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Mind Mapping Effectiveness as Genomic Learning Tool: Revolutionize the Nursing Thinking

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Abstract: The present study **aims** to discover students' knowledge to genomic. In addition; examine the effectiveness of mind mapping as a genomic learning tool on students' knowledge. As well as determine educational activities that improve genomic course as reported by the study participants. Furthermore; evaluate students' perception to mind mapping and satisfaction toward genomic after using mind mapping learning tool. Finally; the influence of socio-demographic characteristics like gender, age, study year and marital status on students' knowledge. ***Design:*** Quasi-experimental design (pre-posttests, study and control groups design). ***Setting:*** The study was conducted at Technical Institute of Nursing, Mansoura University, Egypt. ***Sample:*** 212 nursing students were divided into two equal groups, study group (mind mapping) and control group (traditional teaching method as lectures) (106 students per each group) randomly selected as a convenience sample. ***Tools:*** Structured interviewing questionnaire, Genetics Needs Assessment Survey to assess students' knowledge, Likert scale to assess students' perception and satisfaction. ***Results:*** The genomic teaching by mind mapping affected positively on students' knowledge in study group post intervention ($p<0.001$& $p<0.05$), most of them had reported that mind mapping is the best teaching method to improve genomic knowledge. The students in study group had positive perception toward mind mapping as a genomic learning tool. As well as high satisfaction score toward genomic study among study group students more than those in the control group. ***Conclusion:*** The findings of this study have highlighted that there is a need for using mind mapping during genomic teaching as it affected positively on students' knowledge. Fortunately; the most of them had reported that mind mapping is the best teaching method to improve genetic knowledge. The students in study group had positive perception toward mind mapping as a genomic learning tool as well as high satisfaction. ***Recommendations:*** Replicate this study on a larger sample in different faculties of nursing to generalize the findings. Also; nursing genomic should be included in the faculty of nursing curriculum in theoretical and practical aspects for under and postgraduate students with using mind mapping as a learning tool.

Key words: Genomic, Learning tool, Mind mapping, Nursing thinking, Students' perception, Students' satisfaction, Teaching methods.

INTRODUCTION

Education has been described as an indispensable key to any form of development; it is an instrument for economic, political and scientific development of all nations. In nursing education, there is an increasing consciousness of the significance of learner-centeredness in the teaching-learning situation which has created a lot of care in relation to understanding how learners procure and how to help them learn about thoughts in nursing. The researchers' efforts supporting learners to learn more successfully have led to the development of meta-cognitive strategies to augment expressive learning (1).

Nursing students are an exclusive group of skilled health care experts who would work in all zones of health care. It is imperative that nursing students keep abreast of all required health professionals' competencies. The most current revolution in health care within the last several decades has been the study of the genetics and human genome. Genetics is the study of inheritance and difference while genomics is the study of the structure and function of the genome and its interactions with the environment. The expansion of appreciative of genetics and genomics is altering medicine, nursing, and health maintenance as a whole. Genetic and genomic science is redefining the understanding of the human health and illness. The required competency of providing crucial information, support, guidance, and education pertaining to genetic conditions is expected for all levels of heath care professionals, from earlyprelicensure preparation to practicing professionals. Holistic nurses will need this knowledge to provide proper care, explanations of genetic conditions, and referrals to patients. The application and integration of genomic information represent numerous areas for nursing participation (2).

Mind map (Mm) is a visual diagram used to represent concepts, ideas or tasks linked to and arranged radially around a central key word or idea. Primary branches represent the major ideas around the central topic and secondary branches tend to contain more real expressive illustrations. Cognitive maps have been described by researchers as a demonstrating technique which intends to interpret ideas, beliefs, values and attitudes and their rapport one to another in a form which is acquiescent to study and exploration (3,4) **(figure 1)**.Mind map is considered a powerful meta-cognitive tool that can facilitate the attainment of knowledge through meaningful learning, and can thus be used to promote and evaluate critical thinking. Fortunately; learners make a bond between indefinite and definite information that leads to unfathomable considerate and it aids recalling of existing memories by using mind maps (5, 6). This teaching-learning method does not teach students to think, but helps them to actively attain information. Moreover, Mm simplifies the attainment of a theoretical considerate of a huge amount of information,

integrating concepts together and helps spanning the gap between theory and clinical proficiency (7, 8, 9).

