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The Impact of the Employment of Geogebra Software in Acquiring Some Visual Thinking Skills and On the Academic Achievement among 8th Grade Students

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Abstract: *This study aimed to investigate the impact of the use of Geogebra software on the academic achievement and visual thinking skills for eighth-grade students. To achieve the objectives of the study, the researcher used the quasi-experimental design, in which the study tools consisted an achievement test and a test for visual thinking skills applied to a sample of 70 eighth grade students, by which it was distributed evenly over two groups (experimental and control group). The results of the study showed that there are statistical significant differences between the mean scores of the experimental group students and the control group in the achievement post-test and the post test of visual thinking skills, as the value of T was (14.38), (13.71), respectively in favor of the experimental group students at the level (0.01), which indicates great impact reaching (0.752) (0.734), respectively. The study recommended the need to provide a sufficient number of computers commensurate with the number of students in all schools, and downloading Geogebra software and to train teachers to employ this software effectively in teaching.*

Key words: *Geogebra software **;** Academic achievement; Visual thinking skills.*

I. Introduction

Mathematics used to and is still playing an important role in all life aspects, for it is a science geared to serve the many applied fields in various sciences, such as humanitarian, political and economic sciences. Mathematics has gained great interest by scientists and thinkers, for it's characterized by both accuracy and rigidity, in which it has become an asylum for every human being looking for accuracy and reliability of thinking, and building information on a clear basis that is far from suspicion.

Geometry is considered one of the important branches of mathematics and one of its essential components, as it is concerned with studying the geometric shapes and their properties, figures in space and the relations between them and their applications in life (Alsoai 2004: 12). Geometry is considered important to the human being, in which it meets their wishes, and brings a sense of delight , joy and fun when dealing with through realistic and natural models and forms (Mowafy 2004: 251).

Geometry is considered to be a fertile ground for training on how to use the different thinking patterns, as it includes concepts, hypothesises and theories based on Inference; visual thinking patterns is one of the thinking patterns that should be developed among students through geometry, where (Maqat 2007: 30) sees that visual thinking is one of the most important thinking patterns that is used in teaching geometry, which train the student to see and focus on the geometric shapes, so that the student can imagine something different or similar between these forms to complete an incomplete form using given data. While (Hamada 2009: 23) adds that that visual thinking is a pattern of thinking that stirs the mind of the student using visual stimuli to understand the relationship between mathematical knowledge and information, and to present, organize and integrate it into his cognitive structure, and align it with his previous experiences and transform it into a meaningful experience.

Many studies have recommended the development of visual thinking and including it in the educational process. Among these studies are the study of (Hamada, 2006), which recommended the need to focus on the development of visual thinking in mathematics, particularly in Geometry; the study of (Hamada, 2009), which recommended the need to enrich the mathematics books with visual activities, and the training of students at all levels of education on the use of visual thinking networks, and the study of (Shaath, 2009), which recommended the focus on enriching the contents of Geometry in the various educational stages on visual thinking and rely on the diverse skills because of its importance.

And thus emerged the need for new trends in method of teaching Geometry, especially in light of scientific and technological progress in the technological innovations that have contributed to the expulsion of the educational process from the old traditional technique that is based on memorization and listening to a new systematic educational technique with its unique aims, activities, methods, tools and results; where Geogebra software is one of the most prominent innovations of modern educational techniques which is an interactive electronic software that combines different branches of mathematics (algebra, geometry and analytical calculations). It is useful for creating multiple geometric shapes by entering coordinates or by drawing dots, as

well as its availability in Arabic language. In addition to that, it's designed in a way that enables students to develop a deep understanding of the mathematical theories through the practical application and the self-discovery of the concepts. This software includes all the means necessary to make the learning process easy and interesting, in which it helps student built their knowledge on their previous learnings, and this is entirely consistent with the constructivist learning oriented model (Akkaya, Tatar, & Kagizmanli, 2011)

The beginning of the design of Geogebra software was in 2001, as a Master's thesis presented by Marx Hohensalzburg and Larter (Markus Hohenwarter) at the University of Salzburg in Austria, where they tried to integrate Geometry software with Algebra software, aiming to design an educational mathematical software that combines the ease of use available in the Geometry software, such as Capri and sketchpad, and the advantages and strong possibilities available in Algebra software such as Derive, Mathematica and Maple, to be able to use the new software easily by teachers and students alike. (White, 2012: p15)

After the publication of the software on the Internet in 2002, teachers in Austria and Germany began using it in teaching mathematics. Contrary to what its designer has expected, the software has been received with much encouragement and enthusiasm, and has been provided with a positive feedback from teachers. In 2002, the software designer was granted the European academic Prize in Sweden (EASA), and a project for the software development have been supported by granting it a Prize from the scientific Center in Austria, with awarding the software designer (Hohenwarter) a scholarship to study doctorate degree, which motivated him to continue the development of the software, and completing it through his study, which was on the Geogebra software applications. The software has also been granted a number of awards in Europe and America , and in 2006, it found its way to Florida Atlantic University after Hohenwarter's visit there as a visiting professor, to work for the Teachers' Training Project, which is supported by the national Science Foundation of Mathematics and Science. (Hohenwarter & Lavicza, 2007: p1; Preiner, 2008: p36)

