PalArch's Journal of Archaeology of Egypt / Egyptology

THE EFFECTIVENESS OF ACCELERATING LEARNING IN THE ACHIEVEMENT AND FORMAL THINKING OF CHEMISTRY FOR SECOND-GRADE INTERMEDIATE STUDENTS

Dr. Ahmed Laibi Hussein Al-Tamimi[1], Israa Naji Kadom[2]

[1] Assistant Professor Al-Riyadh High School for Outstanding Students

[2] Chemistry teaching methods /Department Science / Diyala University

Email: [1]rx.ahmed43@gmail.com [2]Israanaji78@gmai.com

Dr. Ahmed Laibi Hussein Al-Tamimi, Israa Naji Kadom. The Effectiveness of Accelerating Learning In The Achievement And Formal Thinking Of Chemistry For Second-Grade Intermediate Students -- Palarch's Journal Of Archaeology Of Egypt/Egyptology 19(3), 1497-1517. ISSN 1567-214x

Keywords: Accelerated Learning, Intermediate Students, Formal Thinking

ABSTRACT

The current research aims to identify the effectiveness of learning via accelerated learning methods for achievement and formal thinking for students in the second intermediate grade of chemistry. The researchers adopted the experimental approach to achieving the research goal. A quasi-experimental design with partial control was used for two equal groups with a post-test for achievement and formal thinking. The technique was conducted on (61) students, the experimental group (30) students, and the control group (31) students from the second intermediate grade students in Al-Riyadh Secondary School for Outstanding Students for the academic year (2020-2021 AD). The two groups were equal in some variables, and the experiment requirements were prepared, represented by the scientific material, the formulation of behavioral objectives, and the preparation of study plans. The research relied on two tools: the Summative test for chemistry, which consisted of (40) items, and the formal thinking test, which consisted of (38) items. The results showed significant differences at the level (0.05) between the mean scores of the experimental and control group students in achievement and formal thinking. The data were also processed using the T-test for two independent samples. The study showed the progress of the students of the (first) experimental group, which was taught based on the accelerated learning method, on the students of the control group (the second), which were trained classically in the achievement and formal thinking of the (chemistry) classes of the second intermediate grade. Accordingly, a set of recommendations and suggestions were developed.

RESEARCH PROBLEM

The traditional methods used in teaching science to students are still of the classical or fixed type, characterized by memorization for the test prepared to obtain high marks. Chemistry is an essential subject that concerns students' thinking, scientific levels, and integration into the lesson for cognitive progress. Formal thinking is one of the most critical forms of thinking that modern teaching methods should be interested in because of its creativity and holistic view of subjects that require accelerated learning. Formal thinking considers students part of the lesson or training within the laboratory with all their senses and interaction in the class. A new method of education has to be used to provide pleasure and interaction in the course. Thus, accelerated learning can raise students' attainment and develop their formal thinking. The problem can be summarized as follows:

What is the effectiveness of accelerated learning in the achievement of second-grade intermediate students and their formal thinking in chemistry?

THE RESEARCH IMPORTANCE

The human being is the main element in the progress and development of the world. Therefore, education has an active role in preparing the development of human forces to maintain this development and improvement and consider the adaptation process with the advancement of technology. Thus, education has become an intended and purposeful method with organized scientific planning in its highest forms and levels in educational institutions. (Adas, 20006: 21).
Therefore, the learning mechanism is related to the learner and is closely related to the education process, as it is a direct product of the education process. It can be inferred that the student has benefitted from the education process by performing a specific performance that he could not achieve before. (Mari and Mohammed, 2009:23)

The purpose of teaching chemistry is to teach students how to think rather than memorize books without understanding, perceiving, or applying them functionally (Canut, 2009:25).

Accelerating chemistry learning focuses on many aspects of students, whether mental, social, or educational, and is one of the crucial requirements of the era and the rapid development of knowledge. This prompted the need for science education to pay attention to students in terms of how they think, the skill of solving the problems they face, and how they employ scientific knowledge to be able, in the end, to face life's problems (Zaytoun, 1996: 107). The importance of formal thinking emerges among middle school students because it represents the stage in which formal thinking skills in their logical form begin to appear. Students can think abstractly away from the properties of sensory stimuli, as Piaget's studies indicate that formal thinking skills begin to appear at this age (Piaget, 1986: 101). This is what was confirmed by some studies, including (Al-Mufleh, 1995), (Al-Heti 2008) and Laibi (2011), and other studies.

The importance of the current research can be summarized as follows:

1. Benefit from this study to help chemistry teachers synchronize the vast evolution of teaching methods.
2. The importance of the research comes from the importance of the school stage, which is the intermediate stage concerned with the number of students moving to middle school.
3. Enriching the planning and development of curricula with such methods for the training and development of teachers.
4. It is hoped that this research will help educators to create an educational environment that accelerates learning, offering modern and diverse teaching methods.