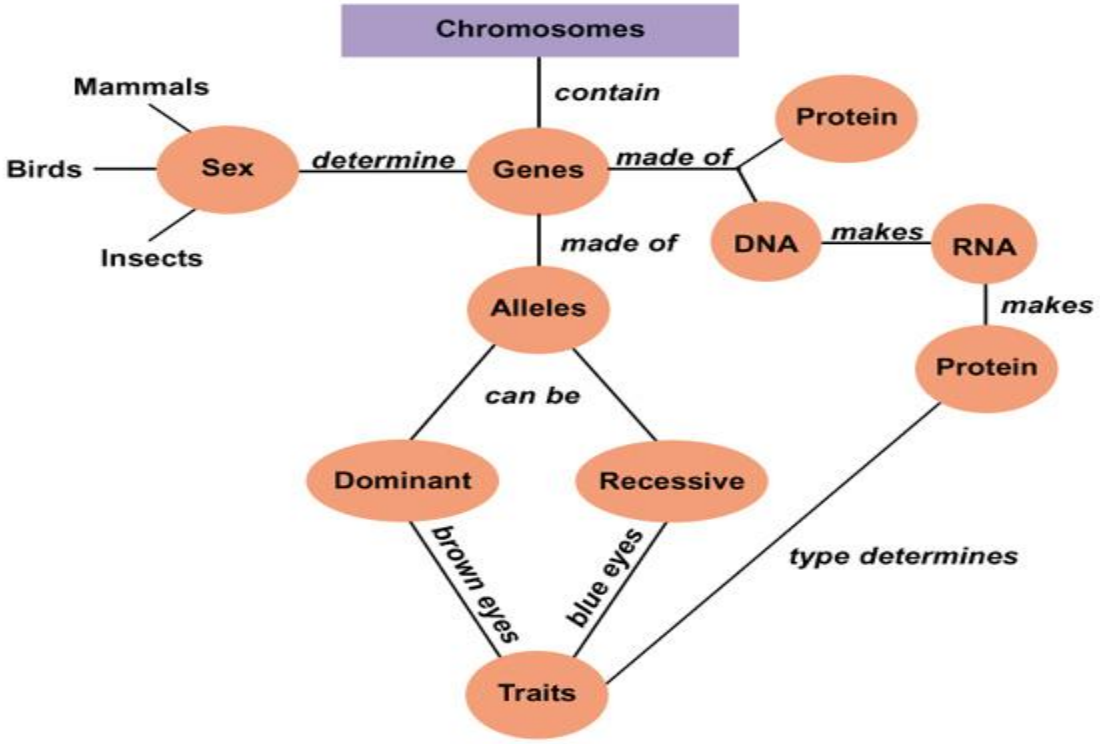

Figure 1: Example of Mind Mapping

Health care has progressively assimilated genetics information and technology along the alleyways of prevention, screening, diagnosis, prognosis, treatment selection, and monitoring of therapy effectiveness. It's vital for nurses to have suitable information and skills to provide harmless and operative nursing interventions in gratitude of developing science. Subsequently; information of genetics is vital to warrant proper referral and learning of patients who would advantage from genetic facilities what's more, nurses adapt interventions to singular patients based on various issues, counting the patients and family insight of requirements, patient favorites, physical and psychosocial assessment and existing proof. However these issuesstayenergetic, geneticerraticism could additional notify nursing interventions and lead to enhanced results for patients. It will be valuable in several arenas, as but not limited to health advancement, disease inhibition and symptom management (10, 11).

Implementing genetics into nursing has disputably become one of the most pressing issues in nursing education. Experts in the field of nursing recognize that genetics expertise is integral to nursing education, practice, research (12).In Egypt the importance of medical genetics started in the Twentieth century in the early 1960s it was well valued at Cairo and Ain Shams Universities. In 1966, the field of Human genetics at the National Research Centre was established. In 1967, the medical genetics unit at the Medical Research Institute in Alexandria was started. This was followed by the opening of medical genetics units in other universities for instance; El-Mansoura and Alexandria Universities. Mubarak City of Scientific Research includes centers for frontier sciences including genetic engineering and biotechnology (13).

Scientific information of genetics has improved in the 1stdecade of the 21st century, but while the scientific world now recognizes anabundantpact about genetics. The mission of the National Coalition for Health Care Professionals Education in Genetics (NCHPEG) is to endorse the incorporation of genetics into healthcare teaching and use this information to advance health through the country. Since genetic information is crucial to the gratitude of many sicknesses, nurses want to be well-versed about genetics. A better considerate of genetic data and insinuations for practice would motivate nurses to integrate genetics into nursing care, afford more universal care, and support better for their patients (14).

In 2000, the Senior Clinical Advisor to the Director of the National Human Genome Research Institute, emphasized the significance of genetics to healthcare and described the insinuations of genetics for nursing teaching. The Clinical Advisor renowned the need to complement genetic content to the nursing syllabus and to brand this data accessible to practicing nurses. Professionals documented early on the nurses' requisite to interpret genetic data into clear language for their patients. So; all nurses would essential to be acquainted with genetic terminology and values, along with genetic technology; even though the type of genetic information might vary depending on the nurses' clinical emphasis and level of training (15).

SIGNIFICANCE OF THE STUDY

Genetic/genomic learning of nurses and their following suitability to training, an inquiry ascends like to whether nurses have satisfactory information of genomics or

genetics. Recent academic nursing learning does not sufficiently prepare nurses for their favorable role in today's genomic era. Preceding researches have exposed that numerous nurses have slight training in genomics and genetics. The American Association of Colleges of Nursing (AACN) now integrates genomic / genetic concepts likewise foundational for all baccalaureates nursing curriculum. (16).Nursing staff are under stress to prepare alumnae who are talented to think judgmentally and illuminate problems in different clinical training locations. They need dynamic learning approaches to promote expressive education, instead of depending on traditional methods that endorse recall and memorization. A review of the present formal of the science with concern to mind mapping endorses that this learning- teaching method can assist nursing staff to prepare nursing students to think judgmentally in the multifaceted health care areas. Furthermore; Nurse educators should create learning experiences that empower students to think and to be better learners. Mm is a creative way for students to involve in a unique method of learning that can enlarge memory recall and help generate a new environment for processing information. This strategy was assisting students to command their thinking through mentally mapping words or notions and clarify their thinking. Therefore; the researchers were inspired to investigate the mind mapping effectiveness as genomics learning tool.

Aims:

Current study donated to

1. Discover students' knowledge to genomic.
2. Examine the effectiveness of mind mapping as genomic learning tool on students' knowledge.
3. Determine the educational activities that improve genomic course as reported by the study participants.
4. Evaluate students' perception toward mind mapping as a genomic learning tool.
5. Furthermore; evaluate students' satisfaction toward genomic after using mind mapping as a learning tool.
6. Finally; determine the influence of socio-demographic characteristics like gender, age, study year and marital status on the students' knowledge.

Research Questions:

1. What are overall knowledge of students about genomic?
2. Is there an effectiveness of mind mapping as genomic learning tool on students' knowledge?
3. What are the most educational activities that improve genomic course as reported by the study participants?
4. What is students' perception toward mind mapping as a genomic learning tool?
5. What is students' satisfaction toward genomic after using mind mapping as a learning tool?
6. Is there an influence based on gender, age, study year and marital status on students' knowledge about genomic?

METHODOLOGY

Design:

Quasi-experimental design (pre-posttests, study and control groups design).

Study settings:

This study was conducted in Technical Institute of Nursing, Mansoura University, Egypt.

Sampling:

604 students were invited to participate in the study; the study focused on 212(response rate = 35.1%) undergraduate female and male students of nursing joined in nursing program at Technical Institute of Nursing**,** Mansoura University, Egypt during first semester of the academic year 2016- 2017. **Inclusion criteria** were that; the nursing students had taken basic bioscience course and could speak and understand English. All of them did not receive genomic course.

Group assignments:

212nursing students were randomly divided into two equal groups, study group (mind mapping) and control group (traditional teaching method as lectures) (106 students per each group) randomly selected as a convenience sample. Randomization was supported using a numbered name list of students. Offbeat numbers represents group of mind mapping and uniform numbers denotes the control group.

Research Tools:

The research tool consisted of four tools:

Tool I: The first tool is structured interviewing questionnaire that consists of socio-demographic characteristics (gender, age, study year and marital status).

