convenience sampling, and assigned to either the intervention or control groups. They were matched for age and gender. The sample size was 100 students in each group. This sample size was large enough to demonstrate a post-intervention score difference of 5.0 or more between the two groups, with 10.0 standard deviation, at 95% level of confidence and 90% study power, and accounting for an expected dropout rate of about 15%.

**2.3 Data collection tools:** The investigator utilized a written test and an evaluation sheet as data collection tools to achieve the objectives of the study. The written test consisted of 30 questions related to the studied topics: 10 short essay questions, 20 multiple-choice questions. The test was administered to both groups, once before the intervention, and a

second time after the intervention. The students were asked to write down their age, gender, and marital status at the end of the test sheet.

The second tool was intended to assess the perception of students in the intervention group about the Mind Map as a learning technique. It had 11 statements, both positive and negative. The responses were on a 5-point Likert scale ranging from “strongly agree” to “strongly disagree.” These were scored from five to one, respectively. The scoring was reversed for negative statements so that a higher score indicates more positive agreement. The scores of the eleven items were summed-up and divided by the number of statements to provide a mean score with a maximum of five. Means, standard deviations, medians, and quartiles were computed for each item and for the total scale.

The tools were vigorously revised by a group of nursing educators from faculty members various nursing specialties. They face and content-validated the tools through assessing were their format layout and consistency as well as knowledge accuracy and relevance. The reliability of the perception scale was assessed through testing its internal consistency. It showed good reliability with Cronbach alpha coefficient 0.86, i.e. higher than the acceptable level of  $\geq 0.70$  according to (*Kirk and Miller, 1986*).

**2.4 Study maneuver:** Upon obtaining official approvals to conduct the study, the researcher started to meet with the students to explain to them the aim and procedures of the study and its procedures and invite them to participate. Those who consented were distributed into two equal, age and gender-matched groups, one for intervention and the other for control.

The intervention group was divided into small subgroups of ten students. The educational guidelines were presented in theoretical and practical sessions. Each subgroup got four sessions, two theoretical and two practical. The theoretical sessions (45 -60 minutes each) included lectures using data show and group discussions and covered the basic concepts, methodology, advantages, and applications of mind mapping. They were also informed about the principles of how to use mind mapping through drawing the topic in the center with keywords branching out in a divergent pattern; the keywords corresponding to subtopics. Then, smaller branches project from the subtopics with further details regarding the subject. The practical part was conducted in two sessions, one-hour each using demonstration-re-demonstration. They involved hands-on training in producing mind maps for selected topics. Five topics were selected as study materials, namely diabetes, hypertension, renal failure, pneumonia, and angina. During training participants were given the opportunity to ask questions regarding the technique and its application. Students were informed to be in contact with the researchers by telephone for any guidance.

The control group students were exposed to the routine method of teaching for the same selected topics and the same study period. Students in both groups were assessed by the end of the course time using the same evaluation tool and methodology. This included a written test with 10 short-essay questions and 20 multiple-choice questions. The test duration was 90 minutes. Questions reflected various cognitive levels according to Bloom taxonomy. The scores obtained by students in the two groups were compared. Additionally, students` perception regarding the new mind map technique was obtained from the intervention group using the pre-designed scale. The work lasted for two months.

**2.5 Administrative and ethical considerations:** In the planning stage, a written approval was obtained from the Director of the above mentioned setting after examination of the study protocol and tools. All students were informed about the study aim and procedures and about their rights to participate or refuse, as well as to withdraw. Oral informed consents were obtained from each student who agreed to participate in the study.

**2.6 Statistical analysis:** Data entry and statistical analysis were done using SPSS 20.0 statistical software package. Cronbach alpha coefficient was calculated to assess the reliability of the developed tools through their internal consistency. Quantitative continuous data were compared using the non-parametric Mann-Whitney test. Qualitative categorical variables were compared using chi-square or Fisher exact tests as suitable. Spearman rank correlation was used for assessment of the inter-relationships among quantitative variables and ranked ones. In order to identify the independent predictors of the knowledge score, multiple linear regression analysis was used, and analysis of variance for the full regression models was done. Statistical significance was considered at p-value  $<0.05$ .