The research objective

1. Recognize the effectiveness of accelerated learning in:

1. The achievement of second-grade intermediate students in chemistry.
2. Their formal thinking

The research hypotheses

To achieve the research objectives, the two researchers develop the following two hypotheses:

1. There is no significant difference at the significance level (0.05) between the average scores of the students of the experimental group who will be taught based on Accelerated Learning and the average scores of the control group students who were trained according to the usual methods of chemistry.
2. There is no significant difference (0.05) between the average scores of the experimental group taught according to the Accelerated Learning method and the average scores of the students of the control group. They were trained according to the usual ways of formal thinking.

Research limits

The research was limited to:

1. Human limit: Second-grade intermediate students in Outstanding Schools / Morning study/ Baghdad.
2. Spatial limit: The General Directorate of Education, Baghdad, the third Karkh.
3. Time limits: the academic year (2020-2021).
4. Cognitive limits: the science book for the second intermediate grade (Chapter One, Two, Three, and Four) Edition 2 (2018).

Terminology identification

The following is a definition of the terms mentioned in the current research:

Effectiveness

Operational definition: Accelerated learning can change the achievement of chemistry and formal thinking among second-grade students in middle school, measured by scores.

Accelerated learning

(Sheikhoun, 2019): "A learning method that offers a variety of educational activities that suit different types of learners and allows the student to actively participate in those activities by providing a comfortable, enjoyable, and encouraging environment for learning." (Sheikhoun, 12: 2019).

Operational definition: It is the design of educational activities supported by teaching methods that provide fun and excitement for the student who is the focus of teaching.

Achievement

(Al-Khalidi, 2008) defined it: It is obtained in return for fulfilling the requirements of the study" (Al-Khalidi, 92: 2008).
Operational definition: (practical): It is all the marks obtained by the students of the second intermediate grade after the specified experiment period has passed and after answering the axes of the Summative test for the science subject, which the researcher prepared for this purpose.

Formal thinking

(Melhem, 2009): "The student's ability to process abstractions, such as ideas, symbols, relationships, concepts, and principles, in a more distinctive way than physical tools or sensory subjects, such as machine tools and sensory-related activities (Melhem, 286: 2009).

Operational definition (practical): It is a different mental activity of the formal thinking skills of students, and it is measured by the scores obtained by the students through their answers to the paragraphs of the formal thinking test adopted by the researchers.

THEORETICAL BACKGROUND:

The emergence of accelerated learning:

Accelerated learning is (a natural learning method based on the use of the different senses, the brain, the legislative nature of the brain, and the educational curriculum). The concept of accelerated learning emerged in the second half of the twentieth century, drawing on its beginnings from a set of experiences that took place fifty years before its emergence as a modern trend in training (Meyer, 2010:43).

The advantages of accelerated learning can be summarized as follows:

1. Compatibility with prosperity, technological growth, knowledge breakthrough, and the communication revolution in dealing with knowledge.
2. It offers a new method to invest the human mind and all the senses in learning through practical applications and exercises to achieve the best results.
3. The ability to engage the participants' minds, bodies, and senses in the different learning processes.
4. Create a healthy and appropriate educational climate for rapid acquisition of knowledge.
5. Continuous improvement and development to accelerate the learning process in the fields of education to keep pace with modern knowledge developments.
6. Creating conditions to open wide horizons of imagination, innovation, and creativity in the various fields of education.
7. Paying attention to the different levels of students and offering meaningful options that suit the diverse needs of students, their learning styles, and intelligence. In addition, it achieves active learning because it depends on dividing students into small interactive and cooperative groups while they practice different activities.
8. Improving students' thinking skills and helping to learn with great ease. (Hilal, 2007:13)

Basic principles of accelerated learning:

The basic principles should be known to employ accelerated learning in the educational process, and Mayer summarizes these principles as follows:

1. Education must be consistent with the way the human brain works.
2. Active learner participation involves the mind, body, and emotional side of teaching.
3. Learning by cooperative learning in a social, not competitive, environment.
4. Focus on practicing the material in practice in its natural context, with feedback.
5. Learning in a safe and comfortable environment filled with fun and positive feelings.
6. Diversity in teaching methods allows each student to learn according to their preferred style.
7. Successful learning applies the principles of memory. (Mayer: 49.2010-50)

Accelerated learning stages:

Meyer defined it in the following stages:

1. Preparation stage
2. Presentation stage
3. Training stage
4. Performance stage (Mayer, 2010: 213–111).

The two researchers have adopted it because it is the most common in Arabic applications of this method.

Formal thinking: The characteristics of formal thinking can be defined as:

1. The ability to understand proportions and engineering matters.
2. Thinking beyond the present, focusing on relationships more than content, and relying less on facts and material things.
3. Recognize and treat most things logically.
4. Formal thinking is a kind of hypothetical deductive reasoning.
5. Formal thinking is based on the general formula required to carry out an exact scientific experiment with all other things.
6. At the beginning of the stage of formal thinking, the individual realizes that his reliance on processing material objects does not lead him to a complete and comprehensive understanding of his problems.
7. At the formal thinking stage, the assimilation and alignment processes are balanced, and here the individual reaches a high degree of mental balance.
8. The individual develops the ability to imagine the choices involved in a new situation before presenting practical solutions to this situation.
9. Formal thinking consists of abstract activities within the second order that are based initially on the operations of the first degree and that depend on tangible processes. (Spring, 2008: 115).