Tool II: The second tool used in this study was an adapted version questionnaire of the "Genetics Needs Assessment Survey" that was developed by (17), to assess perceived genetics knowledge of students in various health disciplines. Initial revisions to the survey were based on an extensive review of latest work to integrate genetic content into nursing curricula. The modified version included 38 items; 31 to assess perceived knowledge of human genetic principles and genetic disorders (13 items related to genetic terms, 14 items related to genetic conditions and 4 items related to genetic procedures) and 7 items regarding educational methods of teaching genetics.

Scoring system; overall score extended from 0 -31, the advanced scores indicate the advanced knowledge. Knowledge scores were categorized to three categories; no knowledge if scores were less than50%, some knowledge if scores were more than 50% and less than 75% and high knowledge if scores were more than75% till 100%.

Tool III: The third tool was adopted from (18); it was proposed to assess the students' perception in the study group about the mind mapping as a learning technique. It had 11 statements, both positive and negative, the first nine statements were positive and last two statements were negative. **Scoring system;** an answers were on a 5-point Likert scale extending from "strongly agree" to "strongly disagree." These were scored from five to one, respectively. The scoring was inverted for undesirable statements so; an advanced score indicates extra 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.

The tool was vigorously revised by a group of nursing educators from faculty members various nursing specialties. They face and content-validated the tool through assessing was their format layout and consistency as well as knowledge accuracy and relevance. The reliability of the perception scale was assessed through testing its inside reliability. It displayed respectable reliability with Cronbach alpha coefficient 0.86.

Tool IV: Students' satisfaction scale to determine students' satisfaction toward genomic course after using mind mapping as a learning tool, this scale was developed by(19). It involves5 items that was originally deliberated to measure satisfaction of students with the mind mapping activity. The scale was adapted in the current study to measure satisfaction of students with the two allocated learning experiences either mind mapping or traditional. **Scoring system**; as 5 point Likert scale each item was scored. Strongly disagree was scored one, disagree was scored two, undecided was scored three, agree was scored four, while strongly agree was scored five. Overall score extended from 5 - 25, the advanced scores indicate the advanced satisfaction.

Validity and reliability:

Tools content validity established by a board of 5 experts in the field of maternity& newborn health and pediatric nursing and the considered for modifications were approved. The reliability was confirmed as mentioned for each tool. The average content validity index for the modified version was measured indicating adequate content validity. While the tools reliability were tested giving Cronbach's $\alpha = 0.88$ for the 2^{nd} tool, 0.86 for 3^{rd} tool and 0.98 for the 4^{th}tool.

Administrative and Ethical considerations:

An official permission was obtained from corresponding authority. Informed consent was gotten from the joined students after study aims description, approach and benefits of present study in addition to about their rights to participate or refuse, as well as to withdraw. Privacy was protected by using the students' scores for research aim only but not as a part of student evaluation marks. Potential study participants were informed that their involvement was voluntary, their information would be kept trusted and anonymity will be assured too through coding the data. They would not be castigated for answering the questions imperfectly, and their standing in the nursing class would not be pretentious whether or not they participated. Students were inculcated not to put their names on the tools. Moreover; after gathering the required data, students who had been assigned to the control group were requested to present the mind mapping classes to achieve the equal advantages.

Pilot study:

Pilot study was accompanied on two teams of twenty students (ten students for study group and ten students for control group). It aimed to evaluate the requisite time for each team to implement the task and to assess the tools clearness and applicability. The pilot study results showed that the task wants 15 to 20minutes to be accomplished for each tool, additionally; exam time and statements of the tools are clear, applicable and no problems were reported in considerate either the questions or the response. The sample of pilot study was excepted from the study.

Research procedure:

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 then invite them to participate. Those who consented were distributed into two equal groups, one for study and the other for control, the students in both groups were tested pretest to assess the students' knowledge before intervention and collect the socio-demographic data using tools I and II.

The study group students were instructed about the educational guidelines during sessions. They had gotten ten sessions; each session includes theoretical and practical parts, one session / week lasted 60 - 90 minutes (each included 10-15 minutes for preparation or revision before starting genomic topic explanation and 10-15 minutes for conclusion at the end of topic explanation) and 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 diverging out in a divergent pattern; the keywords corresponding to subtopics. Then, smaller branches scheme from the subtopics with extra details concerning the subject. The practical part was conducted in each session; one-hour each using demonstration by the researcher and re-demonstration by the students for mind mapping drawing. They involved hands-on training in producing mind mapping for selected topics. During practical part the students were divided into small subgroups of ten students.

Five topics were selected as related to maternity and newborn and children; they were:

1. Introduction and overview to Genetics including; basic principles of genetics, practical application of genetics in Nursing, cellular division mitosis and meiosis, DNA and RNA structure and replication, characteristics and structure of genes, chromosomes and chromosomal aberrations patterns gene inheritance and mutations.
2. Maternal, prenatal and genetic influences on development of defects and diseases including mothers' genetic and infections, consanguinity atopy, prenatal nutrition and food allergies, maternal age, maternal drug therapy, prenatal testing and diagnosis, effect of radiation, drugs and chemicals, infertility, spontaneous abortion and neural tube defects and the role of folic acid in lowering the risks Down syndrome (Trisomy21).
3. Genetic diseases in neonates and children including; newborn screening, prenatal testing and pre-implantation genetic diagnosis, congenital abnormalities, developmental delay, childhood predictive testing and dimorphisms.
4. Genetic condition including; Gausher disease, familial hypercholesterolemia, Duchenne's muscular dystrophy, Trisomy 21 (Down syndrome), Trisomy 18, Trisomy 13, Turner syndrome, Klinefelter syndrome, cystic fibrosis, breast cancer, ovarian cancer, thalassemia, sickle cell disease and fragile X.

5. Genetic related procedures including; Polymerase Chain Reaction (PCR), gene therapy, genogram genetics test and pharmacogenesis.

Participants were given the opportunity to ask questions regarding the technique during the training course and its application at the end of each session. The researcher was revised of previous session in first 10- 15 minutes before beginning of each new session. 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 such as lectures 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 3 short-essay questions (6 marks), 10 true or false (10 marks) and 15 multiple-choice questions (15 marks). The test duration was 90 minutes. The scores obtained by students in the two groups were compared. Additionally; students` perception regarding the new mind mapping technique was obtained from the study group using the pre-designed scales, tool 3. Furthermore; determine students satisfaction toward genomic after using mind mapping as a learning tool using tool 4. Finally; determine educational activities that improve genomic course as reported by the study participants in study group. The work lasted for three months.

