

The Effect of Using The Sketch Pad Program on The Higher Thinking Skills of The Technical Institute Students in A Mathematics' Subject

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Abstract:

The aim of the current research is to know the effect of using the Sketch pad program on mathematics achievement and higher thinking skills among students of the Technical Institute, and in order to achieve the objectives of the research, the researchers adopted the experimental design with a post-test for higher thinking skills. The experiment was achieved by testing (64) students of the first stage in the Survey Techniques Department at the Technical Institute / Baquba.

The experimental group (30) students studied using the Sketch pad program and the control group (34) students planned to study mathematics according to the usual method. Previous achievement - previous knowledge - (Udel Daniles) test for intelligence, the scientific material and behavioral goals were determined according to Bloom's cognitive levels and the preparation of teaching plans for the two research groups as well as the higher thinking skills test which consists of (25) paragraphs of two types (objective and essays) distributed on (5) Skills (analysis - synthesis - evaluation - creative thinking - critical thinking), and by using the appropriate statistical methods and the SPSS program, the results reached the existence of statistically significant differences at the level of (0.05) In favor of the experimental group.

Introduction

It will tackle the research problem:

First: The Research Problem

Mathematics is the main basis for scientific and technical developments in all fields, for it is the queen of science and its servant, and it is a framework for research, inference and building laws, concepts, rules, generalizations and theories, so that mathematics can successfully play its role, it must be taught the appropriate methods that interact positively with the learner and the content to be taught to the learner according to his abilities and capabilities.

Al-Abbasi and others (2018: 28) stated that mathematics is a science that needs to be thought, thus, it is necessary to pay attention to it and stand there to study it, The investigation includes higher thinking skills and technical universities which are the responsible party to provide society with a middle cadre working in all institutions, so the research required strategies and programs that promote Level and higher thinking skills.

This research came to answer the following question:

What is the effect of using the sketch pad on the higher thinking skills of students of the Technical Institute in mathematics?

Second: The Importance of Research

- 1-Providing a standardized test for higher-order thinking skills in mathematics for the university stage.
- 2-Consistent with modern educational trends in teaching in light of the technological and informational revolution.
- 3-The study is the first according to the researchers' knowledge.

Third: The Aim of the Research

The current research aims to find out the effect of the Sketch pad program on the higher thinking skills of students of the Technical Institute.

Fourth: The Research Hypothesis

There is no statistically significant difference at the level of significance (0.05) between the average scores of the experimental group who will study mathematics on the Sketch pad and the average scores of the control group who will study mathematics according to the usual method of testing higher thinking skills.

Fifth: Research Limits

The current research is limited to (the first semester of the academic year 2021-2020 and to the students of the first stage of the Technical Institute in Baquba and on topics from the mathematics course for the first stage, and it includes higher thinking skills represented by (analysis skill - syntax skill - evaluation skill - creative thinking skills – Critical thinking skills).

Sixth: Defining terms

Sketch Pad: An interactive program that explores Euclidean geometry, algebra, arithmetic, calculus and other areas of mathematics, created by Nicholas Jacqui (1991) and is designed to work under Windows or Macintosh environments, (Wikipedia).

Procedural definition: Version 5.6 of the program, which enables students to explore concepts of analytical geometry, allows building accurate geometric shapes, provides measurements of lengths, edges, and inclinations, and works on developing visual models for analytical geometry.

Higher-order thinking skills

Douce, (2016):

It is the skills through which learners are able to acquire knowledge as a result of their mental activity and apply it in new situations to solve problems and achieve the desired results (Douce, 2016, 13).

Procedural Definition:

The ability of students of the first stage of the Survey Techniques Department of the research sample to (analysis, synthesis, evaluation, creative thinking and critical thinking) representing higher thinking skills, and it is measured by the degrees that the student gets but does not answer for a test prepared by the researchers for this purpose.

A Theoretical Framework and Previous Studies:

First: A Theoretical Framework

Educators endeavored to introduce computers in school and university educational institutions, hoping to educate learners and educate them on the computer, and develop their ability to possess various computer skills and employ it as a modern technology that contributes to improving the educational process by using it as an educational tool that helps to achieve educational goals (Al-Hersh et al., 2003: 17).

The fields of computer use in teaching and learning

1-Learning about the computer: It is intended to use the computer as an educational goal, where the focus is on computer education processes, the skills of its use and its programming.

2-Computer Assisted Learning: This role is one of the most common and widespread computer roles associated with education, where computers are used as an aid in the learning process.

3-Computer-managed learning: This computer role is indirectly related to student education, as computer-managed education is concerned with the assistance of administrators in charge of the educational process services.