Geogebra software is characterized by its ability to help the learner understand and embody the concepts in sensible ways, connecting math to life through its employment in the life matters, build self-confidence, improve academic achievement in math and develop thinking skills (Balawi 2012: 25)

Many studies and researches have proved the effectiveness of the use of Geogebra software in the teaching and learning of mathematics, including the studies of Saha (2010), Jaser (2011) ,Udi & Radakovic (2012), and the study of (Zengin, et. al., 2012)

All of the above emphasize the need to take advantage of the teaching method using Geogebra software in Geometry for the development of visual thinking and academic achievement among primary eighth-grade students, because it can provide the educational material in an interesting, exciting, educational and scientific manner, through its employment of colors, movement and drawings, which attracts students towards learning Geometry, and raises their motivation to learn.

The researcher sensed the problem of this study and the need for it through the following indicators:

- The researcher search of the results of tests conducted by the Palestinian Ministry of Education at the end of the academic year 2014/2015, which showed that there is a decline in student achievement in mathematics (Palestinian Ministry of Education, 2015)
- The researcher's conduct of an exploratory study on the eighth-grade students, to measure visual thinking skills, where the results revealed the low level of visual thinking among students, in which the average grades did not exceed (25%); this result was supported by the results of some studies on visual thinking, including the study of (Shaath, 2008), and the study of (Khozondar, 2008), which showed low levels of visual thinking among students.

In light of the foregoing, there is an urgent need to carry out such a study, which aims to answer the following main question:

The impact of the employment of Geogebra software in acquiring some visual thinking skills and on the academic achievement among 8th grade Students

To answer this question, the following sub-questions have to be answered:

1. What visual thinking skills are necessary for eighth grade students?
2. What is the impact of the employment of Geogebra software on the academic achievement among primary eighth-grade students?
3. What is the impact of the employment of Geogebra software on the development of visual thinking skills among primary eighth-grade students?

Study Hypotheses

The study aims to verify the validity of the following hypothesis:

1. There are no significant statistical differences ($\alpha \leq 0.05$) between the mean scores of the experimental group students and their peers in the control group in the achievement post-test.

2. There are no significant statistical differences ($\alpha \leq 0.05$) between the mean scores of the experimental group students and their peers in the control group in the post test of visual thinking skills.

II. Objectives Of The Study:

The present study aims to investigate the impact of the employment of Geogebra software in acquiring some visual thinking skills and on the academic achievement among 8th grade Students.

III. Significance Of The Study

The study is expected to contribute to the following

1- This study is a response to modern trends, which calls for the employment of technology in teaching, so as to overcome the shortcomings and disadvantages of the traditional way in the various courses of study, and in the course of mathematics in particular.
2- Shed light on the potential role of the Geogebra software in the development of the academic achievement and in acquiring some visual thinking skills.
3- Draw the attention of those in charge of the educational process to the role of the effective Geogebra software.
4- It might be useful to Mathematics teachers in the development of teaching and evaluation methods.
5- The current study may open new avenues to researchers to conduct future studies in the use of new technological innovations in the educational process in the different stages of teaching and various educational courses.

IV. Operational Definitions Of The Study:

Geogebra Software: an educational tool that employs the use of open source technology that gives both students and teachers the freedom to use it in the classroom and at home; it is easy to use and suitable for learning and teaching mathematics from primary levels up to university level (Escuder, & furner, 2011: p. 77).
It is a software that is based on global mathematics standards and that supports, not substitutes, the curriculum. It designed in a way that enables students to develop a deep understanding of the mathematical theories through the practical application, and the self-discovery of the concepts. The software is composed of a set of tools that contribute to providing students with mathematical skills, as well as all of the aids necessary to make the learning process easy and interesting, in which the student constantly builds on previous learning, and this is entirely consistent with the constructive learning curve (Balawi 2012: 24)
Geogebra software can be defined as "a set of tools that contribute to providing students with mathematical skills, and that helps does not substitute the teacher; it is used with the experimental group in teaching mathematics for the second grade.

Academic achievement: a set of concepts, experience and knowledge acquired by the learner as a result of passing through the educational experience; it is measured by the grade obtained by the student in the basic eighth-grade achievement test prepared for this purpose.

Visual thinking skills: a system of processes that translates an individual's ability to read visual forms and convert the visual language to verbal significance represented in the skill to identify and describe the geometric shape, the skill of linking geometric shapes, the skill of linking relationships in geometric shapes, the skill of perception and interpretation of the ambiguity in the geometric shapes and mathematical problems and the skill of extracting geometric meanings and concepts; this skill is measured by the grade the student gets in the test designed for this purpose.