Formal thinking skills: These skills relate to the basics of advanced thinking, especially in determining the mental level, in most aspects such as cognitive, emotional, kinetic, and social. Studies and research indicate an increase in the development of intelligence among individuals in the stage of abstract thinking. Individuals are also characterized by special mental abilities such as creativity and general cognitive skills (Ibrahim, 2005: 352). Both (Al-Jarjari, 2003) and (Al-Mawla, 2011) showed (9) formal thinking skills on which the researcher relied:

1. Hypothetical inference: It is an inference about possible outcomes and is called prediction.
2. The deductive inference is an inference from a general rule to a particular case.
3. Proportional inference: that is, inference using relations and ratios.
4. Synthetic inference: composing a list of all possible combinations or associations of several variables.
5. It is determining and controlling variables: i.e., fixing one factor, excluding unrelated factors, and ensuring its impact on other factors.
6. Relational reasoning: Determining whether two events are inevitable, i.e., cause and effect.
7. Probabilistic inference is an estimate of the probability that an event may occur.
8. Suggesting solutions: employing virtual, mental, or symbolic relationships.
9. Problem-solving: Organizing events in a new way to solve a specific problem.

(Al-Jarjari, 2003: 96-70) (Al-Mawla, 2011: 40-41)

Research Methodology and Procedures:
First: Experimental Design: The experimental method was relied on because it fits with the nature of the research, and it includes one independent variable, which is (accelerated learning) and two dependent variables (achievement) and (formal thinking). Therefore, the researchers adopted the experimental design with partial control with a post-test for two equal groups, as in Scheme No. (1)

Scheme No. (1)

Group	Equivalence	independent variable	dependent variable
Experimental	intelligence Chronological age in months Previous information in chemistry Previous achievement in chemistry Fine thinking test	learning	Summative test formal thinking test
Control		Traditional method	

Research community:

The community included the total number of second-intermediate students in secondary and intermediate governmental morning schools in Baghdad Education Directorate / Karkh third for the academic year (2020-2021 AD).

The research sample:

The sample was chosen from the students of the second intermediate grade in Al-Riyadh Secondary School for outstanding students for the following reasons:

The school principal's cooperation with the researchers and the proximity of the school's location to the researchers' residence.

Accordingly, by random selection, Division (A) represented the control group, and Division (B) the experimental group (first). The number of students in the two groups was (61) students, of whom (31) were for the control group and (30) for the experimental group, and there were no failed students in the two groups.

Control procedures: Before starting the experiment, the two researchers were keen to control factors or variables that would influence the application of the experiment and the accuracy and truthfulness of its results:

1. Experimental design and internal integrity: To achieve the internal integrity of the experimental design and the validity of the current research with the criterion in which the difference between the two research groups can be attributed to the independent variable and not to any other factor or extrinsic variable, the researchers conducted an equivalence between the control and experimental groups in the following variables:

Intelligence: The researchers chose to test the general mental ability (Otis - Lennon), which is standardized to be representative of the target environment, which included (50) paragraphs that are not similar in terms of content, including (22) verbal paragraphs (14) symbolic paragraphs, and (14) shapes and images. Paragraphs were formulated with five answer alternatives, and the test was carried out on the students of the two research groups on Tuesday. The researchers followed the instructions for applying the test accurately and clarified the test to the students of the research sample.

Table (1) The statistical description of experimental and control groups at (the IQ) variable

Group	No.	Arithmetic mean	standard deviation	Degree of freedom	standard error Arithmetic mean	Trust period of Arithmetic mean	
						Maximum	Minimum
Control	31	24.87	4.56	59	0.82	4.33	1.12-
Experimental	30	23.27	5.99		1.09	4.34	1.13-

Age in months: What is meant is the age of the students based on the months, and this was achieved by relying on the students' school cards, as their ages were calculated from the date of their birth until (December 1, 2020) the date of the start of the experiment as shown in Table (2):

Table (2) The statistical description of the two groups according to (age in months) variable

Group	No.	Arithmetic mean	standard deviation	Degree of freedom	standard error Arithmetic mean	Trust period of Arithmetic mean	
						Maximum	Minimum
Control	31	164.5	3.12	59	0.56	2.20	1.23-
Experimental	30	164.0	3.58		0.65	2.25	1.24-

Chemistry test for previous information:

The researchers prepared a test-to-test chemistry for the previous information, and when formulating its paragraphs, they relied on the chemistry book for the first intermediate grade of chemistry that will be taught in the second semester for students of the control and experimental groups. The test included (25) multiple-choice items, as shown in Table (3).