### 3. RESULTS

**Table 1: Socio-demographic characteristics of students in the study and control groups**

	Group				X <sup>2</sup> test	p-value
	Intervention (n=100)		Control (n=100)			
	No.	%	No.	%		
Gender:						
Male	20	20.0	20	20.0	0.00	1.00
Female	80	80.0	80	80.0		
Age:					U=1.48	0.22
Range	17.0-19.0		17.0-19.0			
Mean±SD	18.2±0.4		18.2±0.5			
Median	18.0		18.0			
Marital status:					Fisher	1.00
Single	99	99.0	98	98.0		
Married	1	1.0	2	2.0		

(U) Mann-Whitney test

as shown in Table (1) The study involved two equal groups of nursing students with exactly the same gender distribution, having a majority of females. The two groups had exactly the same median age of 18.0 years. Only one student in the intervention group and two in the control group were married.

**Table 2: Test results and scores among students in the study and control groups**

	Group				X <sup>2</sup> test	p-value
	Intervention (n=100)		Control (n=100)			
	No.	%	No.	%		
Pre-score:					1.63	0.20
Pass (80+)	51	51.0	42	42.0		
Fail (<80)	49	49.0	58	58.0		
Range	51.0-88.0		48.0-81.0			
Mean±SD	68.2±8.1		65.6±8.2			
Median	70.0		67.5		U=3.53	0.06
Post-score:					25.98	<0.001*
Pass (80+)	89	89.0	57	57.0		
Fail (<80)	11	11.0	43	43.0		
Range	55.0-95.0		59.0-88.0			
Mean±SD	84.2±9.3		70.8±6.7			
Median	87.0		71.0		U=82.97	<0.001*
Post-pre difference:					U=83.76	<0.001*
Range	-3.0-36.0		-7.0-24.0			
Mean±SD	16.0±8.4		5.2±4.6			
Median	17.0		4.0			

(\*) Statistically significant at  $p < 0.05$

(U) Mann-Whitney test

As illustrated in Table 2, before the intervention the control group had a slightly lower pass rate (42.0%) compared with the intervention group (51.0%), but with no statistically significant difference. At the post-intervention phase, the success (pass) rate was 89.0% in the intervention group and 57.0% in the control group, with statistically significant difference ( $p < 0.001$ ). They also had a higher median score (87.0) compared to 71.0 in the control group ( $p < 0.001$ ). Moreover, the median post-pre difference in their score was 17.0 compared to only 4.0 in the control group ( $p < 0.001$ ).

**Table 3: Perception of mind mapping technique among students in the intervention group**

	Perception (%)			Score (max=5)				
	Strong agree/ Agree	Uncertain	Strong disagree/ disagree	Mean	SD	Median	Quartiles	
							1 <sup>st</sup>	3 <sup>rd</sup>
Valuable when learning concepts	87.0	13.0	0.0	4.05	0.56	4.00	4.00	4.00
Improving understanding of topics	89.0	9.0	2.0	4.13	0.73	4.00	4.00	5.00
Helpful in recall information	76.0	21.0	3.0	4.23	0.98	5.00	4.00	5.00
Helpful in organizing information	83.0	11.0	6.0	4.06	0.87	4.00	4.00	5.00
Encouraged us to read & outline the chapters	83.0	9.0	8.0	4.12	1.01	4.00	4.00	5.00
Helped to clear my concepts	83.0	11.0	6.0	4.16	0.92	4.00	4.00	5.00
Good self-study tool	83.0	9.0	8.0	4.15	1.05	4.00	4.00	5.00
Helpful for rapid revision	82.0	11.0	7.0	4.15	1.04	4.00	4.00	5.00
Enjoyed learning nursing with this method	82.0	11.0	7.0	4.14	1.01	4.00	4.00	5.00
Not my style learning	3.0	15.0	82.0	1.90	0.80	2.00	1.00	2.00
I don't think it helped with retention of material	3.0	16.0	81.0	1.91	0.84	2.00	1.00	2.00
Total perception	89.0	3.0	8.0	3.73	0.58	3.86	3.55	4.09

As regards students' perception of the mind mapping technique in the intervention group, Table 3 demonstrates very high agreements upon all positive statements. This ranged between 76.0% for being helpful in recall to 89.0% for improving understanding of topics. Their first quartile scores were 4.00, indicating that at least three-fourth of the sample were agreeing. On the other hand, the table shows very low agreements (3.0%) upon the negative statements such as "Not my style of learning," and "I don't think it helped with retention of material." Overall, the total median score was 3.86 indicating a trend towards agreement.

