Effect of Cognitive Maps on Students` Academic Achievement at Imbaba Technical Health Institute

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Abstract

Background: Cognitive mapping is one of the new teaching styles that enable learners to connect all information in their mind, enhance learning as it is evident in academic achievement. **The study aimed to:** Assess the effect of cognitive maps on students` academic achievement at Imbaba Technical Health Institute. **Design:** experimental design was utilized to conduct the study. **Setting:** The present study was conducted at Imbaba Technical Health Institute that affiliated to Ministry of Health. **Sample:** All nursing student who were enrolled in the second academic year (140 students), they were classified into 2 groups (study & control group). **Tools for data collection**: Three tools were used: Cognitive maps knowledge questionnaire, attitude assessment tool and students` academic achievement. **Results**: Majority of study group (95.70%) had adequate knowledge and (98.60%) had positive attitude toward cognitive maps at post program phase, There was more than one third of the study group students (38.6%) have excellent degree in the final exam, while there was only (12.9%) of the control group students have excellent degree in the same exam. **Conclusion**: There was significant improvement in nursing student's knowledge, attitude and academic achievement regarding cognitive maps. And there was a highly statistical significant correlation between nursing students` knowledge and their academic achievement after implementing the educational program. **Recommendations**: Provide training course for nursing instructor about cognitive maps, its benefits and how to use.

Keywords: Academic achievement, Cognitive map, Imbaba Technical Health Institute & Nursing students.

Introduction:

Nursing education is important for improving judgment and thinking skills of nursing students. One of the aims of nursing education is to graduate nursing students for ready to different clinical environments. The permanence of taught information and students participate in the process is important for realizing these objectives. Cognitive maps have a great impact on nursing student competencies for their nursing profession **(Wong et al., 2020)**.

Cognitive maps are one of the important teaching methods that help learners accurately acquire the information they need. A cognitive map is a learning and teaching strategy which bridges between how people learn and meaningful learning issues **(Nuuyoma, & Fillipus, 2020)**. In nursing education, Using of the cognitive map teaching method in nursing students improves the students' critical thinking skills, the sense of accomplishment, self confidence and making a cognitive map on their own. In addition, it was found that students can more easily identify subjects they don't know and understand, can better understand the subject and it has a positive effect on their academic achievement **(Akanbi et al., 2021)**.

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Academic achievement is something students achieve at school, college or university in class, in a laboratory, library or field work. The academic achievement refers to the average marks obtained by an individual in the final examination. It has long been recognized as one of the important goals of education encompassing the culture of a faculty and its presiding ethos and characteristics, including how students interact with and treat one another, as well as the ways in which teachers may organize an educational setting to facilitate learning (**Essa, et al., 2020**).

Regarding to effectiveness of cognitive mapping on students' academic achievement there are number of implications can be drawn from the concept mapping research. The first implication is that oral and written discourse is critical to conceptual change. Second, representing what learners know in only a single way engages only a limited set of cognitive skills and proficiency in cognitive map construction fosters meaningful learning. Finally, cognitive maps provide teachers with an avenue for developing insight into student understanding and have served as tools that foster student`s academic achievement, critical thinking abilities and the measurement of those thinking abilities within subject domains (**Huang et al., 2020**).

Significance of the study

Cognitive maps can be utilized to define the overlapping relationships among the various items and details of the subject. Accordingly, information saving and retrieval can be facilitated through using cognitive maps to create relations among information, connect old and new knowledge, and correct errors without duplication, saving the time and effort of the learner (**Aljaser, 2018**). In the learning process, cognitive mapping is an enormously appreciable technique to be learnt

and used by the students frequently. This technique permits nursing students to "organize facts and thoughts" in a map format containing a "central image in which the main themes radiating from the central image, branches with key images and key words, plus branches creating a connected nodal structure (**Muchhal, 2018**). So, this study will be conducted to assess effect of cognitive maps on nursing students` academic achievement at Imbaba Technical Health Institute.