Table (3) The statistical description of the two groups according to (previous information) variable

Group	No.	Arithmetic mean	standard deviation	Degree of freedom	standard error Arithmetic mean	Trust period of Arithmetic mean	
						Maximum	Minimum
Control	31			59			
Experimental	30						

Mid-year exam score in chemistry:

The scores of the students of the two research groups for the end of the first-course exam in chemistry for the academic year (2019-2020 AD) were obtained from the school administration, as shown in Table (4)

Table (4) The statistical description of the two groups according to (**First-course exam score**) variable

Group	No.	Arithmetic mean	standard deviation	Degree of freedom	standard error Arithmetic mean	Trust period of Arithmetic mean	
						Maximum	Minimum
Control	31			59			
Experimental	30						

Formal reasoning test for equivalence between the two groups:

The researchers adopted this test for Al-Jarjari 2003, which is compatible with the intermediate stage. The two researchers applied it to the two research groups before applying the experiment in the first week of the first semester on Thursday (3/12/2020) for equivalence between the two groups. The test included nine skills identified by Al-Jarjari (2003): (problem-solving, identifying and controlling variables, correlational reasoning, synthetic reasoning, hypothetical reasoning, deductive reasoning, proportional reasoning, probabilistic reasoning, and proposing solutions). The test consisted of (38), and the typical answer for the test was prepared in a (zero - one) method, Table (5).

Table (5) The statistical description of the two groups according to (Formal reasoning test) variable

Group	No.	Arithmetic mean	standard deviation	Degree of freedom	standard error Arithmetic mean	Trust period of Arithmetic mean	
						Maximum	Minimum
Control	31			59			
Experimental	30						

Experimental design and external integrity

Internal safety is not only what is taken into account in the experimental design, as researchers should take into account the external safety related to the subjects and students of the experiment to the large community to which they return and the extent to which the results of the experiment can be designed (Al-Azzawi, 118: 2008).

To ensure the external safety of the experimental design, the researchers carried out the following actions:

- Experimental conditions and accompanying accidents:

During the duration of the experiment, the sample students in (experimental and control groups) were not exposed to any significant incidents that would lead to an obstacle in the course of the research experience that may affect the two subordinate variables (attainment and formal thinking) as well as the independent variable.

- Experimental extinction (Leaving in the experiment):

The accidents the sample students are exposed to during the study are represented by the abandonment or interruption of students from work, which impacts the dependent variables. Then the results vary (Melhem, 363: 2000).

- Processes related to the maturity of the sample students:

The experiment began on Tuesday, which coincided with (January 21, 2020, AD). It was completed on Tuesday, corresponding to June 1, 2021 AD, and it was found that these factors had no effect because the students of the two research groups are equivalent in age.

Impact of experimental actions: The two researchers tried to minimize some of the side effects that may occur as a result of the procedures of his research experiment, which could affect the course of the experiment, including:

- Confidentiality of the research experience: It was agreed with the school administration not to elaborate or inform about the experience carried out by the two researchers for the streamlining of lessons naturally.
- Subject: The two researchers taught the students of both groups the same amount in terms of educational content represented in the chapters (first, second, third, fourth) of the science book for the second intermediate grade / second edition of the academic year 2018

- Duration of the experiment: The duration of the experiment is equal for the two research groups, as it started on Tuesday (1/12/2020 AD) and ended on Tuesday (1/6/2021 AD).
- Place of the experiment: The experiment was applied to the two groups in (Al-Riyadh High School for Outstanding Students).

Research tools

The researchers' Summative test and the formal thinking test they adopted were based on and applied to the two research groups on two consecutive days after the completion of teaching.

Fifth: Preparing the research requirements:

The scientific material and its identification: The scientific material that the researchers studied for the research sample during the experiment was determined from the second edition of the chemistry book for the second intermediate grade for the year 2018, and the chapters are:

- Chapter One: Elements and Chemical Bonding.
- Chapter Two Chemical Compounds.
- Chapter Three: Formulas and Chemical Reactions.
- Chapter Four: Solutions

Formulation of behavioral objectives: The two researchers formulated (233) cognitive behavioral goals according to Bloom's classification on the first levels, which is (understanding (comprehension), remembering, application and analysis). The researchers presented the behavioral objectives to a group of experienced arbitrators, as in Table (6):

Table (6) Behavioral goals for each cognitive level

No.	Content	Remember	Understanding	Application	Analysis	Total
1	Chapter One					
2	Chapter two					
3	Chapter three					
4	Chapter four					
	total					

Preparation of teaching plans: The researchers adopted scientific material and behavioral purposes for the work of the teaching plans and both groups, reaching 32 study plans each.

