

The Effect of using the Algebrator Program in Acquiring Mathematical Concepts for Second-Grade Intermediate Students

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Abstract: *The aim of the research is to identify the impact of the program Algebrator in the acquisition of mathematical concepts among students of the second intermediate grade, and to achieve the goal of the research, the experimental method with two groups (experimental and control) with a post-test was adopted, as the number of the research sample reached (54) students from the class. The second average was distributed into two groups, one of them was an experimental group whose members were (28) students who were studied according to the Algebrator program, and the other was a control group whose members numbered (26) students who were studied according to the usual method, and the two groups were equalized with a number of variables. A multiple-choice test for acquiring mathematical concepts was prepared consisting of (30) test items, and the appropriate statistical analyzes were conducted for the research tool while ensuring its psychometric properties. The results showed the superiority of the experimental group that was taught using the Algebrator program over the control group in acquiring mathematical concepts. In light of the research results, it was recommended to take advantage of the Algebrator program in teaching and learning mathematics, training educational staff on how to use it, and paying attention to computer-based teaching methods that enhance students' self-confidence. He also suggested conducting a study similar to the current research on other variables such as mathematical thinking and solving mathematical problems.*

Keywords: *Algebrator program, acquiring mathematical concepts*

- **Introduction:** Society lives in an era characterized by rapid development, as dozens of new ideas are generated at every moment in various fields. Information has become a prolific flow of multiple sources of diverse opinions, and as a result of the convergence between computer technology, software engineering and communication technology, it has become the biggest problem facing humans, the difficulty of knowing and selecting from this bloated information. Qualitatively and qualitatively at every moment, and thus, the educational system has become in a very sensitive stage, because modern and renewable technology has affected the methods of teaching and learning. Which led to the spread of knowledge and a change in the perception of the ways of its generation and acquisition? In the face of this development and rapid changes in our current era, the concept of education and learning has differed greatly, as the old concept of education is no longer as a certain

amount of information to fill the minds of students with is tempting for students, but rather a monotonous method that led Their reluctance to study and consequently the low level of students' learning in various subjects, especially mathematics. (Aqilan, 2002) mentioned several reasons for this drop in the level, including: Focus on automated training and memorization;The emergence of concepts, rules, facts and processes separate from each other. And Failure to observe accuracy and clarity in expression. (Aqilan, 2002: 12)

Through the researcher's work in teaching mathematics at the university and supervising student teachers in the College of Education and his visit to public education schools during the period of practical training for students of the fourth stage in the college, he noticed that there is a weakness in the students' ability to acquire mathematical concepts as well as retaining them in their minds, so converting mathematics into an indoctrination subject And memorization led to the loss of the real value of its teaching, and this defect was supported by a group of mathematics teachers in the secondary stage who have (25) teachers and schools when the researcher directed a questionnaire that included a question regarding the weak ability of the student in acquiring mathematical concepts. The study of (Al-Azzawi, 1995) and (Al-Mayouf, 1999) indicated the existence of this defect in the acquisition of mathematical concepts in public education schools in Iraq. There is another reason for this defect, which is one of the important reasons in our time, which is the time factor, as one of the mistakes that teachers and students make alike because of following the usual methods is trying to teach or study a large amount of scientific material in a tight time, which leads to a defect in the Learning new concepts, "therefore, the teacher must follow methods or methods that take into account the limited time available in the school, because learning new concepts is a relatively slow process and requires time that varies from one concept to another" (Abu Zina, 2010: 185).

The NCTM,2000 document referred to the principle of technology that emphasizes the necessity of using mathematics software, as it helps in moving from traditional mathematics to real world problems, and the use of the computer as an educational environment is one of the renewable methods and methods that help provide a rich interactive environment that enables the learner to establish Mathematical concepts in their minds, enabling them to link them to procedures through practical application in a computerized way. (Al-Wadiya, 2017, pg. 4).Based on the foregoing, the research problem can be determined by the following question:

Will the acquisition of mathematical concepts be affected by the second intermediate grade students when they teach mathematics according to the Algebrator program?

• **Research importance hypotheses, limits, and Concepts :**

- 1- The traditional methods and methods are no longer sufficient to face the new life situations and problems. Therefore, it is logical for the learner to get acquainted with the computer and its applications, in preparation for the life that awaits him. The opportunities offered by the computer and the challenges it imposes make it an educational priority.
- 2- Mathematics teaching is witnessing great global and local interest because it helps draw connections between what goes on in the mind of the individual and his experiences, as we live in the age of science and technology.
- 3- It is expected that the current research will benefit those in charge of preparing mathematics curricula and updating curricula according to the use of computer programs in teaching.