The two researchers used in their research the second type of computer use is computer-assisted learning through their use of the Sketch pad educational program for mathematics, which will be mentioned later.

Interactive Electronic Programs in Mathematics

Al-Balawi, (2012) is as those electronic programs that create an active learning environment, and these programs support learning by doing and learning by discovery. (Al-Balawi, 2012: 23).

The two researchers define it, as an active learning environment with which the student interacts to conclude and apply theories as well as discover the properties of different geometric shapes away from memorization and indoctrination, which are consisted of many programs, including (Geogebra - Capri D3 - Geo Petra – Sketchpad Program, G. S.P).

Definition of the Program

The Sketchpad Program (GSP) was first introduced in the United States of America in (1991) by its designer Nicholas Jackiw, and it was based on the idea of the necessity of using computers in education, the program was developed as part of the visual engineering (Visual Project Geometry), where he joined Designed by Nicholas Jackiw on the project in the summer of 1987, he did a sharp programmatic work until he reached the initial version, which belongs to the American company Key Curriculum, and it is one of the most powerful interactive programs in the field of mathematics, as it contributes to transforming the learning process from centering around the teacher to the learner, and many studies have proven Its effectiveness in improving the level of achievement of learners in mathematics. (As-Sa'edi, 2010: 37).

Thinking skills are defined by (Shehata, 2012) as the learner's ability to practice thinking through his mental capabilities and to implement these capabilities of prediction, interpretation, deduction and experimentation. (Shehata, 2012: 547).

Methods of Teaching Higher Thinking Skills

1-Education for thinking: It is intended to teach implicit thinking processes during the teaching of school subjects.

2-Inclusion in teaching thinking: It means teaching content and thinking skills at the same time, and thinking skills to be learned are part of the usual class.

3-Direct teaching of thinking: It means teaching thinking skills independently of the content of the subject taught by students. (Zaitoon, 2003: 101).

Rankings of Higher Order Thinking Skills

Skills	Classification	Seq.
Analysis - Structure - Evaluation	Bloom (1956)	1
Problem Solving Skills - Creative Thinking - Critical Thinking	Al-Jamal (2005)	2
Observation - Description - Organization - Critical Inquiry - Problem Solving - Data Analysis and Modeling - Prediction Formulation - Analysis - Synthesis - Evaluation	Atoum (2009)	3
Decision-making - Critical Thinking - Problem Solving - Innovative Thinking - Thinking and Metacognitive	Al-Mandalawi (2019)	4

Higher-Order Thinking Skills

First: - the skill of analysis

Khattabiah, (2005) defines analysis as the analysis of a topic into its components or parts that make up it so that the hierarchical structure of ideas and meanings or the relationship between ideas becomes clear (Khattabiah, 2005: 57).

Second: - Installation skill

Al-Khalifa (2014) defines it as adding the parts together to form an unknown model. (Khalifa, 2014: 148).

Third: - Evaluation skill

It is the ability of the learner to make judgments about things based on internal and external self-criteria, and to prove the validity of things and provide evidence. (Zaghloul, 2012: 61).

Fourth: - Creative thinking skills

Or it is a set of cognitive activities carried out by the individual to solve a specific problem or situation, or a kind of effort and the use of imagination and intelligence to confront such cases, i.e. proposing a new real design and solving the problem with the help and discovery of new applications. (Birgili, 2015: 72) and includes (Fluency Flexibility, originality, abundance, sensitivity to problems).

Fifth: - Critical thinking skills

It is one of the important thinking patterns that the individual resorts to deal with many complex situations and stimuli, in which this thinking is included in many political, intellectual, scientific, social, literary and educational fields, Deduction).

Second: Previous Studies

1-Darawsheh (2014)

This study was conducted in Palestine, and it aimed to know the effect of the Sketchpad program on ninth-grade students' achievement in basic mathematics and their self-concept in Nablus governorate, and the study sample consisted of (64) students, and followed the (semi-experimental) curriculum and used my tool (achievement test Dimensional - Self-Concept Scale) and concluded that there is a statistically significant difference between the mean scores of the experimental and control group students in the post application of the achievement test for the benefit of the experimental group.

2-Muhammad (2019)

This research was conducted in Iraq and aimed at identifying the effectiveness of John Zahorek's model in higher thinking skills for fourth-graders in the science subject in biology, and the study sample consisted of (71) and followed (experimental design with partial control)

and used (test of higher thinking skills) as a tool for the study And it found that there is a statistically significant difference between the mean scores of the experimental group students and the average scores of the control group and in favor of the experimental group.

Research Methodology and Procedures:

Research Methodology: The researchers adopted (the experimental method) in this research to achieve its objectives and to study the impact of the independent variable (Sketch pad program) on the dependent variable (higher thinking skills).