Sixth: Preparation of research tools: According to the type of research, the researchers prepared a test for collection and adopted a test for formal thinking First: Preparing the Summative test:

The researchers prepared a Summative test that fits the content of the material and behavioral purposes, as follows:

Determining the objective of the test: The main aim of the test is to know the measure of perception of the second intermediate grade students in the content of the four chapters of the science book for the academic year (2020-2021 AD), based on the behavioral objectives previously set for that educational content.
Determine the number of test items: The two researchers used the views of several chemistry teachers with experience in education and the arbitrators who referred them for behavioral purposes, as specified in (40) paragraphs.

Preparing the specification table (experimental map): The researchers designed a specification table in which the topics of the four chapters of chemistry were represented in Table (7)

Table (7) Specifications table for Summative test

content ratio			Behavioral Purpose Ratio				Total 100%
Subject	Classes no.	Percentage	Remember 41%	Understanding 38%	Application 13%	Analysis 8%	
Chapter One	**4**	**15%**	**2**	**1**	**1**	**1**	**5**
Chapter two	**7**	**20%**	**5**	**3**	**1**	**1**	**10**
Chapter three	**5**	**20%**	**3**	**3**	**2**	**1**	**9**
Chapter four	**16**	**45%**	**4**	**8**	**2**	**2**	**16**
total	**32**	**100%**	**14**	**15**	**6**	**5**	**40**

Formulation of test paragraphs (preparation of test paragraphs): The two researchers formulated (40) objective items (multiple choice) based on the behavioral purposes that were identified because they deviate from the subjectivity of the corrector and do not affect him when giving the degree, and are characterized by stability, validity, and comprehensiveness of the study material, as well as the answer, is specific and short and does not require a long period according to the (zero - one) method.

Test validity:

(80%) of the highest criterion to accept the paragraph was adopted, based on their opinions, paragraphs have been accepted.

Content validity: The validity of the content was verified by formulating the specification table to ensure that the paragraphs represented the content of the study material and behavioral purposes.

The first exploratory application of the test:

The Summative test was applied to an exploratory sample consisting of (35) students in the second intermediate grade in (The Mark Hussein Ali Mahfouz Intermediate School)/ General Directorate of Education Karkh Third / Baghdad to determine the appropriate time to answer the test and the clarity of the paragraphs and its instructions after completing the material for the four chapters.

A week ago, the teacher agreed to determine the day of the test on Wednesday (2/1/2020m), where the average response time was calculated at 41 minutes, and all paragraphs were clear because there was no question from students regarding the paragraphs.

The second exploratory application of the test:

The Summative test was applied to a sample of (100) students who were not from the research sample, with three sections in the middle school of (Allamah Hussain Ali Mahfouz), affiliated with the General Directorate of Education of the Third Karkh. The Summative test was applied to analyze the test items and ascertain their psychometric characteristics (paragraph difficulty, item discrimination, stability effectiveness, and alternatives). The purpose is to know the level of the item among students, try to delete or reformulate it, and know the effect of accepting other alternatives on the correct alternative. The test was applied on Wednesday (2/6/2021 AD) under the supervision of the two researchers.

Psychometric properties:

The scores were arranged in descending order from the highest degree to the lowest degree. Then the highest (27%) of the student's scores were taken to represent the upper group, and the lowest (27%) of the female students' scores represented the lowest group. The psychometric characteristics of the Summative test items were extracted as follows:

Paragraph difficulty coefficient:

After applying the equation of the difficulty factor, its value was found between (0.22-0.63), so the test items are considered appropriate. Bloom indicates that the test items are acceptable if the difficulty coefficient is limited to the range (0.20 - 0.80); thus, all test items are good, and their difficulty coefficient is appropriate.

Discrimination coefficient:

After extracting the discrimination coefficient by applying the discrimination coefficient equation, it was found that it ranges between (0.29-0.74) as (Al-Khayyat 2009) indicates that if the discrimination coefficient is between (0.2-

0.8), it is considered a good ratio. Accordingly, the test items are considered acceptable regarding their discriminating ability (Melhem, 2009: 256).

Calculating the effectiveness of the wrong alternatives:

After calculating the effectiveness of the wrong alternatives for the paragraphs that consist of (40) items, it shows that all the values of the alternatives' effectiveness coefficient have a negative value; that is, the wrong options have attracted more students to the lower group than the students of the upper group, and thus it was chosen to keep the paragraphs alternatives.

Test stability: The test's stability was calculated using the Kewder-Richardson-20 equation, as the reliability coefficient of the test was (0.92). Thus, the test is considered good, as the test is characterized by stability, as its value was (0.67) and above. (Al Nabhan, 2004: 240).

The final Summative test and its application:

At the same time and date, the final test was applied to the two research groups on Tuesday, 1/6/2021, after students were informed of the exam date a week earlier.

Second: The Formal Thinking Test:

The Formal Thinking Test (for Al Jarjari 2003) was adopted, as the test consisted of (38) items distributed on the nine formal thinking skills. These skills are (hypothetical reasoning, deductive reasoning, synthetic reasoning, proportional reasoning, probabilistic reasoning, correlational reasoning, controlling variables, proposing solutions problem solving), which is appropriate for the middle school stage.