Limitations of the study:

This study is limited to the following:

1. Objective limit: The study was limited to unit six "Geometry unit" of the math book, "Part II," scheduled to eighth grade students in Palestine.
2. Spatial limit: Deir al-Balah Prep Boys' UNRWA School (b)
3. Time limit: Second semester of the academic year 2015-2016.
4. Human limit: a random sample of primary eighth-grade students.

Previous Studies:

The presented study referred to other relevant Arab and foreign studies to benefit from; these studies can be displayed in two areas, studies related to Geogebra software, and studies related to visual thinking, as follows:

First: studies related to Geogebra software

Udi & Radakovic, 2012: The purpose of this study was to demonstrate the impact of teaching the unit of possibilities using the Geogebra software on critical thinking skills among the tenth and eleventh grade students; it's a pilot study that consisted (48) students who have studied applications on biz theory to make decisions related to health, finance, and politics. The study tool is a test of critical thinking skills; the results of the study indicated that the use of Geogebra software as a dynamic tool contributed to improving the critical thinking skills among students and fostered the process of decision making for them.

Zengin, et.al., 2012: The study was conducted in Turkey, aiming to know the impact of Geogebra software on the achievement of the fifth grade students in teaching trigonometry. It is a pilot study that consisted of 78 students, distributed into two groups: the experimental group (52) students who studied it using the Geogebra software, and the control group, which consisted of (26) students who studied in the usual way; the study tool is an achievement test. The study found a range of results, but most importantly is the presence of significant statistical differences at the level (0.05) between the experimental group and the control group in the achievement post-test.

Hutkemri & Effandi, 2012: The study was conducted in Indonesia, aiming to investigate the effect of Geogebra software on the achievement of high school students in mathematics. It is a pilot study consisted of (284) students from secondary schools, divided into two groups: experimental group (138) students who have studied using the Geogebra software, and the other is the control group made up of (146) students who have studied using the usual way. The study tool was an achievement test; the results showed the superiority of the experimental group over the control group in the achievement posttest, where there were significant statistical differences at the level of (0.05) in both boys and girls, while there were no significant statistical differences at the level of (0.05) according to gender variable.

Abu Thabet, 2012: The study was conducted in Palestine aiming to compare the teaching of the "circle unit" using Geogebra software and teaching aids and the traditional method and their impact on the immediate and delayed achievement for students of ninth grade in Nablus. The study sample consisted of 190 male and female students, divided into two groups: the experimental group (96) students studied using Geogebra software, and the other is the control group consisting of (94) students who studied in the usual way; then an immediate and postponed achievement posttest were applied on the experimental and control groups. The study found various result, of which the most important showed that there were significant statistical differences at significance level (0.05) in the achievement posttest between the experimental group and the control group, in favor of the control group.

Gaser, 2011: The study was conducted in Saudi Arabia, aiming to investigate the effect of teaching using Geogebra software on the achievement of sixth-grade students from elementary school in the course of mathematics. The study sample consisted of two groups: the experimental group, made up of (30) students studying using Geogebra software, and the other is the control group, consisting of (30) students studying in the usual way; then an immediate and postponed achievement posttest was applied on the experimental and control groups. The study found a range of results, most importantly the existence of significant differences at significance level (0.05) in the posttest grades between the experimental group and the control group, in favor of the control group.

Saha, et.al., 2010: this study was conducted in Malaysia, aiming to investigate the effect of using Geogebra software in teaching coordinates geometry on a group of high school students with high and low visual spatial skills. It is a pilot study consisting of (53) students, divided into two groups: the experimental (27) students studying Geometry using Geogebra software, and the second is the control group consisting of (26) students studying in the usual way. Each group was then divided based on the test of visual spatial perception into two groups, one containing high spatial capacity and the other for those with low spatial capacity. An achievement posttest was applied, and the results showed that there are significant statistical differences at (0.05) between the average performance of students between high spatial capacity of the experimental group and their peers studying using the usual manner; the size of the impact is large.

Second: studies related to visual thinking:

Hamada, 2006: This study aimed to investigate the impact of the use of computer educational games in teaching Geometry unit on the development of academic achievement and visual thinking of the fifth graders in math. The study adopted the experimental method, consisting of study tools such as an achievement test, visual thinking test and a software that contains Geometry unit lessons couched in the form of targeted educational

games; the total sample consists 94 students, distributed into two groups (control group and the experimental group). The study reached several conclusions, including that the use of computer educational games in teaching Geometry unit to the fifth grade has a significant impact on increasing the level of achievement and visual thinking ability among students of the experimental group compared to the control group pupils.

Khozondar, 2007: This study, conducted in Palestine, aims to evaluate math books for Primary school levels in light of visual thinking skills. The study used a descriptive analytical approach as an appropriate method to describe this phenomenon, and chose to study a sample of math books for primary levels. The study tool is a content analysis tool in light of visual thinking skills. Several conclusions were reached, most importantly is the focus of math books content on thinking skills in all grades of basic stage, and its neglect of visual thinking skills reaching only (12%).