The nursing student is the core of the educational process and the teacher is a facilitator and a motivator, many of the nursing students' difficulties when they get to the stage before college entrance, such as the institute degree, and their low academic results sometimes are due to the absence or bad acquisition of learning skills. When nursing students enter the institute they find that the subjects differ from those of secondary school.

Aim of the study

This study aimed to assess the effect of cognitive maps on nursing students` academic achievement at Imbaba Technical Health Institute

Research hypothesis

It is hypothesized that, an implementation of the educational program will lead to significant enhancement in nursing students` knowledge and attitude related to cognitive maps and it will have a positive effect on nursing students` academic achievement.

Subject and methods
Research design:

Experimental design was used in carrying out this study where pretest – posttest – study group& control group design was used).

Research settings:

The present study was conducted at

Imbaba Technical Health Institute that affiliated to Ministry of Health (MOH). Nursing is one department of 8 departments in the institute. The student is enrolled of a general secondary school, except in nursing department, the students are enrolled either from general secondary school or nursing schools. The duration of study in the institute is 2 years and after ending studying of these 2 years as technical secondary school, The certificate of the institute is higher technical diploma certificate. The traditional methods of teaching are applied in the teaching at the institute.

Study subjects:

The subjects included in the present study consisted of all the available nursing students (140) students, classified randomly into two group: Group(A) & group (B) and then the investigator randomly assigned to teach the administration course to group (A) in the second term so "Group (A) was study group (70) who learned the administration course through using cognitive maps & group (B) was control group (70) who learned the administration course through traditional methods.

Tools of data collection:

Data were collected for this study using three tools:

1- Cognitive maps knowledge questionnaire.

Was developed by **(Abd Elwareth, 2016)** and modified by the investigator to assess students` knowledge about cognitive maps. It included two parts:

First part: Personal data such as (age, gender, residence, previous education, the grade for last academic year) and students` experience with cognitive map.

Second part: It consisted of different items to assess students` knowledge regarding to cognitive maps. It included (19) items in form of MCQ and true or false questions

Scoring system:

Subjects responses were scored on a 2-answers as follow: (1) correct answer, (0) incorrect answer. The total scores are summed up and mean and S.D calculated, then converted into percent score. The student who had a percent more than 60% this indicated an adequate knowledge and if less than 60% this indicated an inadequate knowledge.

2- Attitude assessment tool:

It was developed by **(Willis et al., 2010)** and adapted from **(Farrag, 2017)** and also modified by the investigator to assess the students' attitude toward cognitive maps.

Scoring system:

Subjects responses were scored on a 3-point Likert scale as follow: (3) agree, (2) uncertain, (1) disagree. The total scores are summed up and mean and S.D calculated, then converted into percent score. The student who had a percent more than 60% this indicated positive attitude toward cognitive maps and if less than 60% this indicated negative attitude of nursing student's toward cognitive maps.

3- Students` academic achievement:

Depended on the final exam for nursing service administration subject for academic year 2020-2021.

Scoring system:

This scoring system according to the scoring system at the institute academic setting:- Excellent: 85% up to 100% - Very good: from 75% to less than 85% - Good: from 65% to less than 75% - Pass: from 60% to less than 65% - Poor: less than 60%.

Validity of the tools:

Testing the validity: of the proposed tools by using face and content validity. Face

validity aimed at inspecting the items to determine whether the tools measure what supposed to measure. This was done by a jury of five faculty staff. The members of jury were two assistant professors from Faculty of Nursing at Benha University, professor from Faculty of Nursing at Zagazig University and two professors from Faculty of Nursing at Ain Shams University. Finally, modifications were done in the light of their valuable comments such as modify some words to give the most appropriate meaning for the phrases, which they are commented on it.

Tools reliability:

The study tools were tested for internal consistency using Cronbach's Alpha coefficient. For Cognitive maps Knowledge Questionnaire was α = 0.868 and for Attitude assessment tool was α =0.944.

Pilot study

In January 2021 the revised questionnaires were piloted with 10% from the subject: 14 nursing students were included in the main study subject to evaluate the effectiveness of the proposed data collection tools, and assess the feasibility and clarity of language and applicability of the tools and to detect the obstacles and problem that may be encountered during data collection . In addition to estimating, the time required to fill the tools that approximately ranged from 30 - 45 minutes.