- 4- Providing a guide for the teacher prepared according to the use of the Algebrator program, which may lead to the acquisition of concepts among middle school students.
- 5- The current research may help teacher guidance to work towards achieving the goal of future schools of raising a thinking generation by teaching them how to think, how to access knowledge, and how to use and apply it to find solutions to their life problems.
- 6- The importance of the intermediate stage, which is a transitional stage from the primary stage, in which the transition takes place from tangible concepts to abstract concepts and it is one of the most appropriate stages in which the student's behavior is formed.
- 7- Providing the library with a concept acquisition test that may benefit researchers in conducting research on this subject.

In order to verify the research object, the following hypothesis have been formulated Research: There is no statistically significant difference at the level of significance (0.05) between the percentages of students who will acquire the mathematical concepts of the experimental and control groups in the test of acquiring mathematical concepts. The current research is limited to the Second year middle school students in middle schools affiliated to the General Directorate of Education in Baghdad / Rusafa II, As well as, The content of the chapters (third: Frontiers, and fourth: Equations and Inequalities) of the mathematics book to be taught to second-grade intermediate students, part 1, i 2, 2019 AD, during The first semester of the academic year (2020-2021) AD

(Kalantarnia, Z &Others, 2012: p3) define Algebrator : It is one of the computer algebra programs (CAS) that focuses on solving algebraic problems mainly in order to develop the educational process in all its stages, and it has a role in solving algebraic problems such as matrices, equations and linear systems using simple commands that help the student to follow up on solving the algebraic problem step-by-step with the appropriate explanation of each step" . the Procedural definition of Algebrator: It is a computer program that contains a set of instructions that were used by students of the second intermediate grade to solve mathematical activities when they study the mathematics content represented by the two chapters (borders, equations and inequalities) of mathematics, and to give them the opportunity to start from their real level, and gradually from easy to difficult, giving an explanation for each step of the solution. (Abu Zina ,2010) define Concept of Mathematics as a mental construction or mental abstraction, that is, it is the mental image that is formed by the individual as a result of generalizing qualities and characteristics that were deduced from similar things to things that are exposed later. (Abu Zina, 2010: 221)The procedural definition of the mathematical concept refers to any agreed word, term or symbol that carries a mathematical meaning or connotation characterized by common characteristics and qualities that are mentioned in the mathematics textbook for second-grade intermediate students, the second edition of the teaching of the topics (boundaries, equations and inequalities)." (Reigeluth,1997) define Acquisition of concepts as The process in which the learner is able to understand the concept by helping him to collect the examples that indicate them or classify them in a way that enables the learner to reach the concepts to be reached." (Reigeluth,1997:P.3). The procedural definition of concept acquisition refers to ability of second-grade students to comprehend mathematical concepts, which will be measured by the scores obtained by students in the test prepared by the researcher for this purpose.

• Previous Theoretical Background and Studies:

Introduction: Algebrator is a program based on international standards of mathematics that supports the curriculum approved by the Ministry of Education and is not a substitute for it. It is designed in a way that enables the student to develop a deep understanding of solving

mathematical problems through practical application, and discover the method of solving himself. The program is a set of tools that contribute to providing the student with mathematical skills. The program includes all the necessary aids to make the learning process easy and interesting, as the student builds constantly on his previous learning, and this is fully consistent with the constructivist approach to learning. And (Yulian, 2016) showed that the Algebrator program is characterized by its ability to solve all difficult mathematical problems (all levels) using traditional or modern methods, in addition to its ability to display the answer steps and be a teacher for students, and depict mathematical problems in the form of graphs (Yulian, 2016,p22). Program philosophy: The program is based on a firm conviction and a deep belief that every student can learn mathematics if given the opportunity to learn it, and worked on solving problems of a level appropriate to his abilities at the speed that suits him. The program is also based on a scientific concept that depends on learning by doing. Mathematics requires a lot of practice to master its skills, understand its concepts, and link these skills and concepts. Therefore, providing adequate opportunities for practice makes the student's learning of mathematics possible. The student begins to solve problems that fit his abilities. Then he gradually moves to more difficult problems after he has mastered the previous learning needed to solve them. Thus, the fear of mathematics and the lack of confidence in the ability to learn it gradually disappears. (Yulian, 2016: p26).

Program slogan: The student himself reaches the mathematical concept before the concept reaches him from the teacher.

