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**The Effectiveness of Digital Visual  
Learning in developing the Cognitive  
Performance of Female Students at a  
Faculty of Education in Saudi  
Arabia**

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**Abstract**

This research aimed to investigate the effectiveness of digital visual learning in developing the cognitive performance of female students of the first undergraduate stage majoring in teaching primary stages (enrolled in Methods of Teaching Science (3) course) at faculty of education in Saudi Arabia. To achieve the purpose of study, the researcher used several models of applications of electronic mind maps software. The study sample is purposive which consisted of (95) female students. The experimental group consisted of (46) female students and the control group of (49) students. The researcher used the qualitative and quantitative research methodology (the quasi-experimental methodology). The researcher used two tools, A Pre - Post Test was applied in the study. In the qualitative approach used the interview technique for collecting data. The results showed statistically significant differences in favor of the experimental group that show the effect of digital visual learning is effective. And the students in the experimental group asked to apply electronic mind maps in the curriculum and include them in the teaching methods. The researcher recommends using the electronic mind maps in developing the cognitive performance in the science curriculum, and inclusion of electronic concept maps applications in teaching methods for university courses, and provide training opportunities for students to use these applications.

**Keywords:** Digital Visual Learning, Electronic Mind-Map, Cognitive Performance.

**فاعلية التعلم البصري الرقمي في تنمية الأداء المعرفي لدى طالبات كلية التربية في السعودية**

**المخلص:**

هدف البحث الحالي إلى الكشف عن فاعلية استخدام نماذج من تطبيقات برامج الخرائط الذهنية الالكترونية، لدى طالبات المرحلة الجامعية الاولى، تخصص معلم الصفوف الاولى، في مقرر طرق تدريس العلوم (3) بكلية التربية في السعودية. استخدم في البحث عدة نماذج من تطبيقات الخرائط الذهنية الالكترونية في البحث. تكونت عينة الدراسة من (95) طالبة درس المقرر بصورة قصدية، (46) طالبة في المجموعة التجريبية وشكلت البقية المجموعة الضابطة. استخدم في البحث منهج البحث الكمي باستخدام المنهج شبه التجريبي، حيث تم تطبيق اختبار قبلي - بعدي في الدراسة، واستخدم في النهج النوعي أسلوب المقابلة كطريقة لجمع البيانات، وأظهرت النتائج وجود فروقاً ذات دلالة احصائية ولصالح المجموعة التجريبية، كما دعى عدد من طالبات المجموعة التجريبية إلى تطبيق الخرائط الذهنية الالكترونية في المقررات الدراسية واعتبارها ضمن مجموعة الطرق التدريسية، واوصت الدراسة بتضمين تطبيقات خرائط المفاهيم الالكترونية ضمن طرق التدريس للمقررات الجامعية، وإتاحة فرص التدريب للطلاب على استخدام هذه التطبيقات.

**كلمات مفتاحية:** التعلم البصري الرقمي، الخرائط الذهنية الالكترونية، الأداء المعرفي.

## **Introduction**

There is an English proverb which says "A picture is worth a thousand words". It means that the meaning of a complex idea can be conveyed more effectively and easily with just a single picture, than a words do.

There is much truth in this proverb, as we live in a visual- oriented society which is, full of visual stimuli that express a large number of written words. Due to rapid advances in technological developments, thousands of new software and computer applications are released every day and making their way in the education sector, such as making the teachers' work easier and more efficient. This has invited many researchers to study the effect of this technological invasion on teaching and learning process. Consequently, educators need to consider how to help students manage learning materials, rather than simply memorizing them and increasing their quantitative inventory of information unconsciously.

Therefore, it is important to introduce computer-based e-learning tools such as electronic mind mapping programs, with their varied potentials and fascinating applications that are crucial in developing teachers' visual learning (Al-Otaibi, 2016).

Visual learning appeals more to students and helps them clarify their ideas, organize and analyze their information, and integrate new knowledge with old knowledge. It also helps them connect and organize ideas and information with images. As such, visual learning is a learning tool for of creative thinking and as it enables learners to remember image-supported information faster than text-based materials only (Marquardt, 2012). A lot of researches indicate that the vast majority of students in the classroom need to see information in order to learn because reading the image are much easier than reading the written text (sword, 2005). In addition, visual learning is a cognitive social learning process that helps the learner to generate the meanings of information using multimedia including written texts and visual images (Williams, Burns, & Daisey, 2016).

Thus mind maps are a visual learning instrument used to build and organize knowledge. They reflect an innovative way of gathering information, generating ideas, brainstorming, helping students to study, read and organize. They are also utilized in problem solving and decision making (Christodoulou, 2010).