Ethical considerations:

Ethical approval was obtained from research Ethics Committee at Faculty of Nursing Benha University as well as from director of institute and head of teaching affairs at Imbaba Technical Health Institute. The purpose and benefits of the study and the impact of this study on the students was explained to director of institute and head of teaching affairs befor applying the tools to gain confidence and trust. An informed consent was

obtained from each nursing student. Participation in the study was voluntary and each student had the right to withdraw from the study at any time without any consequences. The data were collected and treated confidentially. The results were used as a component of the necessary research for study as well as for future publication and education.

Field work:

The field work of this study was carried out through preliminary (**preparatory phase**): At Imbaba Technical Health Institute: The director of institute and head of teaching affairs were contacted, and agreed on the selected teaching methods in the nursing administration course, the investigator conducted the pilot study on 10% of the total sample (14 nursing students), were included in the main study subject. (**Planning phase**) The investigator started the preparation of the action plan for using cognitive maps in the administration course after reviewing the related literature. (**Implementation and evaluation phase**): The impact of using the cognitive maps on administration course was evaluated immediately after using the cognitive maps

Statistical analysis:

Data entry was done by using SPSS V17 computer software package. Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables, and means ± standard deviations for quantitative variables. Qualitative variables were compared using a chi - square test. T-test was used for comparisons between two independent quantitative variables. The paired t - test was used to compare between two means in the same studied group pre and post applying experiential learning theory.

Results

Table (1): Show distribution of studied nursing students according to their personal characteristics. The table clarifies the personal characteristics of study group less (74.3%) of them were aged 20 years with Mean±SD (20.285±0.85) as far as their gender more than half (55.7%) of them were male. And the majority of them were from rural area. In relation to their previous education the majority of them had nursing school. In relation to control personal characteristics, (60.0%) of them were aged 20 years old with Mean ±SD (20.428±1.11). And (67.1%) of them were from rural areas. (87.1%) of them had nursing school as previous education, and more than two fifth (42.9%) of them had very good in the previous academic grade.

Table (2): Shows that (98.6%) of the study group students and (100%) of the control group use traditional strategy in their study, and (72.9%) of the study group and (87.1%) of the control group had prefer traditional method. (64.3%) of the study group and (47.1) of the control group preferred traditional method as they used to this method, In relation to using cognitive maps befor during study (78.6%) of the study group and control group students not use cognitive maps before during study. Also (66.7%) of the study group students who used cognitive maps before where using it during studying period while (60.0%) of the control group where using it during self-learning period. As far as the more method used in creative (67.1%) of the study group students show that student interaction is the more method used in creative education while (71.4%) of control group shows that using videos, cognitive maps and models is more creative.

Figure (1): Illustrates that most of studied nursing students (77.10% of 80.00%) at both group study and control group at pre program had inadequate level of knowledge respectively. While (95.70%) had adequate knowledge about cognitive maps at post program phase than control group.

Figure (2): Shows that (98.60%) of nursing students had positive attitude toward cognitive maps at post program compared to pre program phase.

Figure (3): Illustrates that there were highly significant improvement in nursing student's academic achievement after using cognitive maps in their study. There was (38.6%) of the study group students have excellent degree in the final exam, while there was only (12.9%) of the control group students have excellent degree in the same exam.

Table (3): Reveals that there was statistical significant positive correlation between total nursing students` knowledge and their total attitude at post implementation of the study. This mean when correctly using cognitive maps during study, it will improve nursing student attitude toward studying.

Table (4): Reveals that, there was a statistical significant correlation between levels of knowledge and attitude at post program phase and there was a highly statistical significant correlation between nursing students` knowledge and their academic achievement in the post program phase. Also, there was a highly statistical significant correlation between nursing students` attitude and their academic achievement in the post program phase.