Shaath, 2008: The study, conducted in Palestine, aimed to identify the availability of visual thinking skills in Spherical Geometry curriculum content in the tenth grade in Gaza, and to enrich the tenth grade curriculum. The study followed the descriptive analytical approach, and the sample of the study is the content of the tenth grade math book. The study used the content analysis tool to collect data, which included visual thinking skills. The results revealed the low availability of visual thinking skills in the tenth grade curriculum in the unit of Spherical Geometry.

Hamada, 2009: This study, which was conducted in the Egypt, aimed at the effectiveness of visual thinking networks in the development of visual thinking skills and the ability to solve and ask verbal problems in mathematics and on the attitudes of the fifth grade students towards solving it in the rounding and divisions unit. It is a pilot study consisted of (68) female students, divided into two groups (experimental and control). The study used a test of visual thinking skills, an achievement test, and test for solving verbal problems in mathematics. The findings of the study showed that visual thinking networks have contributed to the development of visual thinking skills, academic achievement and asking verbal problems in mathematics as well as improvement in the students' attitudes towards solving verbal problem in mathematics.

Zankor, 2013: This study, conducted in Saudi Arabia, aimed to investigate the effect of an interactive software based on computer simulations of the 3D geometric shapes in the development of visual thinking and self-organized learning skills on the second grade students in Baha Region. As for the study tools, the researcher used a quasi-experimental method, and consisted the interactive software simulations of the 3D geometric shapes (unit of area and volume) for the students of the second grade, in addition to a test of visual thinking skills. The study sample consisted of 80 students from Al-Tawfiq and Al Mousa schools in Al- Baha, distributed into two groups (experimental and control). The findings showed that there are significant statistical differences at significance level (0.05) in the post-test of visual thinking skills and in the scale of self-organized learning between the experimental group and the control group; this difference is in favor of the experimental group.

General comment on the previous studies

According to the previous studies, we can conclude the following:

1. Most previous studies focused on the use of Geogebra software to identify its impact on the educational process on the students' achievement, except for the study of (Udi & Radakovic, 2012), which focused on the development of critical thinking skills.
2. Previous studies related to visual thinking focused on identifying the extent of visual thinking skills availability in Geometry content, such as Shaath study (2008), while the study of Khozondar (2008) focused on the assessment of math books in light of the visual thinking standards, while some studies have focused on studying the impact of some software or ways to develop skills such as visual thinking, such as the study of Hamada (2006), and Hamada (2009).
3. Most previous studies have adopted the experimental method, while others adopted the descriptive analytical approach such as study of Shaath (2008) and Khozondar (2008).
4. The most important finding of the previous studies is that Geogebra software have a role in raising the students' academic achievement.
5. The present study benefited from previous studies in drafting the problem of the study, consolidating its theoretical framework, and preparation of its tools.
6. The present study is distinct from other previous studies, as it is a new study in the use of Geogebra software in the development of visual thinking skills and academic achievement among primary eighth-grade students.

V. The Study Methodology And Procedures:

First: Study Methodology

The researcher used the quasi-experimental approach that is based on two groups, the first is the experimental group which adopted that Geogebra software in learning, and the second is the control group studying in the traditional way.

Second: Study population

The study population consisted of all eighth-grade students, totaling (2240) students, distributed over 65 classrooms in 11 Preparatory UNRWA school in Deir al-Balah and Maghazi for the academic year (2015 - 2016).

Third: Study sample

The researcher chose the sample from Deir Al Balah Preparatory Boys School (B) in a targeted way for the existence of a cooperative and motivating educational faculty. The sample consists of 6 eighth grade classrooms, where the sample was chosen using the simple random way. The study sample targeted (74) male student, evenly distributed into two groups, the first is experimental groups that adopts the Geogebra software in studying, and the other is the control group that studies using the traditional way.

Fourth: Study Tools

To achieve the objective of the study of identifying the impact of the employment Geogebra software to acquire some visual thinking skills and on the academic achievement among primary eighth-grade students, the researcher used an achievement test and a visual thinking skills test, as the explained below:

1- Achievement test:

a. Determine the test purpose: the achievement test is designed to measure the impact of the employment of the Geogebra software on the academic achievement of eighth grade students.

b. Analysis of the course content: The content of the sixth unit entitled "Geometry" of the eighth grade Math book was analyzed into three levels (conceptual knowledge, procedural knowledge, and problem solving). During analysis, the study was committed to the following definitions:

- **Conceptual knowledge**: Includes recognition of relationships between facts, information and assumptions concerning the concept of a single network, and put them in a mathematical frame.
- **Procedural knowledge**: knowledge that includes algorithms and skills of implementing problem solving procedures.
- **Problem Solving**: include verbal non-routine problems containing an obstacle or hindrance to solve, or involves the application of knowledge in new situations.