Program Goals:

- 1- Helping the student to understand concepts and embody them in a tangible way.
- 2- Helping the student to link mathematical ideas together.
- 3- Helping the student to link mathematics with life by employing it in life issues.
- 4- Building the student's confidence in himself and his ability to learn mathematics.
- 5- Developing the skill of self-learning.
- 6- Improving student achievement in mathematics.
- 7- Develop thinking skills.
- 8- Develop positive attitudes towards mathematics.
- 9- Giving each student the opportunity to demonstrate his full potential. (Kusamah,2014:p87)

How to achieve the goals:

Solve math problems ranging from easy to difficult; and providing modern learning strategies in mathematics teaching. Moreover; giving the student the opportunity to start from his real level, not from where the teacher wants.

Mathematics topics covered by the program: The program covers most of the topics identified by the National Council of Teachers of Mathematics in the United States of America (NCTM) for content, in addition to verbal issues. Specifically, it covers the topics: measurement Geometry, and Algebra.

How the program works:

- 1- The student works individually or participates with a colleague in the training provided by the teacher.
- 2- The teacher provides assistance when the student does not understand what is required, but does not give him the solution.
- 3- If the student is not able to reach the solution, the teacher helps him and directs him to exercises similar or related to the exercise he was unable to solve.
- 4- The exercises are corrected daily and returned to the students the next day to correct their mistakes or save them in their files if there are no mistakes.
- 5- Monitoring the daily progress of each student in his follow-up file.

Importance of using Algebra software:

- 1- Helping the student to understand concepts and embody them in a tangible way.
- 2- Helping the student to link mathematical ideas together.
- 3- Helping the student to link mathematics with life by employing it in life issues.
- 4- Building the student's confidence in himself and his ability to learn mathematics.
- 5- Developing the skill of self-learning.
- 6- Improving student achievement in mathematics.
- 7- Develop thinking skills.
- 8- Develop positive attitudes towards mathematics.
- 9- Giving each student the opportunity to demonstrate his full potential.

(Ghandora, 2015:p12)

Acquisition of mathematical concepts: The process of acquiring concepts begins from childhood and is based on sensory perception and the child's observation of the surrounding things, people and events, and for this reason, the process of acquiring concepts is one of the main goals that educators seek to achieve through different educational situations and for all stages, because the acquisition of concepts is a major part of the learning and teaching process inside the classroom. The process of concept acquisition is based on sensory perception and observation, and the processes of generalization and discrimination play an important role in the acquisition process, and the steps of concept acquisition are sensory perception, balancing, abstraction, and generalization. (Saleh, 2012: 84-85). Bruner believes that the process of acquiring concepts is achieved with the help of the learner to collect examples that indicate the concept and classify it, which leads him to reach the concept being taught, and he also sees that the process of acquiring the concept is a subsequent stage to the process of forming the concept. The learner has acquired the concept or the basic set of concepts contained in that subject. Bruner distinguished the process of concept acquisition

between two processes of learning factors: the selection process and the reception process. In the first, the examples are not categorized, so the learner chooses one of them and investigates whether it is an affiliated or unaffiliated example. As for the reception process, the teacher presents the examples in a specific order and categorized as positive and negative examples (Hamdan, 2005, 96).

- **Benefits of acquiring concepts:** The acquisition of concepts helps students to:
 - 1- Retaining information, benefiting from it and applying it in different situations, if it is organized in the form of specific categories related to their direct experience and interests.
 - 2- Organizing their cognition process and preparing them to identify the distinctive characteristics of the different things in their environment.
 - 3- Enabling the learner to distinguish between its characteristics, as concepts are the basis of personal knowledge and scientific knowledge.
 - 4- Accustom learners to be more accurate and effective in learning other concepts and developing their meaning.
 - 5- Learn specific concepts related to the acquisition of knowledge.
 - 6- Acquiring the concept gives the learner the ability to apply it and generalize it to new situations that include relational qualities that qualify them for inclusion in the category of interest.(AL-Titi,2007;14-15)

Previous studies.

- Study (Yuliana, 2016): This study was conducted in Indonesia, and aimed to reveal the effect of using the (Algebrator) software in solving mathematical problems and students' attitudes towards learning mathematics. The research sample consisted of (80) students from the eighth grade, divided randomly into Two groups: experimental and control. Research tools: a test of the ability to solve mathematical problems, and a measure of the attitude towards learning mathematics, student behavior. The results related to the test of ability to solve mathematical problems showed that the students of the experimental group who studied using the Algebrator program were superior to the students of the control group who studied in the usual way. The students' attitude was more positive among the students who studied using the Algebrator program than it was among the students who studied using the normal method.
- Study (Saleh, 2017): This study was conducted in Palestine. This study aimed to reveal the effect of using the (Algebrator) software on academic achievement and motivation towards learning mathematics among eleventh grade students in Nablus Governorate. The research sample consisted of (64) A female student from the eleventh grade, divided into two groups: an experimental group who studied using the Algebrator program, and a control group who studied using the usual method. An achievement test was prepared in mathematics, and a measure of motivation towards learning mathematics, and one of the statistical methods used was the accompanying one-way analysis of variance (ANCOVA). The results related to the achievement test showed that the students of the experimental group who studied using the Algebrator

program were superior to the students of the control group who studied in the usual way, and that the motivation towards Mathematics learning was more positive for female students who studied using the Algebrator program.