Statistical analysis:

All statistical analyses were performed using SPSS for windows version 20.0 (SPSS, Chicago, IL). Cronbach alpha coefficient was calculated to assess the reliability of the developed tools through their internal consistency. Continuous data were expressed in mean ±standard deviation (SD) while categorical data were expressed in number and percentage. The comparisons were determined using Student's t test for two variables with continuous data. Chi-square test was used for comparison of variables with categorical data. The 95 % Confidence Interval (CI) of the mean difference regarding the students' satisfaction toward mind maps as a genomic learning tool among the study and control groups was calculated. Statistical significance was set at $p<0.05$.

Limitations of the study:

The study sample was selected from unique setting so; generalization of investigation findings cannot be obtainable. Additionally; Egyptian studies deficiency about mind mapping as a genomic learning tool in maternity and newborn health nursing and pediatric nursing specialties was extra limitation of current study the cause of deprived in national references in the introduction and discussion partitions.

RESULTS

Table (1) presents the socio-demographic characteristics of students in both groups, it is clear from this table that, about two third (65.1% & 67.0%respectively) of studied students in study and control groups were females, mean age of students in both groups were (20.3 ±1.2 & 20.4 ±1.7 respectively). Regarding study year, (71.7% & 67.0 % respectively) of students in both groups were in second year. Concerning marital status, a majority (80.2% & 83.0 % respectively) of students in both groups were single. There was no statistical difference between both groups ($p>0.05$).

Table (2) shows number and percentage of nursing students' knowledge regarding the selected genetic topics in both groups pre intervention, it is obvious that; majority of studied students in both groups had no knowledge about genetics regarding genetic terms, genetic conditions or genetic related procedures before intervention. There were no statistical differences between both groups ($p>0.05$).

Table (3) illustrates number and percentage of nursing students' knowledge regarding the selected genetic topics in both groups post intervention, it is clear from this table that, there were statistical differences between both groups after intervention regarding genetic terms, genetic conditions and genetic related procedures ($p<0.001$& $p<0.05$).

Figure (2) shows educational activities that improve genomic knowledge as reported by the studied students in study group. Most (83.0%) of students had reported that mind mapping is the best teaching method to improve genetic knowledge.

Table (4) shows perception of students about the mind mapping as genomic learning tool among the study group students post intervention, it is clear from this table that; majority of the students had high perception toward all positive statements. The majority of students agree that mind mapping is the best learning technique in genetics education. On the other hand, minority of students agree (1.9%) toward the negative statements as (Not my style of learning,) and all of the students not agree about negative statements as (I don't think it helped with retention of material).

Table (5) shows the student's satisfaction toward genomic according to teaching methods among students in the study and control groups, it is obvious that, the total satisfaction score of students among the study group was 21.49± 3.1, paralleled to 9.41± 2.6 in the control group. The students in study group had high satisfaction score than those in the control group. There were high statistically significant differences between both groups after intervention ($p<0.001$).

Table (6) clarifies relation between socio-demographic characteristics of students in study group and their knowledge post intervention; it is obvious that; there was a strong relationship between the studied students' gender and their knowledge after intervention, the female significantly had high knowledge than males. Also; majority (90.9%) of the students which in second year and 94.5% of them were single had high knowledge. This relation was highly statistical significant ($p<0.001$). Additionally; about two third (65.6%) of students in age range between 20-22 years old had high knowledge. The older students had high knowledge than young students. This relation was statistical significant ($p<0.05$).

Table 1: Socio-demographic characteristics of students in the study and control groups (n=212)

Variables	Study (n=106)		Control (n=106)		Chi square test	
	N	%	N	%	X2	p
Gender						
Male	37	34.9	35	33.0		
Female	69	**65.1**	71	**67.0**	0.084	0.772
Age						
18 – 19	50	47.2	45	42.5		
20 – 22	56	52.8	61	57.5	0.477	0.490
Mean ±SD	***20.3 ±1.2***		***20.4 ±1.7***		***0.495****	***0.621***
Study year						
One	30	28.3	35	33.0		
Two	76	**71.7**	71	**67.0**	0.555	0.456
Marital status						
Single	85	**80.2**	88	**83.0**		
Married	21	19.8	18	17.0	0.283	0.595
**** t value, Student's t test***						

Table 2: Number and percentage of nursing students' knowledge regarding the selected genetic topics in both groups pre i*ntervention (n=212)