After finishing the content analysis, the researcher calculated its validity and reliability, as follows:

- **Stability of Analysis:** To test the stability of the analysis, the researcher made one of his colleagues, with specialization in Curriculum and Teaching Methods of Mathematics analyze the content, with commitment to the procedural definitions set by the study, and then the proportion of the agreement between the two analysis was calculated to be (96%) which indicates high stability of analysis.
- **Validity of Analysis:** results of the analysis were presented to a group of arbitrators in order to ensure comprehensiveness of its results of the learning aspects contained in the "Geometry" unit. Its results assured the comprehensiveness if the analysis list.
- Prepare a table specifications: It has been prepared as follows:

Table (1) shows the number of items and the relative weights of the topics of the Geometry Unit

Content	Conceptual Knowledge		procedural knowledge		Problem solving		Total	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Quadrilaterals	2	%6.6	6	%20	2	%6.6	10	%33.3
Middles Theorems	3	%10	6	%20	2	%6.6	11	%36.7
Equality of forms	3	%10	5	%16.6	1	%3.3	9	%30
Total	*7*	*%23.3*	*17*	*%56.6*	*5*	*%16.6*	*30*	*%100*

c. The initial form of the achievement test:

The initial form of the test consisted (30) multiple choice questions.

d. Grading system: test scores were identified by giving one grade for each correct answer, and zero for every incorrect answer.

e. Exploratory experimentation of the achievement test: After the preparation of the initial test, it was applied on an exploratory sample of (40) eighth-grade students outside the study sample, for the purpose of

calculating the easiness and discrimination indexes of the test paragraphs, testing the validity and reliability of the test, and determining how long it takes to answer the test when applied to the study basic sample.

f. Analysis of the paragraphs of the achievement test: The results of students' answers on the achievement test were analyzed in order to identify the degree of difficulty and discrimination index for each paragraph of the test, where the researcher found that the difficulty index for each paragraphs ranged from (0.35 - 0.65), which indicated graduated levels of difficulty.

In addition to that, the discrimination index ranged from (0.25- 0.75) to distinguish between the responses of the upper and lower categories, where metrology accepts discrimination index when it reaches more than (0.20) (Kilani et al., 2008: 448).

Based on the above, the researcher kept all of the test paragraphs.

g. Validity of the achievement test:

The validity of the achievement test was tested through:

- **Validity of the arbitrators:** The achievement test was presented to a group of arbitrators from specialists in education, curriculum and teaching methods of the Palestinian universities, to be guided from their views on the appropriateness of the paragraphs of the test, as well as to ensure the validity and clarity of the language, in which some paragraphs have been added, deleted and modified based on the suggestions of arbitrators.

- **Internal consistency:** internal consistency was ascertained using Pearson correlation between the scores of each paragraph of the test and the total score, in which the researcher found that all values of Pearson correlation are statistically significant at significance level ($\alpha = 0.01$), which indicates that the test is strongly valid.

h. Reliability of the achievement test:

The test the reliability of the achievement test, it was applied to an exploratory sample of (40) eighth grade students outside the study sample. Three weeks later, the test was applied again to the same exploratory sample, where the reliability coefficient was (0.87), which is considered a high and statistically significant coefficient. Then, the researcher used Kuder–Richardson Formula 21 and found that the reliability coefficient is (0.91), which is also highly reliable and statistically significant coefficient, confirming the possibility of applying the test on the study basic sample.

i. Determining the time required to solve the achievement test: It was found that the appropriate time for the application of the test is (45 minutes), which was calculated using the following equation: Test time = (the time it takes the first student to finish the test + the time it takes for the last student to finish the test) ÷ 2

j. The final form of the achievement test: The number of test paragraphs after adjustment is (30) multiple choice questions, so the maximum grade is 30, and the minimum is zero.

VI. The Test Of Visual Thinking Skills:

a. The purpose of the test: the test of visual thinking skills aims to measure the impact of the employment of Geogebra software on developing visual thinking skills among primary eighth-graders

b. Identifying skills of visual thinking: it was identified in answering to the first question of the study, in which it is made up of five skills as follows: (discrimination, analysis, relationship recognition, interpretation, Extracting of meanings)

c. Prepare a table of specifications: It has been prepared as follows:

Table (2) shows the number of variables and their relative weights in the test of visual thinking skills of the Geometry Unit

Content	Discrimination		Analysis		Relationship recognition		Interpretation		Extracting meanings		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Quadrilaterals	2	6.6	2	6.6	4	13.3	2	6.6	1	3.3	11	%36.7
Middles Theorems	2	6.6	2	6.6	4	13.3	2	6.6	1	3.3	11	%36.7
Equality of forms	2	6.6	1	3.3	3	10	1	3.3	1	3.3	8	%26.6
Total	6	*%20*	5	16.6	11	36.7	5	16.6	3	10	30	%100

d. The initial form of the visual thinking skills test:
The initial form of the test consisted (30) multiple choice questions.

e. Grading system: test scores were identified by giving one grade for each correct answer, and zero for every incorrect answer.