Electronic mind map is a type of mind maps. It is an effective tool for generating creative ideas and a mind operation that stimulates thinking to communicate and retrieve information to the brain. Mind maps are one of the ways to improve efficiency of linking between the two sides of the brain because they link the word (left hemisphere) with the image (right hemisphere). Concepts and images are linked using curved lines which vary in intensity and decrease as we move away from the center, (i.e. when we move from Commonality to specificity (Buzan, 2016).

Furthermore, using electronic mind maps in learning has many advantages; it is a modern learning tool that accelerates learning, faster knowledge discovery, and making materials more organized, accurate and ready for retention (Al-badwoi, 2015). It also develops positive attitudes toward learning and achievement using digital-based concept mapping in learning educational technology (Ahmed, 2016), and helps to enforce spatial learning strategies and the individual knowledge management, like organization, representation, communication and self-evaluation (Tergan, 2005). According to Fiktorius (2013), mind maps help to clarify concepts in a simple way

away from complexity, and simple words do not obscure important ideas, and help in linking new knowledge with the old one.

Using electronic mind maps is not limited to teaching subjects due to their effectiveness in solving students' problems in their career achievements (Papushina, Maksimenkova, & Kolomiets, 2017). It, as well, helps the Master's students in studying "educational research curriculum course" and organizing their information and completing assignments required of them with high efficiency and the application of the mind map in this subject has enabled students to more easily understand the content, perceive relations between contents, and memorize the overall concept of the research (Tungprapa, 2015). They also contribute to self-organized learning (SOL) (S.O. Adodo, 2013). Mind map is a teaching method that enables learners to enhance learning, thinking, teaching and searching (Ahlborg, 2013), as well as it a creative way teaching of instruction (Buzan, 2016), and a fascinating method to retain and use information, improve memory and imagination (Tellah, 2012).

As for the electronic mind maps are based on e-learning. The researcher also finds that one of the advantages of using it is ease in handling. The learner can delete and add information to the map in a short time instantaneously. He or she can send the map by email or can create an electronic link for the map when designing it. In addition to designing it collaboratively or individually, the learner can also make it public by using difference applications of electronic maps software such as (Free Mind, X-Mind, iMind Map, Mind Manager, Edraw Mind Map).

## **Literature Review**

Past educational literature includes many studies that confirm the efficiency of teaching by using electronic mind maps in different courses like science, English, technology, and other, and used in different educational stages in school and university. This shows that electronic mind maps are flexible to utilize different types of work and study courses. This efficacy was established in the studies by:

Papushina, Maksimenkova & Kolomiets. (2017) confirmed their effectiveness as a teaching method for the postgraduate course. The comprehension of mind mapping approach adoption is implemented in a form of pedagogical reflection. The data for the pedagogical reflection were gained from the research, which was designed in a mixed methodology. The combination of a survey and a participant observation aimed to get collaborative data on students' perception and estimations of mind mapping. The survey's questionnaire was developed based on the technique's functions and results of participant observation. The analysis highlighted that the Coggle may be confidently use as educational software in case of supporting in class and home collaborative activities on mind mapping. As a result, the set of recommendations for teaching with mind maps was developed. The directions for a further work are discussed.

In another side, Aljaser (2017) was study aimed to identify the effect of using electronic Mind Maps on the academic achievement of the fifth-grade primary female students in the English language curriculum compared to the traditional teaching method adopted in the teacher's guide, and aimed to indicate the attitudes of the fifth-grade female students towards the use of electronic Mind Maps in understanding the study unit adopted in this study. The study utilized the quasi-experimental method applied to two groups: experimental and control, The population of the study

consisted of the fifth-grade of primary school female students, who studied in Ashbeelya Private School in Riyadh for the academic year 2016/2017, The sample of the study is consisted of 30 fifth-grade female students, divided into experimental group (15 students) and control group (15 students). The study resulted that there were statistically significant differences between the mean scores of the experimental group and the control one in the post achievement test scale in favor of the experimental group. The effect size of using Mind Maps was high. There were statistically significant differences between the mean scores of the experimental and control group scores in the post achievement test of the attitude towards learning English in favor of the experimental group.

While AL-Shamrani (2016) study aimed to identify the impact of the use of electronic mind maps to collect and develop deductive reasoning skills among students average third grade in the decision of science in Riyadh. The sample of study is (28) students for experimental group and (28) students of control group. The results showed the existence of statistical significant differences between experimental and control group favor to experimental group.