Preparing the formal test instructions:

Test instructions have been prepared and should be clear and easy. The sample members were asked not to leave any paragraph unanswered and to write down the solution to each paragraph below.

Submitting the test to the arbitrators:

After specifying the formal thinking paragraphs in the initial form, the test finally consisted of (38) items representing the formal thinking test in its final form. Then the alternatives were placed in the form of multiple choice, so there were four alternatives for each paragraph of the test, three wrong alternatives and one correct alternative for the paragraphs (1,6,8,9,10,11,12,32,3313,18,19,20,22,23,24,25,26,28,29,30,31), besides, there were also two wrong alternatives and two correct alternatives for paragraphs (2,3,4,5,7,21,27,34,35,36,37,38). For paragraphs (14 and 17), there were five correct answers, and each answer had one mark. As for the two paragraphs (15 and 16), each had eight correct answers, and each answer received one mark.

Each correct answer was given a score, and zero was given for the wrong answer; thus, the total score on the test items becomes (72) scores, which is the highest score, while the score (zero) is the lowest score for the test, as the hypothetical mean of the test was (36). Key answers were prepared after it was presented to specialists in education and chemistry teaching methods, as their paragraphs were approved by (85%) of the experts.

The first exploratory application of the formal test:

The test was applied on Wednesday, 12/2/2020, to a sample of (50) students of the second intermediate grade from the middle school of Allamah Hussein Ali Mahfouz, in the General Directorate of Education in Baghdad, the third Karkh. The test paragraphs were clarified to the students, and their clarity was confirmed. The time taken to answer was calculated by calculating the weighted mean between the first and last five students who took the test, as it was (45) minutes.

The second exploratory application of the formal thinking test: is applied in two ways:

Retesting (external consistency):

The test was applied on Monday (1/2/2021) to a sample of (50) students from the middle school of Al-Allamah Hussein Ali Mahfouz, who were chosen randomly from the same community. However, outside the sample, after (14) days, the same test was re-applied to the sample students themselves. The Pearson correlation coefficient was calculated between the first and second application scores, and the test's stability values were (0.85). This value is considered high and reliable, meaning the test has high stability (Awda and Al-Khalili: 35, 1988).

Alpha-Krumbach method (internal consistency):

The second exploratory sample test was applied on Tuesday (2/2/2021); the number of students was (70) students from Al-Allamah Hussein Ali Mahfouz Intermediate School. They were chosen from the research community but outside the study sample. The test was verified as a whole and for each skill of it as well by applying the Krumbach Alpha equation, as it showed that the stability value is (0.91), as shown in Table (8):

Table (8) The stability values for the test of formal thinking and its nine skills

Skills	(Alpha-Krumbach) Coefficient	Retest
default inference	**0.84**	**0.84**
Deductive inference	**0.73**	**0.82**
proportional inference	**0.86**	**0.86**
Synthetic inference	**0.72**	**0.87**
Define and adjust variables	**0.82**	**0.77**
Correlational reasoning	**0.72**	**0.84**

probabilistic inference	**0.88**	**0.86**
suggested solutions	**0.73**	**0.74**
Problem Solving	**0.87**	**0.87**
The scale as a whole	**0.90**	**0.86**

Apparent validity:

The test was submitted to specialized arbitrators, who endorsed the test items and considered them appropriate for the purpose they were placed. Thus, the test is valid.

Stability:

It was conducted in two ways: retesting and the method of Alpha Crombach (Table 8).

Eighth: Statistical means:

The SPSS statistical means were adopted for all statistical work in the research.

Presentation and interpretation of results

First: Presentation of the results:

To verify the first hypothesis mentioned previously, the researcher calculated the T-test results for the scores of the experimental and control group students in the achievement of chemistry, as shown in Table No. (9).

Table No. (9) The results of the t-test for the Summative test scores of the two groups (experimental and control)

Group	number of students	Arithmetic mean	Variance	degree of freedom	T value		Significance
					calculated	Tabular	
experimental							Significant
control							

Table (9) shows that the calculated t-value is equal to (4.43), which is greater than the tabular value, which is equivalent to (1.99) at the level of significance (0.05) and the degree of freedom (62). This indicates a statistically significant difference between the experimental and control groups in the Summative test in favor of the control group. Accordingly, the first null hypothesis was rejected, and the above alternative hypothesis was accepted.

To verify the second hypothesis, the two researchers calculated the T-test results for the scores of the experimental and control group students in formal thinking in chemistry, as shown in Table No. (10).

Table No. (10)

Group	number of students	Arithmetic mean	Variance	degree of freedom	T value		Significance
					calculated	Tabular	
experimental							Significant
control							

Table (10) shows that the calculated T-value is equal to (4.42), which is greater than the tabular value, which is equivalent to (1.99) at the significance level (0.05) and the degree of freedom (62). This means a significant difference between the experimental and control groups in the formal thinking test in favor of the experimental group taught by the quick learning method compared to the control group taught according to the usual classic way. Accordingly, the second null hypothesis was rejected, and the alternative hypothesis mentioned above was accepted.