First: the experimental design

It is defined as the plan or action program that represents the mechanism by which the experiment is carried out, i.e. planning for the circumstances and factors surrounding the phenomenon that we study, and then observing what is happening (Al-Asadi and Sundus, 2015: 151).

The researchers chose to design equivalent groups with a post-test to measure the effect of the dependent variable (Sketch pad) on the dependent variable (higher thinking skills) because it fits with this research and achieves its goals as shown in Table (1).

Table (1)

Experimental design for research

Post-test	Dependent variable	Independent variable	Equivalence of two groups	Statistical parameters Group
A test of higher thinking skills	Higher Thinking Skills	Sketch Pad program	Intelligence Chronological age Previous achievement Previous knowledge	Experimental
				Controlled

Second: - The Research Community

A systematic scientific term intended for everyone to whom the results of the research can be generalized, whether it is a group of individuals, books, or school buildings ... etc. (Al-Assaf, 2006: 91), and the current research community is represented by students of the first stage in the institutes of the Central Technical University who study Mathematics for the academic year (2020-2021).

The Research Sample

It is the part of the community on whom the phenomenon is studied through the information on this sample, in order to be able to generalize the results to the community. (Hassan, 2011: 104), and the two researchers intentionally chose (Survey Technology Department of Baquba Technical Institute) affiliated to the Central Technical University to be a sample of their research.

Third: Control Procedures

Table (2)

Sig. Type	value (T) tabular	Value (T) computed	Degree of freedom	standard deviation	arithmetic mean	Number of the sample	group	Variables
Non-Sig.	2	0.81	62	14.71	247.13	30	Experimental	Chronological age
				15.34	250.18	34	Controlled	
Non-Sig.	2	0.46	62	2.20	15.73	30	Experimental	Previous achievement
				2.33	15.47	34	Controlled	
Non-Sig.	2	0.64	62	4.60	27.90	30	Experimental	Intelligence
				5.12	28.68	34	Controlled	
Non-Sig.	2	0.39	62	8.70	59.50	30	Experimental	Previous knowledge
				7.65	58.71	34	Controlled	

External integrity of the experimental design

1-Math's teacher,

The experimental and control groups were taught by the researcher to maintain this variable.

2-The place of the experiment,

In cooperation with the head of the Surveying Techniques Department, the computer lab was prepared within the department and the program was installed on computers to conduct the experiment in it.

3-Scientific material,

It was standardized for the experimental and control groups.

4-Distribution of weekly rations,

The two researchers maintained an equal distribution of the lessons for the two experimental and control groups established in the Survey Techniques Department at the rate of one lecture per week for each group.

5-Duration,

The time period for applying the experiment was equal for the experimental and control research groups, which is the first semester of the academic year (2020-2021) from (1/7/2021) to (3/18/2021), and

6-Maturity

The maturity factor had no effect on the research experience because the time period for its application was for the same two groups.

Fourth: - Research Requirements

A- Determining the scientific material

The mathematics course vocabulary was relied upon in the Survey Techniques Department.

B- Defining behavioral goals

A goal is an intention expressed in a written (or unwritten) sentence or phrase describing a proposed change in the learner's behavior, which is short-term (self-directed) (Al-Helah, 2002: 70).

The researchers were briefed on the general objectives of the mathematics course for the first stage in the Department of Surveying Techniques present with the course vocabulary, and based on the sources mentioned in the preparation of the lectures, the behavioral objectives of which numbered (109) were derived, distributed on Bloom levels, and were presented to a group of experts and arbitrators in mathematics, and methods of teaching it.

Fifthly: - The search tool

The research tool is the means through which data is collected to answer the research hypothesis test and answer its questions, and it is called by means of measurement such as the questionnaire, observation, interview and tests. (Hassan, 2011: 54), the researchers used (higher-order thinking skills test) to verify their research hypothesis.

Higher-order thinking skills test

The two researchers prepared a test to measure higher thinking skills by following the following steps:

1-Determining the objective of the test and the current test aims to measure the higher-order thinking skills of the students of the Technical Institute.

2-Presenting the classifications of higher-order thinking skills After the researchers reviewed the previous literature for higher-order thinking skills, their classifications were presented to a group of experts in the field of education and methods of teaching mathematics.

3-Determining higher-order thinking skills due to the differences in the opinions of experts in determining the classification of higher-order thinking skills appropriate for the current research and its sample. It was relied on to identify the skills that fit the current research, namely (analysis skill - installation skill - evaluation skill - creative thinking skills - critical thinking skills).

4-Formulation of the test paragraphs, after determining the higher-order thinking skills, and reviewing previous studies that dealt with higher-order thinking skills in their various classifications, the test items were formulated for each skill in line with the theoretical definition of each of them, so the test consisted of (25) items for each skill (5) paragraphs.