And Al-Otaibi (2016) was study aimed to investigate the effectiveness of non- hierarchal electronic mind maps in developing the skills of visual thinking in the course of science among primary- stage female learners. The study sample consisted of (44) female students from the sixth grade. (22) Students formed the experimental group and (22) for control group. A pre- post visual thinking skills test conducted on the study sample. The results showed statistical significant differences between student average grades in experimental and control group on the visual thinking skills test favor to experimental group.

The purpose of Ahmed (2016) study was to investigate the effects of using digital-based concept mapping as strategy on students' achievements and attitudes. Data was collected from 58 students enrolled in the course of "Introduction to Educational Technology" in Instructional and Teaching Technologies Department at Sultan Qaboos University. Two sections out of four sections were selected randomly as the sample of the study. One of the sections was randomly chosen as experimental group ( $n = 27$ ) and the other was control group ( $n = 31$ ). Both pre- and post-achievement tests were used. The results of the study revealed that students who were taught with digital-based concept mapping strategy performed better than those who were taught with the conventional method. There was a significant difference between male and female students in the post test scores of the experimental group in favor of females. In addition, no interaction effect for the independent variables was found. The study also showed that students in the experimental group had positive attitude towards using digital-based concept mapping in learning educational technology.

On another part, Tungprapa (2015), the objective of her article is to study results of using the electronic mind map for the teaching and learning in educational research methodology course of Master's degree students in the Faculty of Education, Ramkhamhaeng University, Thailand by using quantitative and qualitative study. Study samples include one class of master degree students. Research tools are comprised of an attitude assessment – pre- post-study form, a questionnaire, and an interview form. Analysis of quantitative data was performed by using fundamental statistics, the  $t$  – test (dependent) and the  $t$  – test (independent) while qualitative data was analyzed by using the content analysis technique. Results of quantitative study showed that the Free Mind program is the

software mostly used by students to create mind map. After the electronic mind map was used, it was found that the students' post-study attitudes towards the research study subject are higher than their pre-study attitudes, at 0.05 level of statistical significance. Results of qualitative study indicated that students had perceived usefulness of applying mind map into the research learning session.

The purpose of Al-Badwoi (2015) study was to investigate the impact of Software based Mind Mapping (SMM). The study determined the outcomes by using Electronic Mind Mapping (EMM) and the positive change in the students' responses. The research was performed on 29 randomly chosen first year students from Ibri CAS during the academic semester year 2014-2015. Three sets of groups were: self-selected study technique, paper and pen based MM and software based Mind Map (MM). All the three groups were given a 30-minute time period to review and study the lesson materials using their own technique. They were requested to answer four structured open questions based on their technique for remembering the information presented in the class lesson. The results showed statistical significant differences test favor to experimental group

In particular, results of this effectiveness in acquiring concepts of teaching technology are evident in the studies by Abdel-Moneim (2015) this study aimed to investigate the effectiveness of using electronic minds maps strategy and traditional methods in achieving some educational concepts among student's teachers at educational faculty in Aqsa University in Qaza. The experimental design was used. Study sample consisted of (190) female students of the academic year 2013L2014, divided into two groups, control group(94) studied traditional method, and experimental group(96) studied by using the strategy of mind maps. Achievement test consisted of (30) multiple choices questions. The results showed statistical significant differences between post achievement test experimental and control group favor to experimental group.

Study of (Jbeili, 2013), was aimed to examine the impact of digital mind maps on science achievement among sixth grade students in Saudi Arabia. A total of female (44) students at the second-semester of the academic year 2012/2013 participated in the study. The students were randomly assigned to two experimental groups to receive different treatments. The first group (DMM) utilized digital mind maps during their learning process, while the second group (PMM) utilized paper mind maps. The results revealed that using digital mind maps had a significant effect on students' science achievement. it was concluded that the utilization of digital mind maps for Saudi sixth students could be helpful in improving their achievement.

Al-Barakati (2012), which study aimed to know the effect of teaching using manual and technical mental maps on the achievement of female students at Umm Al-Qura University, The study sample consisted of 48 students, 24 students for the first experimental group and 24 students for the second experimental group, The analysis of the associated variance analysis was used as a statistical method where the results showed that there are statistically significant differences indicating the superiority of the second experimental group studied by the strategy of technical mental maps.

### **Comment of Literature Review**

This research was similarity with some previous studies by using Electronic Mind Maps concept as independent variable and study effectiveness on the dependent variable. Methodology

used both type (quantitative and qualitative research), and similarity with the type of sample group like (Papushina et al, 2017), (Ahmed (2016), (Tungprapa (2015), Abdel-Moneim (2015), Al-Barakati (2012), but it differed from the rest of the researches in the target group where it was from primary grades as in the rest of the previous studies.