- Study, (Uba Umbara',2018): This study aimed to reveal the effect of using the Algebrator software in improving the ability to understand mathematics, and the research sample consisted of (84) students, who were randomly divided into two groups: experimental, who studied using the program Algebrator, a control group, studied in the usual way. The researcher prepared a test of the ability to comprehend mathematics, and their validity and reliability were verified. The results showed that the students of the experimental group who studied using the Algebrator program were superior to the students of the control group who studied in the usual way in the Mathematics comprehension ability test.

Aspects of the use of previous studies:

- 1- Benefit from how to formulate the research problem.
- 2- Take advantage of the statistical methods used in previous studies similar to the design of the current research to analyze its data.
- 3- Benefiting from the results of previous studies in interpreting the results of the current research

Research Procedures: The research experimental design includes an independent variable and dependent variable, the researcher adopted experimental design with two equivalent groups (experimental group and control group) with partial control, as shown in Table (1).

Table (1) Experimental design for research

Group	Equivalence of the two groups	Independent variable	Dependent variables	Dependent variable test
Experimental	Age, Intelligence, ,Previous information, and Achievement in mathematics for the previous year	Program (Algebrator)	Acquisition of mathematical concepts	Acquisition of mathematical concepts
Control		Normal method		

Research Population & sample: The research community was identified with second-grade intermediate students in government middle and secondary day schools of the General Directorate of Education in Baghdad Governorate / Rusafa II / for the academic year (2020-2021). Al-Idrisi Intermediate School for Boys was intentionally chosen to implement the research experience, as the research sample consisted of (54) students from the second intermediate grade, with (28) students in the experimental group and (26) students in the control group. The two groups were equalized in some variables (Age, intelligence, previous information in mathematics, and previous achievement in mathematics).

Research Accessories:

1- Determining the scientific subject: The scientific subject has been determined by the content of the two chapters (the third: Frontiers, and the fourth: Equations and Inequalities) of

the mathematics book to be taught to second-grade intermediate students, part 1, i 2, 2019 AD. During the first semester of the academic year (2020-2021)

2- Formulation of behavioral objectives: (80) behavioral objectives have been formulated according to the levels of the cognitive domain of BLOOM taxonomy, which include the levels of (remembering, comprehension, application, analysis, synthesis, and evaluation).

3- Preparing teaching plans: A group of teaching plans has been prepared, numbering (30) daily teaching plans, with (15) plans for each of the two research groups.

The Research Tool:

- Testing the acquisition of mathematical concepts: (30) objective test items of the multiple-choice type were formulated in the light of (Badawi, 2003) classification of concept acquisition, which measures acquisition at three levels for each concept, namely (defining the concept, distinguishing the concept, and applying the concept) (Badawi,2003:P64). Since the number of the main concepts is (10) concepts, the number of test items reached (30) with three paragraphs for each concept, provided that the main concept paragraphs include the sub-concepts. A group of arbitrators has been amended according to their opinions so that the test is in its final form.

2- The validity of the test validity: It was based on two types: The test items and the correction key were presented to a group of referees with experience in the field of mathematics teaching methods. The validity of the content was confirmed by analyzing the scientific material and extracting the main concepts, and it was presented to a group of arbitrators in mathematics teaching methods. This is to ensure that the test items represent the content of the study material and behavioral objectives, and accordingly the test is considered honest.

- Statistical analysis of the test items: The test was applied to an exploratory sample consisting of (100) students of the second grade average in Uqba Bin Nafeh Secondary School for Al-Nin, affiliated to the General Directorate of Education in Baghdad, Rusafa II, on Tuesday, 26/1/2021, according to the difficulty factor. Its value ranges between (0.31-0.72) and thus all paragraphs are considered acceptable in terms of the difficulty factor. The discriminatory power was also calculated and found to range between (0.25-0.60). Thus, all paragraphs are considered acceptable in terms of their discriminatory ability. The effectiveness of each wrong alternative was also calculated. It was found that the coefficients of all alternatives are negative, and thus all alternatives are effective. According to the reliability of the test using the Kewder-Richardson equation 20, where the test reliability coefficient reached (81%), which is a good and high stability coefficient.