Table (3)

Distribution of higher thinking skills to the test items

paragraphs represented by	Skill
5-4-3-2- 1	Analysis skill
10-9-8-7-6	Installation skill
15-14-13-12-11	Estimate skill
20-19-18-17-16	Creative thinking skills
25-24-23-22-21	Critical thinking skills

Sixth: Procedures for applying the experiment

- The two researchers started applying the experiment on Tuesday (7/1/2021) in the first semester of the academic year (2020-2021), with a lecture per week for both the experimental group and the control group.
- The two researchers studied the experimental and control groups by themselves, as the experimental group was taught using the Sketchpad program, and the control group was taught in the usual way.
- The higher-order thinking skills test was applied to the experimental and control groups on March 28, 2021, to the two research groups.

Seventh: - Statistical means

Appropriate statistical methods were used for the research.

Presentation and interpretation of results will be seen.

First: - View the results

Results related to the hypothesis (there is no statistically significant difference at the significance level (0.05) between the mean scores of the experimental group who will study mathematics on Sketch pad and the average scores of the control group who will study mathematics according to the usual method in the higher-order thinking skills test).

Table (4)

The results of the t-test to determine the significance of the difference between the averages of the two research groups in the higher-order thinking skills test

Statistic- al signifi- -nce	Value of (t-test)		degree of freedo- m	standard deviation	arithmetic mean	No. of student -s	section	Statistical parameter- s group
	Tabular	Calculated						
Sig.	1.99	9.06	62	6.34	79.34	30	A	Experimen- -tal
				7.43	63.44	34	B	controlled

According to the results, the null hypothesis is rejected:

(There is a statistically significant difference at the significance level (0.05) between the average scores of the experimental group who will study mathematics on Sketch pad and the average scores of the control group who will study mathematics according to the usual method in the higher-order thinking skills test).

In order to find out the extent of the effect of the Sketch pad program on testing higher-order thinking skills for first-stage students, the researcher used Atia square (2η) to calculate the size of the effect of the independent variable, which is the Sketch pad program, on the dependent variable, which is (higher-order thinking skills), and to ensure that the size of the differences is the result using the t-test which is real differences due to the independent variable and not to other variables), and then calculate the value (d) that expresses the size of this effect.

Table (5)

The impact of the program on higher-order thinking skills

amount of the effect size	Value d	Value($^2\eta$)	computed t value	Dependent variable	independent variable
very Large	2.32	0.574	9.06	Higher Thinking Skills	Sketch pad program

It appears from Table (5) that the size of the effect of (Sketch pad) on higher thinking skills is very large because the value of (d) of (2.32) is greater than (1.10), based on the reference table to determine the magnitude of the effect.

Table (6)

A reference table to determine the size of the effect

size of the effect				The used tool
Very Large	Large	Medium	Small	
0.20	0.16	0.06	0.01	$^2\eta$

1.10	0.8	0.5	0.2	D
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(Hassan, 2011: 283)

This table indicates that the impact of the Sketch pad program on the higher-order thinking skills of stage students was very large and in favor of the experimental group who studied according to this variable.

Second: Interpretation of the results

The result of the experimental group's students' superiority over their peers from the control group in the higher thinking skills test is attributed to the effect of the independent variable (the Sketch pad program). Teaching using modern technology makes the classroom environment rich in stimuli. It presents the cognitive content in an interesting and attractive way that stimulates thinking. Learners have higher-order thinking skills.

Third: Conclusions

Based on the results of the current research, the researchers reached the following conclusions:

- 1-The use of the Sketch pad program showed a clear positive impact on the higher-order thinking skills of first-stage students at the Technical Institute as it is a dynamic, interactive and enjoyable environment for the learner.
- 2-The use of the Sketch pad program showed a clear positive impact on the learners' attention to the lesson, their interest in mathematics and interaction with the academic content.

Fourth: Recommendations

- 1-Activating the method of teaching using Sketch pad program in teaching mathematics curricula,
- 2-The necessity of holding training courses for mathematics teachers, in the use of educational software in teaching mathematics, especially the Sketch pad program that was used in the study and provided an educational guide for the user.

Fifth: Suggestions

Based on the research results, the researchers suggest conducting the following studies and research:

- 1-Studying the impact of Sketch pad program on students in other variables such as (visual thinking - geometric thinking),
- 2-Studying the obstacles facing students and teachers and limiting the use of Sketch pad program at the Central Technical University and Iraqi universities, and
- 3-A study to build an educational program based on the use of interactive programs, including Sketch pad, in teaching and learning mathematics for the university stage.

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