Second: results interpretation

The current research results are shown in Table (9) showed a significant difference between the two research groups in the academic achievement variable in chemistry.

The researchers' interpretation

1. The use of accelerated learning has a positive impact on academic achievement in chemistry. This is because this method makes the student a primary focus in the educational process compared to the traditional method, which gives the teacher the most important and prominent role in controlling and managing the lesson. In contrast, the accelerated learning method allowed students to participate positively in the course of the study, as this method urged them to actively participate in all the different activities given to them in the lesson or on the electronic platform. This allows feedback on multiple activities and methods and the use of visual aids by displaying pictures, power points, and e-books. Besides, it will enable students to assume responsibility, pay attention to the scientific material, and strive hard, leading to increased understanding and thus raising academic achievement.
2. The experimental group taught according to the accelerated learning method outperformed the students of the control group taught according to the usual methods in the formal thinking test (Table 10); this may be due to:

This approach allows students to use their formal thinking through adequate opportunities during the course of the lesson, which may develop the skill of providing appropriate solutions to solve a problem and adjust some extraneous variables and find productive reasoning by making some synthetic evidence between chemical concepts and giving the logical relationship between them to

solve the problem. Students also have a significant role to play in this approach, as it is clear that they participate in the educational process within the classroom by giving a great deal of freedom to interact with each other.

Third: Conclusions

The current search results are the following:

1. Teaching chemistry using the accelerated learning method directly contributed to raising the achievement of the students of the experimental group.
2. The interaction and cooperation of the students studied according to the accelerated learning method are better than those studied in the standard group.
3. Teaching using the accelerated learning method increased the formal thinking skills of the second intermediate grade students of the experimental group compared to the control group.

Fourth: Recommendations

The researchers recommended the following:

1. Inviting chemistry teachers of the different stages to use the accelerated learning method in teaching chemistry,
2. Paying attention to the accelerated learning method by providing an e-learning environment and qualifying chemistry and science teachers on how to use the devices and technologies offered by e-learning as part of effective learning.
3. Holding training courses to train teachers on how to use the accelerated learning method.
4. Attention to preparation, training, and continuing education courses at the university and secondary levels, and these courses include topics on accelerated because they help raise the level of achievement and formal thinking.

Fifth:

Suggestions

The researchers suggested the following:

1. Conducting other studies in which the accelerated learning method is used and its effect on achievement for different academic stages such as (elementary, intermediate, and university).
2. Conducting a study to compare the accelerated learning method with other teaching methods in the same variables.
3. Work on conducting other research to know the extent to which
4. middle school students possess formal thinking.

REFERENCES

Arabic sources

Foreign sources

Ibrahim, Ahmed Ibrahim (2005): Self-regulation of learning and internal motivation in their relationship to academic achievement and divergent thinking among students of the College of Education, a predictive study, Journal of the College of Education - Ain Shams University, No. 31, Part 3, Cairo, Egypt.

Abu Jadu, Saleh Muhammad Ali (2008): Educational Psychology, 6th Edition, Dar Al Masirah for Printing and Publishing, Amman, Jordan.

Al Shadeed, Abdullah (2014): The effectiveness of a training program for primary school teachers in developing rapid learning skills for their students, an unpublished master's thesis, College of Education, King Saud University, Riyadh.

Ambo Saidi, and Al-Naqbiya (2014): Investigating the effect of teaching science using the learning cycle of (Smith) and his colleagues on the trend towards science and self-concept for tenth grade students, Part Two, Journal of Educational Development, Muscat

Piaget, Jean (1986): The mental development of the child, translated by: Samir Ali, 1st edition, Children's Culture House, Baghdad.

Al-Jarjari, Khashman Hassan (2003): The effect of an educational program on developing formal thinking skills among middle school students, an unpublished doctoral thesis, College of Education, University of Mosul.

The trick, Muhammad Mahmoud (2001): Instructional design (theory and practice), 4th edition, Dar Al Masirah, Amman.

Al-Khalidi, Adeeb Muhammad (2008): Psychology of Individual Differences and Mental Excellence, 2nd Edition, Wael Publishing House, Amman, Jordan.

Khairallah, Hamid Shaya (2016): Recognizing the effectiveness of formal organizations in achievement and formal thinking among students of the fifth scientific in mathematics, unpublished PhD thesis, College of Education, Ibn Al-Haytham, University of Baghdad, Iraq.

Al-Dulaimi, Ihsan Alawi and Adnan Mahmoud Al-Mahdawi (2005): Measurement and evaluation in the educational process, 7th edition, Ahmed Al-Dabbagh Office for Printing and Publishing, Baghdad.

Daoud Maher Muhammad and Majid Mahdi Muhammad (1991), Fundamentals of General Teaching Methods, Mosul, Iraq.