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Table (1): Distribution of nursing students according to personal characteristics (n=140)

Variable	Study group N= 70		Control group N= 70	
	No	%	No	%
Age (years)				
19 years	4	5.7	8	11.4
20 years	52	74.3	42	60.0
21 years	8	11.4	9	12.9
≥22 years	6	8.6	11	15.7
Mean ±SD	**20.285±0.85**		**20.428±1.11**	
Gender				
Male	39	55.7	34	48.6
Female	31	44.3	36	51.4
Residence				
Rural	61	87.1	47	67.1
Urban	9	12.9	23	32.9
Previous education				
High secondary school	7	10.0	9	12.9
Nursing school	63	90.0	61	87.1
Previous academic year grade				
Excellent	26	37.1	14	20.0
Very good	23	32.9	30	42.9
Good	20	28.9	22	31.4
Pass	1	1.4	4	5.7

Table (2): Distribution of nursing students according to their experience with cognitive maps (n=140)

| Variable	Study group N= 70		Control group N= 70	
	No	%	No	%
The kind of educational strategy used in your studies is				
Traditional strategy	69	98.6	70	100.0
Advanced strategy	1	1.4	0	0.0
Do you prefer traditional method				
Yes	51	72.9	61	87.1
No	19	27.1	9	12.9
Why do you prefer traditional method? (choose more than one answer)				
Suitable	14	20.0	24	34.3
I am used to it	45	64.3	33	47.1
Easy to understand	20	28.6	32	45.7
The only one which used	36	51.7	24	34.3
Do you use cognitive maps before during study?				
Yes	15	21.4	15	21.4
No	55	78.6	55	78.6
In which period did you use cognitive maps?(15)				
Self-learning period	5	33.3	9	60.0
Studying period	10	66.7	6	40.0
What is the more method used in creative education? (choose more than one answer)				
Self-learning	20	28.6	18	25.7
Student interaction	47	67.1	38	54.3
Using videos, Cognitive maps and models	46	65.7	50	71.4
Perform pretest of the lecture	20	28.6	31	44.3
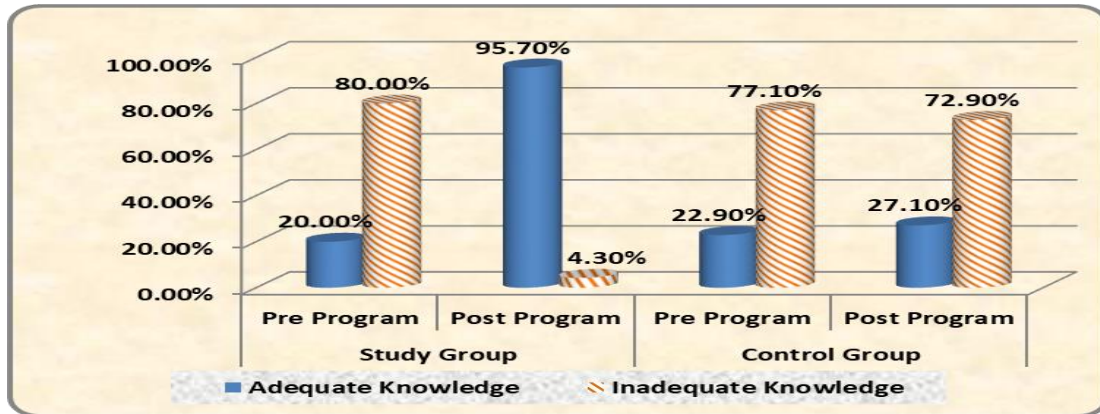
Figure (1): Total knowledge levels regarding to cognitive maps between study-control group of nursing students (pre-post program)
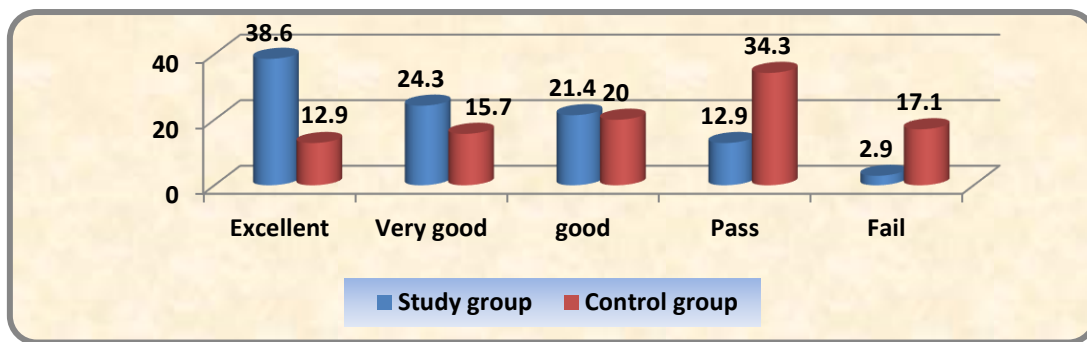