	level of Knowledge													
Genetic Topics	**No**				**Some**				**High**				**Chi square test**	
	Study (n=106)		**Control (n=106)**		**Study (n=106)**		**Control (n=106)**		**Study (n=106)**		**Control (n=106)**		**X2**	**P**
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**		
I- Genetic Terms														
Mitosis	89	84.0	92	86.8	13	12.3	12	11.3	4	3.8	2	1.9	0.756	0.685
Meiosis	101	95.3	105	99.1	5	4.7	1	0.9	0	0	0	0	2.744	0.098
transcription	106	100	106	100	0	0	0	0	0	0	0	0	0	1.000
translation	100	94.3	101	95.3	6	5.7	5	4.7	0	0	0	0	0.096	0.757
Mutations	87	82.1	89	84.0	10	9.4	12	11.3	9	8.5	5	4.7	1.347	0.510
DNA replication	102	96.2	99	93.4	4	3.8	5	4.7	0	0	2	1.9	2.156	0.340
DNA structure/function	48	45.3	45	42.5	51	48.1	56	52.8	7	6.6	5	4.7	0.664	0.717
RNA structure/function	96	90.6	99	93.4	6	5.7	4	3.8	4	3.8	3	2.8	0.589	0.745
Autosomal dominant inheritance	102	96.2	104	98.1	4	3.8	2	1.9	0	0	0	0	0.686	0.408
Autosomal recessive inheritance	103	97.2	104	98.1	3	2.8	2	1.9	0	0	0	0	0.667	0.414
X- linked inheritance	106	100	106	100	0	0	0	0	0	0	0	0	0	1.000
Mitochondrial inheritance pattern	106	100	106	100	0	0	0	0	0	0	0	0	0	1.000
Protein synthesis	101	95.3	102	96.2	5	4.7	4	3.8	0	0	0	0	0.116	0.733
II- Genetic Conditions														
Gausher disease	106	100	106	100	0	0	0	0	0	0	0	0	0	1.000
Familial hypercholesterolemia	106	100	106	100	0	0	0	0	0	0	0	0	0	1.000
Duchenne's muscular dystrophy	106	100	106	100	0	0	0	0	0	0	0	0	0	1.000
Trisomy 21 (Down syndrome)	87	82.1	85	80.2	19	17.9	21	19.8	0	0	0	0	0.123	0.726
Trisomy 18	106	100	106	100	0	0	0	0	0	0	0	0	0	1.000
Trisomy 13	106	100	106	100	0	0	0	0	0	0	0	0	0	1.000
Turner syndrome	106	100	106	100	0	0	0	0	0	0	0	0	0	1.000
Klinefelter syndrome	106	100	106	100	0	0	0	0	0	0	0	0	0	1.000
Cystic fibrosis	95	89.6	96	90.6	8	7.5	7	6.6	3	2.8	3	2.8	0.072	0.965
Breast cancer	25	23.6	29	27.4	67	63.2	63	59.4	14	13.2	14	13.2	0.419	0.811
Ovarian cancer	46	43.4	52	49.1	53	50.0	44	41.5	7	6.6	10	9.4	1.732	0.421
Thalassemia	37	34.9	25	23.6	61	57.5	75	70.8	8	7.5	6	5.7	4.049	0.132
Sickle cell disease	36	34.0	33	31.1	65	61.3	70	66.0	5	4.7	3	2.8	0.816	0.665
Fragile X	106	100	106	100	0	0	0	0	0	0	0	0	0	1.000
III- Genetic related procedures														
Polymerase chain reaction (PCR)	106	100	106	100	0	0	0	0	0	0	0	0	0	1.000
Gene therapy	103	97.2	101	95.3	3	2.8	5	4.7	0	0	0	0	0.52	0.471
Genogram	106	100	106	100	0	0	0	0	0	0	0	0	0	1.000
Pharmacogenesis	104	98.1	106	100	2	1.9	0	0	0	0	0	0	2.019	0.155

Table 3: Number and percentage of nursing students' knowledge regarding the selected genetic topics in both groups post intervention (n=212)

	level of Knowledge													
Genetic Topics	**No**				**Some**				**High**				**Chi square test**	
	Study (n=106)		**Control (n=106)**		**Study (n=106)**		**Control (n=106)**		**Study (n=106)**		**Control (n=106)**		**X2**	**P**
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**		
I- Genetic Terms														
Mitosis	10	9.4	38	35.8	40	37.7	38	35.8	56	52.8	30	28.3	24.245	**<0.001
Meiosis	24	22.6	47	44.7	39	36.8	30	28.3	43	40.6	29	27.4	11.347	*0.003
transcription	22	20.8	41	38.7	46	43.4	39	36.8	38	35.8	26	24.5	8.557	*0.014.
translation	21	19.8	31	39.2	32	30.2	51	48.1	53	50.0	24	22.6	17.195	**<0.001
Mutations	11	10.4	34	32.1	32	30.2	42	39.6	63	59.4	30	28.3	24.817	**<0.001
DNA replication	12	11.3	24	22.6	39	36.8	51	48.1	55	51.9	31	29.2	12.298	*0.002
DNA structure/function	9	8.5	26	24.5	34	32.1	41	38.7	63	59.4	39	36.8	14.558	**<0.001
RNA structure/function	17	16.0	27	25.5	34	37.7	49	46.2	55	51.9	30	28.3	12.337	*0.002
Autosomal dominant inheritance	15	14.2	36	34.0	55	51.9	45	42.5	36	34.0	25	23.6	11.631	*0.003
Autosomal recessive inheritance	17	16.0	31	29.2	35	33.0	42	39.6	54	50.9	33	31.1	9.789	*0.007
X- linked inheritance	19	17.9	37	34.9	50	47.2	41	38.7	37	34.9	28	26.4	7.922	*0.019
Mitochondrial inheritance pattern	15	14.2	30	28.3	37	34.9	41	38.7	54	50.9	35	33.0	9.261	*0.010
Protein synthesis	14	13.2	31	29.2	35	33.0	40	37.7	57	53.8	35	33.0	12.016	*0.002
II- Genetic Conditions														
Gausher disease	20	18.9	33	31.1	42	39.6	51	48.1	44	41.5	22	20.8	11.393	*0.003
Familial hypercholesterolemia	13	12.3	25	23.6	32	30.2	52	49.1	61	57.5	29	27.4	19.929	**<0.001
Duchenne's muscular dystrophy	19	17.9	38	35.8	48	45.3	42	39.6	39	36.8	26	24.5	9.333	*0.009
Trisomy 21 (Down syndrome)	5	4.7	19	17.9	35	33.0	50	47.2	66	62.3	37	34.9	18.979	**<0.001
Trisomy 18	16	15.1	28	26.4	35	33.0	43	40.6	55	51.9	35	33.0	8.538	*0.014
Trisomy 13	21	19.8	38	35.8	40	37.7	45	42.5	45	42.5	23	21.7	12.310	*0.002
Turner syndrome	17	16.0	30	28.3	39	36.8	46	43.4	50	47.2	30	28.3	9.172	*0.010
Klinefelter syndrome	18	17.0	29	27.4	38	35.8	50	47.2	50	47.2	27	25.5	11.081	*0.004
Cystic fibrosis	10	9.4	22	20.8	47	44.3	58	54.7	49	46.2	26	24.5	12.706	*0.002
Breast cancer	2	1.9	8	7.5	24	22.6	42	39.6	80	75.5	56	52.8	12.744	*0.002
Ovarian cancer	3	2.8	9	8.5	39	36.8	50	47.2	64	60.4	47	44.3	6.963	*0.031
Thalassemia	5	4.7	9	8.5	30	28.3	54	50.9	71	67.0	43	40.6	14.877	**<0.001
Sickle cell disease	8	7.5	19	17.9	29	27.4	36	34.0	69	65.1	51	48.1	7.935	*0.019
Fragile X	16	15.1	25	23.6	42	39.6	52	49.1	48	45.3	29	27.4	7.728	*0.021
III- Genetic related procedures														
Polymerase chain reaction (PCR)	13	12.3	25	23.6	42	39.6	47	44.3	51	48.1	34	32.1	7.47	*0.024
Gene therapy	5	4.7	19	17.9	41	38.7	34	32.1	60	56.6	53	50.0	9.254	*0.010
Genogram	9	8.5	19	17.9	42	39.6	52	49.1	55	51.9	35	33.0	9.08	*0.011
Pharmacogenesis	6	5.7	21	19.8	34	32.1	42	39.6	66	62.3	43	40.6	14.029	**<0.001