f. Exploratory experimentation of the visual thinking skills test: After the preparation of the initial test, difficulty index was applied on all paragraphs of the test, and it was found to range between (0.36-0.69), and thus all of the test paragraphs were kept; it was applied on an exploratory sample of (40) eighth-grade students outside the study sample, for the purpose of calculating the easiness and discrimination indexes of the test paragraphs, testing the validity and reliability of the test, and determining how long it takes to answer the test when applied to the study basic sample.

g. Analysis of the paragraphs of the visual thinking skills test: The results of students' answers on the test were analyzed in order to identify the degree of difficulty and discrimination index for each paragraph of the test, where the researcher found that the discrimination index ranged from (0.33- 0.75) to distinguish between the responses of the upper and lower categories, where metrology accepts discrimination index when it reaches more than (0.20) (Kilani et al., 2008: 448).
Based on the above, the researcher kept all of the test paragraphs.

h. Validity of test of visual thinking skill:
The validity of the test was tested through presenting it to a group of (5) specialized university teachers, and (5) educational supervisors to be guided from their views on the appropriateness of the paragraphs of the test to the eighth graders; suggested modifications were taken into consideration.
The internal consistency of the test was ascertained using Pearson correlation between the scores of each paragraph of the test and the total score, in which the researcher found that all values of Pearson correlation are statistically significant at significance level ($\alpha = 0.01$), which indicates that the test is strongly valid.

i. Reliability of the achievement test:
To test the reliability of the test of algebraic equations solving skills, the researcher used Kuder–Richardson Formula 21 and found that the reliability coefficient is (0.896), which is highly reliable and statistically significant coefficient.

j. Determining the time required to solve the achievement test: The time needed to answer the test was determined by calculating the mean time it takes for the first and last student to finish the test; it was found to be (50 minutes).

k. The final form of the test of visual thinking skills: Based on the results of the arbitration and exploratory experimentation of the test and doing the necessary modifications, the number of test paragraphs after adjustment is (30) multiple choice questions, ready to be applied in its final form.

Fifth: Evenness of study groups:
The evenness of the experimental and control groups was assured in terms of: (achievement pretest, pretest of visual thinking skills, students 'grades in mathematics, students' grades in all subjects, chronological age). Table (3) illustrates this as follows:

Variable	Group	Number	Mean	Standard Deviation	T value	Significance Level
achievement pretest	Control	35	6.51	4.24	1.36	Statistically insignificant
	Experimental	35	5.17	4.03		
pretest of visual thinking skills	Control	35	3.91	2.83	0.42	Statistically insignificant
	Experimental	35	3.66	2.27		
students 'grades in mathematics	Control	35	72.70	0.74	0.33	Statistically insignificant
	Experimental	35	72.64	0.72		
students' grades in all subjects	Control	35	73.83	0.69	0.63	Statistically insignificant
	Experimental	35	73.93	0.71		
chronological age	Control	35	13.45	0.29	1.06	Statistically insignificant
	Experimental	35	13.53	0.34		

Limits of statistical significance at mean ($\alpha = 0.05$) ,d.f. (68) and tabulated T-value is (2.00)
Limits of statistical significance at mean ($\alpha = 0.01$) ,d.f. (68) and tabulated T-value is (2.66)

It is clear from the above table that the calculated T-value equals (1.36, 0.42, 0.33, 0.63, 1.06), respectively, which is less than the tabulated T-value (2.00), at the degree of freedom (68) and the level of statistical significance ($\alpha = 0.05$); this indicates to insignificant statistical differences between the experimental and control group, and thus both groups are even, and that all students are from similar environment and one school.

Sixth: Steps of the study

The present study included the following steps:

1. Review of educational literature related to the present study, in order to learn how to prepare the study tools.
2. Preparation of an achievement test to measure the academic achievement of eighth-grade students in Geometry, as well as a test of visual thinking skills.
3. Application of tests on a small sample in order to determine the time of the test, and to find the degree of easiness and difficulty, discrimination coefficient, and test the validity and reliability of the test.
4. Choose two classes randomly from Deir al-Balah Boys' Preparatory School (b), in which one class was chosen as the experimental group and the other as the control group.
5. Ensure evenness of the two groups in some variables that are expected to have an impact on the dependent variable in terms of: achievement pretest, pretest of visual thinking skills, students 'grades in mathematics, students' grades in all subjects, chronological age).
6. Teaching the unit to both the control and experimental groups according to the experimental design, so that the experimental group adopts the Geogebra software in learning, while the control groups is taught using the traditional way.
7. At the end of the application of the experiment, the two tests were applied to detect the impact of using Geogebra software.
8. Test grading, data collection, analysis of the results of the study, and discussion.
9. Highlight the study recommendations in the light of its results, and then provide a set of proposals.