Figure (2): Total attitude levels regarding cognitive maps among study group of nursing students (pre-post program) (n=70)
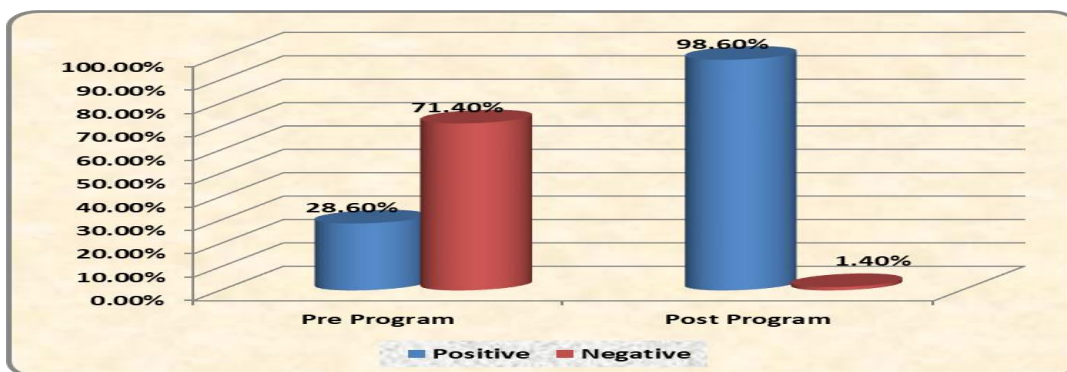

Figure (3): Total academic achievement levels regarding cognitive maps between student-control group of nursing students

Table (3): Correlation between total knowledge of nursing students and their total attitude (Pre-post program). (n=70)

Items	Knowledge pre program		Knowledge post program	
	R	**P**	**R**	**P**
Attitude Pre program	0.143	0.238	0.017	0.886
Attitude Post program	0.116	0.341	0.292	0.014*

* A statistical significant difference P ≤ 0.05 **, A highly statistical significant difference P ≤ 0. 001)

Table (4): Correlation nursing students` knowledge, attitude and their academic achievement. (study group post). (n=70)

Items	Knowledge post		Attitude Post program		Academic achievement	
	R	**P**	**r**	**P**	**R**	**P**
Total knowledge post program	1	-	0.292	0.014[*]	0.980	0.00[**]
Total attitude Post program	0.292	0.014[*]	1	-	0.746	0.00[**]
Academic achievement post program	0.980	0.00[**]	0.746	0.00[**]	1	-

* A statistical significant difference P ≤ 0.05 **, A highly statistical significant difference P ≤ 0. 001)

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Discussion

Cognitive mapping is a powerful and efficient way of depicting data in a graphical structure so that the entire idea being imparted can be broken down into smaller digestible bits. Cognitive maps as linear tools which make connections concerning the situations and concepts about a problem or subject and organize the information. It is a learning strategy that involves visualizing relations between ideas using graphical representations (**Kumar, 2021**).

The cognitive maps are recording techniques developed by Tony Buzan in the late 1960s. They illustrate the relationship among ideas involving the thickness of lines, colors, images, and diagrams creatively. They can help students utilize their knowledge to build new knowledge in their minds so that they can make conceptual changes. In addition, they are known to increase memory retention and increase students' motivation (**Prastiwi et al., 2018**).