** Statistical significant (p<0.05).*

*** High statistical significant (p<0.001).*

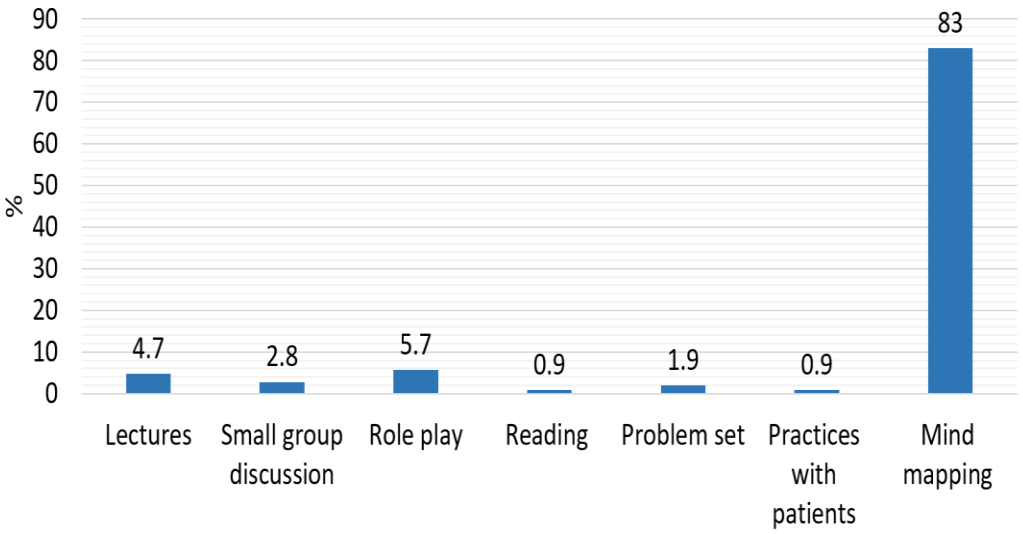

Figure2. Educational activities that improve genetic knowledge as reported by the studied students in study group(n=106)

Table 4: Perception of students about the mind mapping as a genomic learning tool among the study group students post intervention (n=106)

	Perception (%)						Score
	Agree		Uncertain		Disagree		
Variables	**N**	**%**	**N**	**%**	**N**	**%**	**Mean ±SD**
1.Valuable when learning concepts	98	92.5	7	6.6	1	0.9	1.92 ±0.3
2. Improving understanding of topics	100	94.3	6	5.7	0	0	1.94 ±0.2
3. Helpful in recall information	101	95.3	5	4.7	0	0	1.95 ±0.2
4. Helpful in organizing information	101	95.3	5	4.7	0	0	1.95 ±0.2
5. Encouraged us to read & outline the chapters	106	100	0	0	0	0	2.00 ±0.0
6. Helped to clear my concepts	99	93.4	7	6.6	0	0	1.93 ±0.2
7. Good self-study tool	102	96.2	4	3.8	0	0	1.96 ±0.2
8. Helpful for rapid revision	106	100	0	0	0	0	2.0 ±0.0
9. Enjoyed learning nursing with this method	100	94.3	6	5.7	0	0	1.94 ±0.2
10. Not my style learning	2	1.9	7	6.6	97	91.5	0.10 ±0.4
11. I don't think it helped with retention of material	0	0.0	6	5.7	100	94.3	0.06 ±0.2

Table 5: Students' satisfaction toward genetics according to teaching methods among the students in the study and control groups (n=212)

	Study Group (n=106)	Control group (n=106)		Student's t test	
Satisfaction scale items	**Mean ±SD**	**Mean ±SD**	**95% CI**	**T**	**P**
- The teaching method used in genetics study was helpful and effective	4.21 ±1.4	1.61 ±1.1	2.26 – 2.93	15.287	**<0.001
- The teaching method provided me with a variety of learning materials and activities to promote my learning	4.16 ±1.3	1.48 ±1.2	2.34 – 3.02	15.449	**<0.001
- I enjoyed how my instructor taught the genetics	4.07 ±1.42	1.47 ±1.2	2.24 – 2.95	14.569	**<0.001
- The teaching methodused in the genetics study was motivating and helped me to learn	4.11 ±1.5	1.40 ±1.02	2.37 – 3.06	15.455	**<0.001
- The way my instructor taught the genetics was suitable to the way I learn	3.94 ±1.40	1.44 ±1.1	2.16 – 2.84	14.307	**<0.001
- Total score	**21.49 ±3.1**	**9.41 ±2.6**	11.30 – 12.86	30.867	**<0.001

** *High statistical significant (p<0.001).*

Table 6: Relation between socio-demographic characteristics of students in study group and their knowledge level post intervention (n=106)

	Students' knowledge							
	No(n=13)		Some (n=38)		High (n=55)		Chi square test	
	N	%	N	%	N	%	X2	P
Gender								
Male**(37)**	9	69.2	20	52.6	8	14.5		
Female**(69)**	4	30.8	18	47.4	47	**85.5**	22.030	****<0.001
Age								
18 – 19 **(50)**	10	76.9	21	55.3	19	34.5		
20 – 22**(56)**	3	23.1	17	44.7	36	**65.5**	9.134	***0.010
Study year								
One**(30)**	8	61.5	17	44.7	5	9.1		
Two**(76)**	5	38.5	21	55.3	50	**90.9**	22.138	****<0.001
Marital status								
Single**(85)**	6	46.2	27	71.1	52	**94.5**		
Married**(21)**	7	53.8	11	28.9	3	5.5	18.611	****<0.001

* *Statistical significant (p<0.05).*

** *High statistical significant (p<0.001).*

DISCUSSION

Mind mapping is a graphical tool for establishing and indicating information in networks of concepts and linking statements about a problem or subject, it comprises concepts, usually fenced in circles or boxes of some type and relationship between concepts are designated by a connecting line joining words. It is beneficial tool in expressive the construction of information in a procedure that is psychologically well-matched with the way in which human beings construct meaning and can recall of information in genetics instructions(20). Therefore, the recommendations of researchers to involve nursing students in the construction of their knowledge, paved the way to gaze at mind mapping teaching method as it relates to students' meaningful learning and achievement in genetics education.