Seventh / statistical methods used:

The statistical Package for Social Sciences (SPSS) was used to perform the required analysis, in which the (T-test) for two independent samples was used to study the differences between the variables of the study, in addition to calculating the size of the impact of the employment Geogebra software through calculating ETA square ($\eta 2$).

VII. Results Of The Study (Discussion And Interpretation):

Based on the study questions and hypotheses, the following results were obtained:

Presenting and discussing the result of the first question:

What visual thinking skills are necessary for eighth grade students?

To answer this question, the researcher reviewed the educational literature and studies on visual thinking , such as the study of Shaath (2008), Khozondar (2008), Hamada (2006), Hamada (2009), (Jaber, 2010), (Shobaki.2010), and Mehdi (2006), in addition to a sample survey of opinions of specialists in education, through personal interviews (Delphi method). In light of this, the visual thinking skills necessary for eighth grade students were determined, and then presented ti a group of specialists in the field of curriculum and teaching methods in the Palestinian universities, as well as the administrators and teachers of mathematics for primary eighth grade, in order to verify: (The extent of accuracy of linguistic and scientific drafting, and the extent of coverage of these skills, and the importance of these skills to eighth grade students, and to determine the relative weight of each Skill). The researcher obtained the following skills: (discrimination, analysis, relationship recognition, interpretation, extracting meanings); the study was committed to the following procedural definitions:

- Discrimination skill: the ability to determine the dimensions and the nature of the presented format.
- Analysis skill: the ability to see relationships in forms and determine and classify the characteristics of those relationships.
- Relationship recognition skill: the ability to link elements of relations in shape and find a consensus between them and inaccuracies in them.
- Interpretation skill: the ability to clarify the gaps and inaccuracies in the relations and to bring them closer.
- Extracting meanings skill: the ability to infer new meanings and to communicate scientific concepts and principles through the format of the presentation, taking into account this step ensures the previous steps.

Presenting and discussing the results of the second question:
What is the impact of the employment of Geogebra software on the academic achievement among primary eighth-grade students?

To answer this question, the first hypothesis of the study was formulated, stating that there are no significant statistical differences ($\alpha \leq 0.05$) between the mean scores of the experimental group students and their peers in the control group in the achievement post-test. To test this hypothesis, T-test was used for two independent samples; the results were as illustrated in table (4**)**

Table (4) shows the results of T-test to compare the mean scores of the experimental group students and their peers in the control group in the achievement posttest

Group	Number	Mean	Std. deviation	Calculated T-Value	Sig	p-value
Control	35	11.94	6.79	14.39	0.00	Sig at 0.01
Experimental	35	28.83	1.46			

Limits of statistical significance begin at the level ($\alpha = 0.05$), d.f. (68) when the tabulated T-value is (2.00)
Limits of statistical significance begin at the level ($\alpha = 0.01$), d.f. (68) when the tabulated T-value is (2.66)

It is clear from the above table that the calculated T-value equal to (14.38), which is greater than the tabulated T-value (2.66), at the degree of freedom (68) and the level of statistical significance ($\alpha = 0.01$); this indicates to the existence of significant statistical differences between the mean scores of the experimental group and their peers in the control group in the achievement posttest; these differences were in favor of the experimental group. This result is consistent with several previous studies, such as the study of Saha et.al., 2010, Gasser (2011), Zengin, et.al., (2012), Hutkemri & Effandi, (2012), and Abu Thabet, (2012).

Regarding the size of the impact of the employment of Geogebra software on the academic achievement among primary eighth-graders, ETA square ($\eta 2$) was calculated to make sure that the size of the T-test resulting differences are real differences caused due to the study variables, and are not coincidental. The following table illustrates this :

Table (5) shows the size of the impact of the t-test of the differences between students of the experimental and control groups

Group	Number	Mean	Standard deviation	Calculated T-Value	Value of ETA square ($\eta 2$)	d value	Size of impact
Control	53	11.94	6.79	14.38	0.752	3.48	Large
Experimental	63	28.83	1.46				

It is clear from the above table that the value of ETA square equals to (0.752), which indicates a large impact ,where (Afana ,2000: 42) indicates that the size of impact is considered large if the value of ETA square is greater than or equal to (0.14), as is the size of the impact is considered supplementary to the statistical significance , and does not replace it. The success of Geogebra software to improve the academic achievement of eighth graders may be due to the following reasons:

1- The capabilities and characteristics of the Geogebra software, which allows students to see the of abstract geometric concepts and ideas, making it clear and meaningful for them, while the presenting geometric concepts and ideas in the traditional way is often limited to the direct presentation by the teacher, where the student only listens to the teacher's description of the concept, without seeing it, and thus will not be able to visualize (imagine) the concept, and formulate an accurate picture for it, and that means failing to understand the concept well.
2- Using Geogebra software converts the classroom to a scientific and cultural entertainment field endeared to the souls, in which the information is delivered to students in an interesting and attractive image; thus facilitating the understanding process, in which when the students sees with his own eyes and hears with his ears, this makes him interact with it by his senses and conscience, making the information firm.
3- The flexible teaching method of the Geogebra software, which can accommodate a wide range of effective methods and tools and educational activities in an interesting context, where all these elements combine to achieve the desired goals of teaching.
4- Geogebra software helps increase students' attention; because it provides them with continuous motivation.