Students` academic achievement may be affected by different factors like study habits, intelligence and attitudes of learners towards school, socio economic status and different aspects of their personality etc. In our society academic achievement possesses a very imperative place in education as well as in the learning process. Academic achievement defined as the extent to which a learner is profiting from instructions in the given area of learning i.e. achievement is reflected by the level to which skill and knowledge has been imparted to him (**Tam, 2021**).

The present study illustrated the distribution of studied nursing students according to their personal characteristics. The majority of study group were aged 20 years with Mean±SD (20.285±0.85) as far as their gender more than half of them were male. And the majority of them were from rural area. In relation to their previous education the majority of them had nursing school. As far as their previous academic year grade more than one third of them were had excellent grade.

The present study illustrated that the majority of the study group students use traditional strategy in their study, and more than two thirds of them had prefer traditional method. They preferred traditional method as they used to this method, In relation to using cognitive maps befor during study the majority of the students not use cognitive maps before during study. Also two thirds of the study group students who used cognitive maps before where using it during studying period. As far as the more method used in creative education more than two thirds of students show that student interaction is the more method used in creative education, while more than two thirds of control group shows that using videos, cognitive maps and models is more creative.

This study not supported by (**Abd Elwareth, 2016**) who conducted study about "Study Effect of Apply Concept Map on Students' Perception to Antenatal Unit" they reported that the majority of control group students stated that the current type of educational method used is the traditional method and about one third of them prefer using of this method as they considered that traditional method is the most suitable method for them and it is the only method which used during their studying, While the majority of the study group was using the concept map during their studying and they expressed the view that the concept mapping strategy was really help them to link & retrieve information quickly and regularly. Also, they reported that the majority of both study & control group were

reported that using of videos, concept maps and models is a method used in creative education.

Regarding to total knowledge levels regarding to cognitive maps between study-control group of nursing students the present study illustrated that most of studied nursing students at both group study and control group at pre program had inadequate level of knowledge respectively. While the majority of study group had adequate knowledge about cognitive maps at post program phase than control group.

This was supported by (**Farrag, 2017**) who conducted study about " Concept mapping strategy: An effective tool for improving maternity nursing students' achievement" who founded that there was a highly statistically significant difference between before and after the awareness sessions regarding students' knowledge about concept mapping.

Regarding to total attitude levels regarding cognitive maps among study group of nursing students. The present study indicated that, the program had a greater effect on improving nursing students` attitude level as the majority of nursing students had positive attitude toward cognitive maps at post program compared to pre program phase.

In this respect, (**Farrag, 2017**) who conducted study about " Concept mapping strategy: An effective tool for improving maternity nursing students' achievement" who founded that regarding the attitude of both groups toward the teaching strategies used, the study result revealed that, the majority of the students in the study group showed positive attitude toward the concept map strategy more than students in the control group toward the traditional method of teaching.

However, the previous results are contradicting with those of (**Allen, 2012**) who compared the nursing students' attitude who received the lecture course and those who participated in concept map course, and mentioned that there was no statistically significant difference between both groups regarding their attitude toward the teaching method used.

Regarding to total academic achievement levels regarding cognitive maps between student-control group of nursing students the present study indicated that there were highly significant improvement in nursing student's academic achievement after using cognitive maps in their study. There was more than one third of the study group students have excellent degree in the final exam, while there was only of the control group students have excellent degree in the same exam.

The result supported by (**Al-Swalha, 2021**) who conducted study about "The Impact of E-mind Mapping Strategy on the Academic Achievement of Jordanian 9th Grade Students in Citizenship and Civic Education Course" he founded that the cognitive mapping strategy is more effective than the lecturing strategy for improving the achievement of Jordanian 9th grade students in the citizenship and civic education course, Also he reported that the cognitive mapping strategy is effective for improving students' achievement in the social studies course.

This result disagreed with (**Yunan, & Aziz, 2019**) who conducted study about " The Effect of Using Mind Maps on Developing Spelling Skill for First Intermediate Stage Students in English" they reported that the results showed that there was no statistically significant difference between the two groups in spelling skill test.