The findings of the current study revealed that; the students' knowledge in study group was improved significantly after intervention, regarding genetic terms, genetic conditions and genetic related procedures. There were statistical differences between both groups ($p<0.001$& $p<0.05$), this attributed to using of mind mapping in genetics education which improve students' critical thinking and easy remember of genetics topics, this result was in agreement with Jaafarpour et al., (21) in a quasi-experimental crossover study in Iran assessed the effectiveness of mind 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. Also; this result similarity with Koc, (22) who studied tutorial knowledge representation through concept mapping as a study and collaboration tool in teacher education and reported a fixed increase in the mean scores of developed map during the nine sessions of intervention. Current results indicated that this improvement produced an increase in the complexity of drawings, number of concepts extracted, understanding more accurate relationships between concepts as well as improved use of theoretical knowledge in the design of nursing interventions.

Regarding educational activities that improve genetic knowledge as reported by the study group students; current study showed that; most of students in study group had reported that; mind mapping is the best teaching method to improve genetic knowledge. This result was in agreement with Kirk et al.,(23) who studied an iterative consensus-building approach to revising a genetics/genomics competency framework for nurse education in the UK and reported that; simulation can be used in combination with learning strategies such as lecture and discussion to allow students to practice skills such as speaking to patients about genetics-related topics. Moreover; mind mapping has been described as an active learning tool that promotes deeper knowledge of concepts and their intricate relationships with better grasping and remembers (24).

According the current study results, the use of mind mapping not only improved students' post-test of knowledge, but also, the majority of students had positive perception of the mind mapping technique, with majority agreement upon its benefits. Moreover; it was noticed that there was agreement upon the advantages related to higher ranking cognitive levels such as "Helpful for rapid revision and improving understanding of topics" was higher compared to lower ranking ones such as "valuable when learning concepts." 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 gamut of cognitive levels. The students' satisfaction high level and positive perception of mind mapping were revealed in the present study. This finding was agreement with Duffy et al., (25) who studied experiences of using Prezi in psychiatry teaching and found that, the majority of the students using mind mapping viewed the technique as helpful, stimulating, and interesting, (That reflected students' satisfaction high level and positive perception) with only a few of them having some difficulties with its application.

Regarding students' satisfaction toward genetics according teaching methods among the study and control groups, the present study shown that; there were highly statistical differences between both groups after intervention ($p<0.001$). The students in study group were highly satisfied toward mind mapping as a genomic learning tool, this result was agreed with Hsu et al (26) in their study entitled an experimental study with pre and 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 and demonstrated that significantly higher mean scores of learning satisfaction in the study group compared with the control group. On the same line; Grice (27), who studied concept mapping as a learning tool in occupational therapy education in the United States and reported that, the nursing students who used mind mapping as a learning tool found the process of creating such mapping valuable to their learning and they enjoyed the process. Moreover; Saeidifard et al., (28) 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.

Regarding the relation between socio-demographic characteristics of studied students and their knowledge in study group, the findings of current study illustrated that; there were a positive relationship between the studied students' gender, age, study year and marital status and their knowledge after intervention, the female significantly had high knowledge than males, majority of the students which in second year, the older students and single students have high knowledge than young and married students. This relation was statistical significant ($p< 0.001$&$p< 0.05$). This may be due to female students like drawing and figures than males. This finding was in agreement with Vlckova and Kubiatko, (29), they studied perception of genetics by using of semantic differential at high school students and they were reported that, the overall attitude to genetics was 4.71 (SE = 0.10). General attitude to genetics among girls was ($x = 4.82$, $SE = 0.08$) and among boys ($x = 4.49$, $SE = 0.11$). Gender was confirmed to be a statistically significant variable influencing attitudes to genetics ($F = 5.70$, $p < 0.05$). This result was noresemble with Kaddoura et al., (30) who studied impact of a concept mapping teaching approach on nursing students' critical thinking skills in North Carolina and found that; nursing students in the first year of bachelor nursing program taught by mind mapping group had significantly better posttest results in comparison with their peers taught by traditional methods. The single students were not busy and free for study than married students which busy with married responsibilities so that; the single students have high knowledge than those married.

Lastly but not the last; the researchers of the current study stated that; the difficulty of alive with genomic disorders and providing physical, emotional, spiritual, and cultural provision where as providing educational and referral leadership will fluctuate reliant on the distinct life stage of the patient and family elaborated. The patients requirements were diagnosed with genomic disorders will entail nursing provision all over the life extent. Hence; perceptive and being talented to assimilate the essential aptitudes of genomic are crucial for all enthusiastic nurses. There is the need to know teaching methods which students can relate with share information and ideas, as well as interact academically within themselves such as mind mapping technique.

CONCLUSION

Based on the results of the current study; it was concluded that; the genetics teaching by mind mapping affected positively on students' knowledge in study group post intervention, most of them had reported that mind mapping is the best teaching method to improve genetic knowledge and mind mapping well accepted by them. The students in study group had positive perception toward mind mappingas a genomic learning tool. As well as high satisfaction score toward genomic study among students in study group more than those in the control group. These findings achieved the aims of the present study and answered the research questions.

RECOMMENDATIONS

1. Replicate this study on a larger sample in different faculties of nursing to generalize the findings.
2. Nursing genomic should be included in the curriculum of faculty nursing study in theoretical and practical aspects for under and postgraduate students.
3. Importanceof nursing educatorstrainingabout mind mappingdemonstration.
4. **Further studies** are required to examine effectiveness of mind mapping in long-term retention of knowledge, and its impact on the application of the acquired knowledge in practice.Upcoming research should also compriseevaluation of psychosocial knowledge and values regarding genomics and genetic testing. Content mapping of genomics datacomprised in the curriculum was not available; imminent studies would be reinforced by associating curriculum content with student information.

REFERENCES

[1]. Gagdi, J. A., &Zayum, S. D. (2012). Effect of Concept Mapping Teaching Strategy onThe Academic Achievement Of Senior Secondary School Students In Genetics. *ATBU Journal of Science, Technology and Education*, *1*(1), 49-53.