Presenting and discussing the results of the third question:
What is the impact of the employment of Geogebra software on the development of visual thinking skills among primary eighth-grade students?

To answer this question, the second hypothesis of the study was formulated, stating that there are no significant statistical differences ($\alpha \leq 0.05$) between the mean scores of the experimental group students and

their peers in the control group in the post test of visual thinking skills.. To test this hypothesis, T-test was used for two independent samples, the results were as illustrated in table (6**)**

Table (6) shows the results of T-test to compare the mean scores of the experimental group students and their peers in the control group in the post test of visual thinking skills

Group	Number	Mean	Std. deviation	Calculated T-Value	Sig	p-value
Control	35	12.37	5.95	13.71	0.00	Sig at 0.01
Experimental	35	27.94	3.13			

Limits of statistical significance begin at the level ($\alpha = 0.05$), d.f. (68) when the tabulated T-value is (2.00)
Limits of statistical significance begin at the level ($\alpha = 0.01$), d.f. (68) when the tabulated T-value is (2.66)

It is clear from the above table that the calculated T-value equal to (13.71), which is greater than the tabulated T-value (2.66), at the degree of freedom (68) and the level of statistical significance ($\alpha = 0.01$); this indicates to the existence of significant statistical differences between the mean scores of the experimental group and their peers in the control group in the posttest of visual thinking skills; these differences were in favor of the experimental group. This result is consistent with several previous studies, such as the study of Hamada (2006), and Hamada (2009).

Regarding the size of the impact of the employment of Geogebra software on the development of visual thinking skills among primary eighth-graders, ETA square ($\eta 2$) was calculated to make sure that the size of the T-test resulting differences are real differences caused due to the study variables, and are not coincidental. The following table illustrates this :

Table (7) shows the size of the impact of the t-test of the differences between students of the experimental and control groups

Group	Number	Mean	Standard deviation	Calculated T-Value	Value of ETA square ($\eta 2$)	d value	Size of impact
Control	53	12.37	5.95	13.71	340.7	3263.	Large
Experimental	63	27.94	3.13				

It is clear from the above table that the value of ETA square equals to (0.734), which indicates a large impact ,where (Afana ,2000: 42) indicates that the size of impact is considered large if the value of ETA square is greater than or equal to (0.14), as is the size of the impact is considered supplementary to the statistical significance , and does not replace it. The success of Geogebra software to develop visual thinking skills of eighth graders may be due to the following reasons:

1. Nature, capabilities and benefits of the Geogebra software, as it helps students to imagine and formulate correct perceptions of the Geometric concepts and ideas.
2. Geogebra software and its stimuli and movements makes the role of a student positive in the educational process; which has a positive effect on the students' ability to retain information for a long time.
3. Visual thinking skills begin by describing and analyzing the presented shape or the Geometric concepts and ideas, and then realize the relationship, interpret, and extract the desired meaning; the accumulation of these information helps to develop visual thinking skills among students.
4. Geogebra software creates a rich learning environment, keeping the students away from the stereotypes and rigidity, and transports him towards innovation, and think about the situation or problem from different angles, no doubt that this environment provides freedom, increases self-confidence, and encourages students to develop thinking skills, especially visual thinking skills.
5. The graphics presented by the software acts as a visual stimulus to students which participates in the development of visual thinking skills.
6. The method of teaching that adopts Geogebra software makes learning leave an impact more than others, as they stimulate the learner to learn, and make him alert and conscious of everything going on around him in the classroom

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VIII. Study Recommendations

In light of the findings of the study results, the following recommendations can be provided:

1. Providing teachers during-service with all the knowledge and skills related to technological innovations, especially Geogebra software and its use in the educational process.
2. the need to urge teachers to use Geogebra software in teaching mathematics topics.
3. The need to train mathematics teachers during-service, through courses, workshops, and other teaching methods, on the use of Geogebra software in the teaching and learning of mathematics in the various stages of education, to positively raise the academic achievement and for the development of visual thinking skills.

4. The necessity of activating the schools for the learning resource centers, and providing them with the tools, methods, and techniques of modern education, and with a sufficient number of computers commensurate with the number of students, and downloading some educational programs for teaching mathematics on those devices to take advantage of them.
5. Including courses on methods of teaching mathematics, topics that discusses the use of Geogebra software in the teaching of mathematics, as well as different methods of how to train students on the development of visual thinking skills in teacher preparation institutions.
6. That the teacher guide prepared by the Ministry of Education for math book, to include models for how to present some lessons using Geogebra software for the development of visual thinking skills, and improvement of academic achievement.
7. Conducting studies on the use of Geogebra software to teach various subjects of study in a variety of levels, and its impact on some of the different learning outcomes.

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