**Table 4: Correlation between intervention group students' perception of mind exercise and their post-pre score differences**

	Post-pre-intervention scores	
	Spearman's rank correlation coefficient	p-value
Valuable when learning concepts	0.340	0.001**
Improving understanding of topics	0.384	<0.001**
Helpful in recall information	0.649	<0.001**
Helpful in organizing information	0.481	<0.001**
Encouraged us to read & outline the chapters	0.583	<0.001**
Helped to clear my concepts	0.585	<0.001**
Good self-study tool	0.560	<0.001**
Helpful for rapid revision	0.575	<0.001**
Enjoyed learning nursing with this method	0.572	<0.001**
Not my style learning	-0.429	<0.001**
I don't think it helped with retention of material	-0.314	0.001**
Total perception	0.617	<0.001**

(\*\*) Statistically significant at  $p < 0.01$

Table 4 illustrates statistically significant weak to moderate positive correlations between students' post-pre-intervention scores (indicating improvement) and their scores of agreement upon various positive aspects of the mind mapping technique. The strongest correlation was with the statement of helping recall information ( $r=0.649$ ), whereas the weakest was with the statement that it was valuable when learning concepts. Conversely, the table points to statistically significant weak to moderate negative correlations with the scores of agreement upon the two negative statements. In total, there was a moderate positive correlation between students' total post-pre-intervention scores and their total scores of agreement upon various positive aspects of the mind mapping technique ( $r=0.617$ ).

**Table 5: Best fitting multiple linear regression model for the post-intervention score and post-pre score difference**

	Unstandardized Coefficients		Standardized Coefficients	t-test	p-value	95% Confidence Interval for B	
	B	Std. Error				Lower	Upper
Post-intervention score (both groups)							
Constant	74.11	2.60		28.479	0.000	68.98	79.24
Intervention	13.42	1.10	0.64	12.163	<0.001	11.24	15.60
Female gender	5.60	1.38	0.21	4.060	<0.001	2.88	8.32
r-square=0.45 Model ANOVA: F=82.41, p<0.001 Variables entered and excluded: age, marital status							
Post-pre-intervention difference (intervention group)							
Constant	-12.89	4.60		-2.803	0.006	-22.02	-3.77
Perception score	7.76	1.22	0.54	6.366	<0.001	5.34	10.18
r-square=0.29 Model ANOVA: F=40.52, p<0.001 Variables entered and excluded: age, gender, marital status							

In multivariate analysis, Table 5 illustrates that the study intervention (mind mapping technique) was the main statistically significant positive independent predictor of the post-intervention score, in addition to the female gender. The two variables explain 45% of the variation in the post-intervention score as shown by the r-square value.

As regards the post-pre improvement in the scores of students in the intervention group, the table demonstrates that the perception score was its only main statistically significant positive independent predictor. It explains 29% of the variation in the post-intervention score as shown by the r-square value. None of the students' characteristics had a significant influence on this score difference.

#### 4. DISCUSSION

The present study findings point to supremacy of the mind-mapping learning technique over traditional learning methods. The new technique is highly acceptable by students. The study findings demonstrated that the students in the mind-mapping group had better success rates, and quantitatively they had significantly higher post-pre score difference.

Although the present study used a quasi-experimental design rather than true randomized trial, the two groups were matched for age and sex, and were similar in their basic characteristics. Moreover, their pretest results did not show any difference of statistical significance. This group similarity was important in order to obtain a fair comparison of the study intervention. Furthermore, the multivariate analysis demonstrated that the study intervention (mind mapping technique) was the main positive predictor of the posttest, independently of the other variables. Thus, the use of mind mapping seems to be more effective in comparison with the traditional teaching method. This is attributed to its innate characteristics of promoting synergistic work of the brain through the use of codes and graphics with various colors and dimensions to enrich key points of the topic, consequently improving retention (*Spencer et al, 2013*). Moreover, mind mapping has been described as an active learning tool that promotes deeper knowledge of concepts and their intricate relationships, with better grasping (*Berglund, 2015*).