Regarding to correlation between total knowledge of nursing students and their total

attitude (Pre-post program), the present study revealed that there was statistical significant positive correlation between total nursing students` knowledge and their total attitude at post implementation of the study. This mean when correctly using cognitive maps during study, it will improve nursing student attitude toward studying.

This result agreed with (**Choudhari, 2021**) who conducted study about "Applying visual mapping techniques to promote learning in community-based medical education activities" he founded that there was statistically significant relation between students` knowledge and their attitude, the majority of the students opined that these maps were like aid to studying, organizing, summarizing information learned and it promoted active & meaningful learning. They also stated that the assignment of visual mapping helped in attempting questions of the written test by facilitating an easy recall of the information learned, and encouraged its use as a learning tool in gross Anatomy along with the standard note-taking method.

Regarding to correlation nursing students` knowledge, attitude and their academic achievement, the present study revealed that there was a highly statistical significant correlation between nursing students` knowledge and their academic achievement in the post program phase. Also, there was a highly statistical significant correlation between nursing students` attitude and their academic achievement in the post program phase.

This result supported by (**Redhana, 2021**) who conducted study about "Which Is More Effective, A Mind Map or A Concept Map Learning Strategy" he reported that there was statistical relation between the students'

learning achievement and the students' attitude on the application of the mind map learning strategy.

Furthermore, (**Almulla, & Alamri, 2021**) who conducted study about "Using Conceptual Mapping for Learning to Affect Students' Motivation and Academic Achievement". They reported that they found the relationship between students` attitude after using conceptual mapping and their academic achievement.

Conclusion

There was significant improvement in nursing student's knowledge and attitude regarding cognitive maps after implementing the educational program. Subsequently, there were highly significant improvement in nursing student's academic achievement after implementing the educational program. Also, there was a statistical significant correlation between levels of knowledge and attitude. And there was a highly statistical significant correlation between nursing students` knowledge and their academic achievement. Respectively, there was a highly statistical significant correlation between nursing students` attitude and their academic achievement after implementing the educational program.

Recommendations

Recommendations for institute administrator:

1)Provide frequent training courses for nursing instructor regarding different types of teaching strategies.

2) Provide training course for nursing instructor about cognitive maps, its benefits and how to use.

Recommendation for nursing instructor:

1)Encourage nursing instructor for periodically review nursing students' performance in order to evaluate their attitude toward using cognitive maps.

Recommendation for nursing student:

1)Encourage students to use cognitive mapping in the clinical setting as an efficient educational method in all nursing academic courses (theory & practice).

Opportunities for further research:

1)Further researches are still needed for exploring the obstacles hindering the implementation of the cognitive map method in nursing education.

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تأثير الخرائط المعرفية على التحصيل الدراسي لطلاب التمريض بالمعهد الفني الصحي بإمبابة

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يعد رسم الخرائط المعرفية أحد أساليب التدريس الجديدة التي تمكن الطلاب من ربط جميع المعلومات في أذهانهم ، وتعزيز التعلم كما هو واضح في التحصيل الدراسي. هدفت الدراسة إلى تقويم أثر الخرائط المعرفية على التحصيل الدراسي لطلاب التمريض بالمعهد الفني الصحي بإمبابة. وتم استخدام التصميم التجريبي لإجراء الدراسة. العينة: جميع طلاب التمريض الذين التحقوا بالفصل الدراسي الثاني (140 طالباً) ، تم تصنيفهم إلى مجموعتين (مجموعة تجريبية ومجموعة التحكم). وقد أظهرت النتائج بأن غالبية مجموعة الدراسة (95.70٪) لديهم معرفة كافية و (98.60٪) لديهم موقف إيجابي تجاه الخرائط المعرفية في مرحلة ما بعد البرنامج ، كان هناك أكثر من ثلث طلاب مجموعة الدراسة (38.6٪) لديهم درجة ممتازة في النهائي. بينما كان هناك (12.9٪) فقط من المجموعة الضابطة حصلوا على الدرجة الممتازة في نفس الامتحان. واوصت الدراسة بتقديم دورة تدريبية لمدرس التمريض حول الخرائط المعرفية وفوائدها وكيفية استخدامها.