[2]. Sharoff, L. (2016). Holistic nursing in the genetic/genomic era. *Journal of Holistic Nursing*, *34*(2), 146-153.

[3]. Williams, M. H. (2012). Physical webbing: Collaborative kinesthetic three-dimensional mind maps. *Active Learning in Higher Education*, *13*(1), 35-49.

[4]. Burgess- Allen, J., & Owen- Smith, V. (2010). Using mind mapping techniques for rapid qualitative data analysis in public participation processes. *Health Expectations*, *13*(4), 406-415.

[5]. Edwards, S., & Cooper, N. (2010). Mind mapping as a teaching resource. *The clinical teacher*, *7*(4), 236-239.

[6]. Oi, K., & Toyoshima, H. (2011). A study on the effect of hierarchical concept mapping on writing by junior high school students. , Chiba University, Japan,*59*, 223-228.

[7]. Sarhangi, F., Masoumi, M. A. S. O. U. M. E. H., Ebadi, A. B. A. S., SeyyedMazhari, M., &Rahmani, A. Z. A. D. (2010). Comparing the effect of lecture-and concept mapping based learning on cognitive learning levels. *Iranian Journal of Critical Care Nursing*, *3*(1), 1-2.

[8]. Thomas, L., Bennett, S., & Lockyer, L. (2016). Using concept maps and goal-setting to support the development of self-regulated learning in a problem-based learning curriculum. *Medical teacher*, *38*(9), 930-935.

[9]. Jamison, T., & Lis, G. A. (2014). Engaging the learner by bridging the gap between theory and clinical competence: the impact of concept mapping and simulation as innovative strategies for nurse-sensitive outcome indicators.*Nursing Clinics of North America*, *49*(1), 69-80.

[10]. Munro, C. L. (2015). Individual genetic and genomic variation: a new opportunity for personalized nursing interventions. *Journal of advanced nursing*, *71*(1), 35-41.

[11]. Lea, D. H., Skirton, H., Read, C. Y., & Williams, J. K. (2011). Implications for educating the next generation of nurses on genetics and genomics in the 21st century. *Journal of Nursing Scholarship*, *43*(1), 3-12.

[12]. Maradiegue, A., Edwards, Q. T., Seibert, D., Macri, C., &Sitzer, L. (2005). Knowledge, perceptions, and attitudes of advanced practice nursing students regarding medical genetics. *Journal of the American Academy of Nurse Practitioners*, *17*(11), 472-479.

[13]. Temtamy, S. A., Aglan, M. S., &Meguid, N. A. (2010).Genetic Disorders in Egypt.Chapter (8) Pp. 219–272 in Teebi A., editor. , ed. Genetic Disordersamong Arab populations (ISBN:9783,642,050794). Springer, Berlin, Heidelberg.

[14]. Dodson, C. H., &Lewallen, L. P. (2011). Nursing students' perceived knowledge and attitude towards genetics. *Nurse Education Today*, *31*(4), 333-339. Made available courtesy of Elsevier: **http://www.dx.doi.org/10.1016/j.nedt.2010.07.001**

[15]. Maradiegue, A. (2008). A resource guide for learning about genetics. *OJIN: The Online Journal of Issues in Nursing*, *13*(1).

[16]. Hsiao, C. Y., Van Riper, M., Lee, S. H., Chen, S. J., & Lin, S. C. (2011). Taiwanese nursing students' perceived knowledge and clinical comfort with genetics. *Journal of Nursing Scholarship*, *43*(2), 125-132.

[17]. Maradiegue, A., Edwards, Q. T., Seibert, D., Macri, C., &Sitzer, L. (2005). Knowledge, perceptions, and attitudes of advanced practice nursing students regarding medical genetics. *Journal of the American Academy of Nurse Practitioners*, *17*(11), 472-479.

[18]. Kirk, J., Miller, M. L., & Miller, M. L. (1986). *Reliability and validity in qualitative research* (Vol. 1). Sage.

[19]. Zaharah, M. (2011). *Level of Satisfaction on the Implementation of Performance Appraisal AmongNon Academic Staff* (Doctoral dissertation, Universiti Utara Malaysia).

[20]. Sakiyo, J., & Waziri, K. (2015). Concept mapping strategy: An effective tool for improving students' academic achievement in biology. *Journal of Education in Science, Environment and Health*, *1*(1), 56-62.

[21]. Jaafarpour, M., Aazami, S., &Mozafari, M. (2016). Does concept mapping enhance learning outcome of nursing students?.*Nurse education today*, *36*, 129-132.

[22]. Koc, M. (2012). Pedagogical knowledge representation through concept mapping as a study and collaboration tool in teacher education. *australasian Journal of educational technology*, *28*(4). 656–670.

[23]. Kirk, M., Tonkin, E., &Skirton, H. (2014). An iterative consensus- building approach to revising a genetics/genomics competency framework for nurse education in the UK. *Journal of advanced nursing*, *70*(2), 405-420.

[24]. Berglund, A. (2015). What's in a Word? Concept mapping: a graphical tool to reinforce learning of epidemiological concepts. *J Epidemiol Community Health*, jech-2014.69(12):1232-1236.

[25]. Duffy, R. M., Guerandel, A., Casey, P., Malone, K., & Kelly, B. D. (2015). Experiences of using Prezi in psychiatry teaching. *Academic Psychiatry*, *39*(6), 615-619.

[26]. Hsu, L. L., Pan, H. C., & Hsieh, S. I. (2016). Randomized comparison between objective-based lectures and outcome-based concept mapping for teaching neurological care to nursing students. *Nurse education today*, *37*, 83-90.

[27]. Grice, K. (2016). Concept mapping as a learning tool in occupational therapy education. *Occupational therapy in health care*, *30*(3), 309-318.

[28]. Saeidifard, F., Heidari, K., Foroughi, M., &Soltani, A. (2014). Concept mapping as a method to teach an evidence-based educated medical topic: a comparative study in medical students. *Journal of Diabetes & Metabolic Disorders*, *13*(1), 86.

[29]. Vlckova, J., &Kubiatko, M. (2017). Perception of Genetics by Using of Semantic Differential at High School Students: Preliminary Results. *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(1), 311-322.

[30]. Kaddoura, M., Van- Dyke, O., & Yang, Q. (2016). Impact of a concept map teaching approach on nursing students' critical thinking skills. *Nursing & health sciences*, *18*(3), 350-354.