The researcher believes that this research will enrich the educational field in that it targeted the primary stage university, which uses a lot of electronic applications in teaching process.

### **Research Problem and Hypothesis**

During this era of knowledge economy, the learner faces great challenges in how to manage scientific information, maintain and connect it logically and systematically and be able to retrieve it to solve certain problems. Therefore, it is necessary to look for a strategy that copes with the present challenges and helps the learner manage the learning crises. This is why the researcher hopes that this research may contribute to help the learner in how to manage knowledge and deal with it effectively. The research problem is determined by answering the following question:

How effective using digital visual learning is in developing cognitive performance among female students of College of Education in Saudi Arabia?

The hypothesis is determined by the following:

There are no statistically significant differences in the scores of the students on the achievement test of cognitive performance according to different study groups (experimental and control).

### **Methodology and Research Sample**

The research population consisted of all female students of the Faculty of Education - Imam Abdul Rahman bin Faisal University - Saudi Arabia. The study samples included all female students majoring as primary stage teachers and were enrolled in Methods of Teaching Science (3) course. The total number of students was 95 students, divided into two groups (experimental-46) and (control- 49). The research tools consisted of a pre-post achievement test to measure the cognitive performance of the students and interview for the students of the experimental group.

### **Limitations of the study**

The results of this study were limited to the following:

- 1) This study was conducted on first undergraduate stage majoring in teaching primary stages in education college in Saudi Arabia.
- 2) The sample of the study was selected in the first semester of the academic year 2017-2018.
- 3) The results were limited to the post test, which was used to measure students achievement in Cognitive performance in Methods of Teaching Science (3) course.

### **Research Procedures**

1. The researcher applied the pre-test for the students at the beginning of the course.
2. The researcher delivered six lectures using various applications of electronic mind maps (Free Mind, iMind Map, Mind Manager, Edraw Mind Map) for the experimental group. In contrast, lectures were given to the control group in traditional teaching method.

3. The researcher applied the post-test for both groups in Teaching Science (3) course, and recorded each student's time spent on taking the test, and recording data then conduct the appropriate statistical analysis, then writing the recommendations.
4. She interviewed a number of students in the experimental group to assess their attitudes toward using of electronic mind maps.

### **Operational Definitions**

**Digital Visual Learning:** is the teaching method used in the research that includes several Electronic Mind Maps software (Free Mind, X-Mind, iMind Map, Mind Manager, Edraw Mind Map) designed for these applications.

**Electronic Mind Maps:** It is a computer applications program was used by the first undergraduate stage majoring in teaching primary stages, in the experimental group to help them analyze and organize ideas in order to understand science concepts and to draw concept mapping using images, colors, gradient curves.

**Cognitive performance:** The final mark obtained by the student in Methods of Teaching Science (3) course, taking into account the time spent by the student taking the test.

### **Research Findings & Discussion**

The purpose of the research was to answer the question: How effective using digital visual learning is in developing cognitive performance among female students of faculty of Education in Saudi Arabia? And to examine the null hypothesis: there were no statistically significant differences between the study groups (experimental and control) in the female students' marks on the post achievement test. To answer the question and examine the hypothesis, the researcher used quantitative and qualitative research methodology.

### **Quantitative Research Results**

At the beginning of analyzing the results, the arithmetic mean, the standard deviation and the t- value of the variations on the pre= test. Table (1) shows the results.

**Table 1:** *The arithmetic mean, standard deviation and t-value of the variations on the pre- test between the two groups*

#	Group	No.	Mean	Std. Deviation	t	df	p
1	Experimental	46	6.15	1.93	0.288	93	0.774
2	Control	49	6.04	1.83			

After the independent sample t-test, the results showed that there were no statistically significant differences in the means on the Methods of Teaching Science (3) course.

To identify the effect of teaching using electronic mind maps, the data were analyzed for the post-test, calculation of arithmetic mean, standard deviation and the t- values for the variations on the post-test. Table (2) shows the results.

**Table 2:** *The arithmetic mean, standard deviation and t- value of the difference on the post-test between the two groups*

#	Group	No.	Mean	Std. Deviation	t	df	p	ES
1	Experimental	46	12.87	1.42	3.85	93	0.00	0.79
2	Control	49	11.65	1.64				

The t-test was applied to two independent samples to examine the null hypothesis (the mean of female students' marks in the experimental group on the post-test is the same of the female students' marks in the control group). The results of the analysis indicate that the value of (3.85) shows that the group who Taught by using the mind maps (mean = 12.87, and standard deviation = 1.42) obtained higher scores than the group used the traditional learning method (mean = 11.65, standard deviation = 1.64). The effect size value showed a significant practical indication of the results based on Cohen's effect size scale. The researcher conclude that electronic mind maps help students learning and developing concepts them.