Application procedures: The application of the experiment began on Tuesday 10/11/2020 with (5) lessons per week for each group, and the concept acquisition test was applied on Thursday 28/1/2021 on the experimental and control groups after the completion of teaching the material prescribed for the experiment, and the students' answers were corrected according to the correction method. Approved in the search procedures

- Statistical methods: Two independent sample t-test , chi-square test . equation, Difficulty coefficient equation, Paragraph discrimination coefficient equation, Equation of the effectiveness of alternatives, KR-20 equation)

• **Results and discussion:**

The hypothesis: there is no statistically significant difference at the level of significance (0.05) between the percentages of students who acquired the mathematical concepts of the experimental and control groups in the test of acquiring mathematical concepts: To verify the validity of this hypothesis, the students’ answers were corrected and the total score for each student was calculated on each of the concepts. The student is considered to have acquired the concept if he answers the three paragraphs of the concept correctly, where he is given one point, and is considered unacquired for the concept if he makes a mistake in one or more of the concepts. The three paragraphs of the same concept are given zero. The percentages of students who acquired the concept from others were calculated, and using the percentage test, the results showed that the students of the experimental group outperformed the students of the control group in acquiring (9) concepts out of (10) main concepts, or a percentage of (90%) was statistically significant when Level (0.05) as shown in Table (2)

Table (2) Test the percentages of acquiring mathematical concepts for the two research groups

Seq.	concept name	Experimental group		control group		Z. value		Significance level 0.05
		acquired	percentage	acquired	percentage	calculated	tabular	
1	Adding and subtracting algebraic expressions	21	%75	6	%23	3.82	1.96	Sign
2	Multiply an algebraic term by an algebraic expression	20	%71	8	%30	3.02		Sign
3	Multiplying algebraic expressions	17	%60	3	%11	3.73		Sign
4	Dividing an algebraic expression by an algebraic term	14	%50	4	%15	2.73		Sign
5	algebraic expression analysis	11	%39	2	%7	2.75		Sign
6	Solving first-order one-variable one- variable equations with two steps in R	14	%50	5	%19	2.39		Sign
7	Solving first-order equations with one variable in multiple steps in R	12	%42	3	%11	2.54		Sign
8	Solving quadratic equations with one variable in R	10	%35	2	%7	2.48		Sign
9	Solving two-step algebraic inequalities in R	13	%46	2	%7	3.20		Sign
10	Solving multistep algebraic inequalities in R	12	%42	9	%34	0.60		N. sign

It is clear from Table(2)the results reached by the researcher that the students of the experimental group outperformed the students of the control group, which was in agreement with the study of (Saleh, 2017); and the study,(Uba Umbara,2018)’: This can be attributed to several reasons, including:

- 1- Teaching using the Algebrator program leads to breaking the psychological barrier between the student and the subject and provides them with a degree of freedom to make mistakes without being shamed or criticized.
- 2- Teaching using the Algebrator program contributed to creating an educational climate dominated by interaction and active positive participation, which provided the

opportunity for all students to practice dialogue, participate in discussions and give examples. to get his attention. And discover a way to solve it himself. It helps the student to acquire self-learning skills, as this program possesses educational capabilities in the learning and teaching process.

- 3- The dynamic nature of the Algebrator program made it possible for the learner to explore and visualize relationships easily, and the learning by doing that the program provides enables students to master skills, understand concepts and connect them in a way that deepens their knowledge of the material. This is done through a set of tools that contribute to providing the student with algebraic mathematical skills.

• **Conclusions, Recommendations ,and Suggestions**

- 1- Teaching using the Algebrator program has a great role for students of the second intermediate grade in acquiring mathematical concepts.
- 2- The method of teaching using the Algebrator program is one of the methods that keep pace with scientific and technological development and is one of the effective teaching methods because its use depends on the stimulus, response and feedback.
- 3- Encouraging mathematics teachers to use computer programs in teaching
- 4- Employing the Algebrator program in training mathematics teachers, given their need for such training programs
- 5- Paying attention to computer-based teaching methods, which enhance students' self-confidence.
- 6- Conducting studies to find out the effectiveness of the Algebrator program in other dependent variables such as mathematical thinking, solving mathematical problems, levels of mathematics understanding and generative thinking.
- 7- Conducting a study similar to the current study dealing with the gender variable in other grades and stages of study.
- 8- Conducting a similar study to the current study, and its impact on some emotional aspects such as motivation, tendencies and beliefs

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