The present study findings concerning the better success rates and higher mean score differences among the nursing students in the mind mapping group, compared with the control group students are in agreement with similar previous studies. Thus, *Kaddoura et al (2016)* in a study in North Carolina found that nursing students in the first year of the

Bachelor Nursing program taught by mind mapping group had significantly better posttest results in comparison with their peers taught by traditional methods. On the same line, *Jaafarpour et al (2016)* in a quasi-experimental crossover study in Iran assessed the effectiveness of concept mapping as a teaching method for nursing students. The findings favored the use of mind mapping based on their significantly higher posttest scores compared with the conventional methods group. Moreover, their scores demonstrated gradual improvement throughout the eight sessions of the intervention.

Furthermore, *Zadeh et al (2015)* compared the effect of mind mapping and traditional methods on Iranian nursing students in a quasi-experimental study. As in the current study, there were no significant differences in the pretests of the two groups. At the posttest, students in the mind mapping group had significantly higher mean scores compared with the control group. Additionally, a study in the United States gave evidence of the effectiveness of mind mapping not only in improving students' knowledge and practice, but also in enhancing their critical thinking disposition and skills (*Bixler et al, 2015*). A similar positive effect of mind mapping on nursing students' critical thinking was also reported by *Moattari et al (2014)* in a quasi-experimental post-test only study in Iran. Also, a recent systematic review gave evidence of the positive effect of mind mapping in developing critical thinking in nursing education (*Yue et al, 2017*).

According to the present study findings, the use of mind mapping not only improved students' posttest scores of knowledge, but also was associated with high levels of students' satisfaction. Thus, they mostly had positive perception of the technique, with majority agreement upon its merits. Moreover, it was noticed that their agreement upon the advantages related to higher ranking cognitive levels such as "improving understanding of topics" was higher compared to lower ranking ones such as "being helpful in recall." The findings reflect the positive effects of mind mapping on all cognitive levels, with more emphasis on higher-rank ones. This was also evident in the posttest, which included questions covering the whole spectrum of cognitive levels. The high level of students' satisfaction and positive perception of mind mapping revealed in the present study, *Duffy et al(2015)* in a study in Ireland found that the majority of the students using mind mapping viewed the technique as helpful, stimulating, and interesting, with only a few of them having some difficulties with its application.

In congruence with these foregoing present study findings, *Hsu et al (2016)* in an experimental study with pre-post assessment in Taiwan compared the level of satisfaction of nursing students learning through mind mapping with a control group taught by objective-based lectures only. The results demonstrated significantly higher mean learning satisfaction scores in the intervention group compared with the control group. On the same line, *Grice (2016)*, in the United States, reported that the nursing students who used mind mapping as a learning tool found the process of creating such maps valuable to their learning, and they enjoyed the process. Moreover, *Saeidifard et al (2014)* compared concept mapping with lecture-based method in teaching of evidence-based topics to medical students in a randomized controlled trial. Subgroup analysis revealed significantly better scores of students in the intervention group compared with the control group in various cognitive levels.

In a further confirmation of the effect of the mind mapping technique in improving nursing students' scores, the present study revealed significant positive correlations between students' scores improvements and their scores of agreement upon positive statements of mind mapping perception, and negative correlations with the negative statements. Additionally, the total perception score was the significant positive predictor of the improvement in their score. Thus, the more the student is interested in the process and the more he/she perceives it positively, the higher is his/her improvement in knowledge acquisition. In congruence with this, *Jones et al (2012)* highlighted that a more qualified mind map created allows students to understand information with subsequent improvement in their grade values. Additionally, *Daley and Torre (2010)* emphasized that mind mapping can increase intrinsic motivation or motivation that is based on pleasure, which is very good to the learning understanding.

## 5. CONCLUSION AND RECOMMENDATIONS

Mind mapping is a useful and effective educational technique that can help nursing students in learning medical and surgical nursing lessons. It is also well accepted by students. This simple technique that needs only a brief training in its use should be applied in nursing schools. This may necessitate training of nursing educators in its administration. Further studies are needed to examine its effectiveness in long-term retention of information, and its impact on the utilization of the acquired information in practice.

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