To analyze the test time the student took in answering the post-test in both groups, a maximum of two full hours were assigned to the test, the time of each student's completion of the test was recorded. And then the appropriate analysis of the time factor was conducted using the percentage. The results showed the difference between the two groups in terms of spent time. Figure (1) shows the results of students in time spent to perform the test.

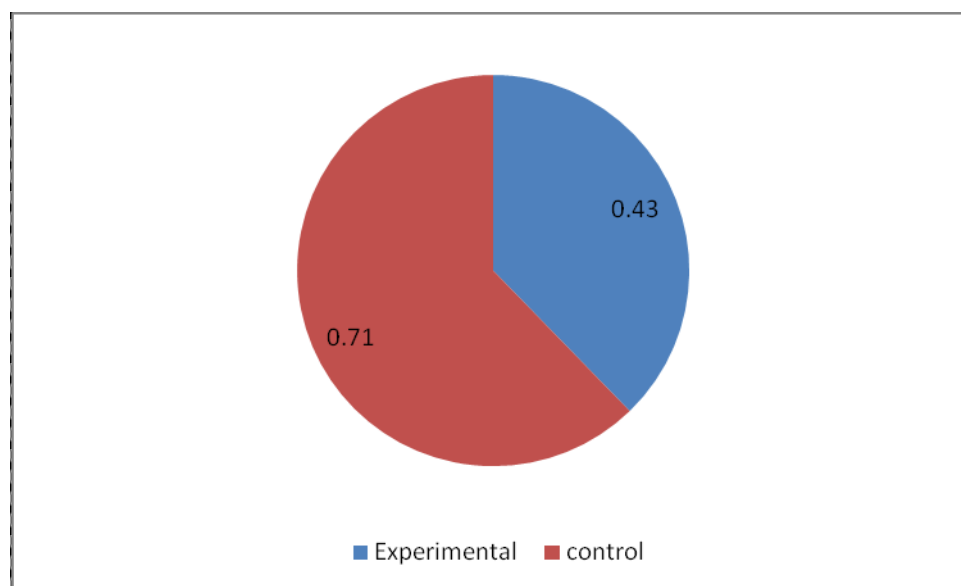


Figure 1: Mean of post-test time for the two groups

The figure shows that the experimental group spent less time on the test by( 0.43) (36 minutes) of the total testing time, against( 0.71) (85 minutes) for the control group.

### Qualitative Research Results

The summary of findings of the qualitative research obtained from interviewing 10 students showed that applications of the electronic mind map enabled the students to better understand the content and the relationship between the content vocabulary and to retain and retrieve information so easily. Moreover, using of the electronic mind maps has also helped the female students in 1110

designing presentation efficiently and to deal quickly with processing and correcting information without any difficulty.

### **Conclusion**

This research aimed to investigate the effectiveness of digital visual learning in developing the cognitive performance of female students of the first undergraduate stage majoring in teaching primary stages (enrolled in Methods of Teaching Science (3) course) at faculty of education in Saudi Arabia, by using different application electronic mind maps.

After applying the electronic mind map in teaching Science Course, students' attitudes positive towards for knowledge was increased when compared with the pre-study attitudes, and improved the students' achievement in less time. This may be due to the fact that the electronic maps are more consistent than the usual teaching methods; Furthermore students could create the electronic mind map by using different types of electronic mind maps applications. Also these maps also helped students to arrange information differently by increase or delete some information on the map itself without great efforts. The students could review the maps and modify them later. And the maps enabled them to deal with information technology easily and efficiently, and provided them with ample time to study and to complete academic assignments. Meanwhile, the qualitative study found that application of the mind map in this subject has enabled students to more easily understand the content, perceive relations between contents, and memorize the overall concept of the lesson .These facts were confirmed by the results of previous studies.

### **Recommendations**

The findings of this study emphasize importance of the electronic mind maps in enhancing and facilitating students' achievements and understanding the content more easily and efficiently. The researcher believes that this teaching/learning method is more advantageous and practical than the traditional one.

The researcher reached the following recommendations:

1. More research is needed on digital visual learning in different courses at different levels.
2. Electronic mind maps should be part of a long term strategy to introduce them in the basic teaching methods.
3. Education authorities must consider the possibility of designing paper books electronically using applications of electronic mind maps.
4. Included electronic concept maps in the student's continuous assessment list in different courses.
5. Conducting educational courses to help students for lessons design by using electronic concept maps.
6. Conducting research studies the effectiveness of some types of electronic concept maps application and comparing them with other application.

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