Al-Douri, Wisal Muhammad Jaber Muhammad (2003): “The Effectiveness of a Cognitive Behavioral Therapy Program in the Mental Health of Gifted Students”, an unpublished PhD thesis, College of Education / Ibn Rushd, University of Baghdad, Baghdad.

Rabea, Hadi Mishaan (2008): Educational Psychology, Arab Society Library for Publishing and Distribution.

Al-Zoba'i, Abdul-Jalil and Muhammad Ahmad Al-Ghannam (1981): Research Methods in Education, Baghdad University Press, Baghdad.

Al-Zayyat, Fathi Mustafa (2006): Cognitive bases for cognitive mental formation and information processing, 2nd edition, Universities Publishing House, Cairo.

Zaitoun Ayesh Mahmoud (1996): Methods of Teaching Science, 2nd Edition, Dar Al-Shorouk, Amman, Jordan.

Shehata, Hassan, and Al-Najjar, Zainab, (2003): A Dictionary of Educational and Psychological Terms, Arabic - English and English - Arabic, 1st Edition, The Egyptian Lebanese House, Cairo.

Al-Shibawi, Majed Sarif (2016): The effect of instructional design according to divergent thinking strategies on the achievement of preparatory stage students in physics and their formal thinking, unpublished PhD thesis, College of Education, Ibn Al-Haytham, University of Baghdad, Iraq.

Sheikhoun, Abdul Hamid Abdul Razzaq (2019): Accelerated learning is your guide to the world of excellence and creativity. Dar Al-Hasnaa for Publishing, Alexandria, Egypt.

Abd al-Rahman, Anwar Hussein and Adnan Haqqi Shihab Zangana (2007): Methodological patterns and their applications in the humanities and applied sciences, 1st edition, Dar Al-Wefaq, Baghdad.

Adas, Abd al-Rahman and Muhyi al-Din Tawq (2006): Introduction to Psychology, 3rd Edition, Jordan Book Center, Amman.

Al-Azzawi, Rahim Younis Crowe (2008): "Assessment and Evaluation in the Teaching Process", 1st Edition, Dar Degla, Amman, Jordan.

Allam, Salah El-Din Mahmoud (2006): Educational and psychological measurement and evaluation (its basics, applications and contemporary directives), 1st edition, Dar Al-Fikr Al-Arabi, Cairo.

Alyan, Shaher Rebhi (2010): Natural sciences curricula and methods of teaching - theory and practice, 1st edition, Dar Al Masirah, Amman, Jordan.

Odeh, Al-Khalili, Khalil Youssef (1988): Statistics for the Researcher in Education and Human Sciences, 1st Edition, Dar Al-Fikr, Amman.

Odeh, Ahmed Suleiman (1999): Measurement and evaluation in the teaching process, I 1, Dar Al-Amal, Irbid

Kanout, Sahar Amin (2009): Methods of Teaching Science, 1st Edition, Dar Degla, Amman, Jordan.

Laibi, Faten Kazem (2011): Formal thinking and its relationship to the five major factors of personality among middle school students, unpublished master's thesis, College of Education _ Ibn Al-Haytham, Baghdad.

Mayer, Dave (2010): Rapid Learning: Your Creative Guide to Designing and Implementing Faster and More Effective Training Programs, translated by (Ali Muhammad), Damascus, Dar Al-Qaimah: ILLAFTrain, Dubai.

Muhammad, Wael and Reem Abdel Azim (2011): Curriculum Design, 1st Edition, Dar Al Masirah for Publishing, Distribution and Printing, Amman.

Marei, Tawfiq Ahmed, and Muhammad Mahmoud Al-Hila (2005): General Teaching Methods, 7th Edition, Dar Al-Masira, Amman.

Al-Mufleh, Khalaf Muhammad (1995): The effect of formal thinking for first-year secondary scientific students in Mafraq Governorate and their attitudes towards physics on the level of their conceptual knowledge of Newton's laws of motion, (unpublished master's thesis), College of Graduate Studies, University of Jordan, Amman.

Melhem, Sami Muhammad (2000): Research Methods in Education and Psychology, 1st Edition, Dar Al-Masira, Amman.

(2009): Measurement and Evaluation in Education and Psychology, Dar Al Masirah for Publishing, Distribution and Printing, Amman.

Al-Mawla, Suleiman (2011): The effect of a proposed strategy supported by directed imagination to solve mathematical problems on achievement and the development of formal thinking among students of the fifth scientific grade, unpublished master's thesis, College of Education, Mosul.

Al-Nabhan, Musa (2004): Basics of Measurement in Behavioral Sciences, 1st Edition, Dar Al-Shorouk, Amman.

Hilal, Mohamed Abdel-Ghani Hassan (2007): Rapid Learning Skills, Speed Reading and Mind Map, Performance and Development Center, Cairo, Egypt.

Al-Hiti, Nasser Obeid (2008). The effect of problem-solving method on formal thinking and academic achievement among female fourth-grade secondary students in mathematics, unpublished master's thesis, College of Education, Anbar.