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The effect of contextual learning in Developing scientific thinking for fifth grade science students in chemistry

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Abstract:

The research aims to identify the effect of contextual learning on the scientific thinking of fifth-grade biology students in chemistry. The scientific thinking test prepared by the researcher was relied upon after being presented to a group of experts and specialists. The researcher verified the psychometric characteristics of the test. The experiment continued to be applied until the end of the first semester. At the end of the experiment, the test was applied to the two groups. After that, the results were analyzed and showed that the students of the experimental group who studied according to contextual learning outperformed the control group who studied in the usual way in the scientific thinking variable.

Keywords: Contextual learning, 5th grade science students, scientific thinking.

Introduction:

Increasing the learner's achievement, developing his abilities, intelligence and appreciation of the importance of what he learns in life has become a major reason for searching for the best modern methods and strategies that are more beneficial in teaching science. Conventional teaching methods do not only affect the learners' academic achievement, but also weaken the abilities that the learner possesses, including analytical abilities, creative abilities and practical abilities known as scientific thinking. Possessing these abilities is different and varied among learners, which requires searching for modern methods and strategies that develop and advance these three abilities in learners. Therefore, the researcher adopted

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contextual learning, which may contribute to activating their scientific thinking abilities.

1. Research definition

1.1 Research problem

Science education has recently undergone many transformations and reform movements from interest in the scientific method to a trend towards scientific processes, then interest in scientific investigation and the dissemination of scientific culture. Thus, science education has become targeting all learners to develop many functional knowledge, skills and intelligences in them, to play a useful and meaningful role in developing society as a responsible citizen. This can only be achieved by increasing the learner's achievement and developing his abilities, intelligence and appreciation of the importance of what he learns in life and society (Holbrook & Rannikmae 2017, p190),The learner's inability to interpret the physical/chemical/biological events that occurred in his environment means that learning science does not achieve the desired goals of science education (Kortland, 2010; Ultay.E, 2012, p233), which requires searching for modern methods and strategies that develop and advance learners' thinking abilities. Therefore, the researcher adopted contextual learning, which may contribute to activating their scientific thinking abilities.

1.2 Importance of research

Modern teaching strategies and methods contribute to developing students' skills in contemplation, listening and research as much as possible. In order to achieve this goal, the teacher began to deal with modern strategies that play a major role in mobilizing the energies of science, research and creativity in the student, in addition to building the personality of the student, learner, researcher, thinker and critic. He can also access knowledge and other experiences and expand the horizons of his idea. A successful teacher is nothing but a successful method, based on psychological foundations and educational facts that are compatible with the learners' tendencies and suit their mood. The importance of modern teaching strategies and methods stems from the fact that they are in line with cognitive and technological progress, and what they require in terms of a huge amount of information, so that they are used to develop students' skills in research, thinking, listening and criticism, and thus develop mental and cognitive abilities and productivity skills. The use of contextual learning in teaching various sciences, especially

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chemistry, contributes to the development of scientific thinking, because it is based on learning from the context of life.

2. Theoretical background and previous studies

2.1 Theoretical background

The context-based approach in choosing life situations and relevant contexts to activate the learner's pre-existing knowledge on which he builds the learning of new knowledge, and to develop coherent mental maps of knowledge and increase the importance of studying the subject (Ultay, E, 2012, p233-234), as he himself builds an internal representation of experiences, phenomena and facts using his concept, understanding and previous experience mastered within his cognitive system, as it places the learner at the center of the learning experience, learning by doing and teachers are organized and supported to facilitate the achievement of competence for each learner so that he becomes independent for life and creates a learning community with more diverse learning activities designed for projects, field study, presentation, reflection, problem solving and group interaction, (Utami, 2016, p100-101) leads to a constructive occurrence that increases learners' interest in science courses and helps them see the links between science and daily events, and helps them develop a more comparative understanding of science. The contextual approach to teaching and learning is considered the essence of the constructivist theory. In (2001), it was suggested Crawford says that contextual learning consists of five learning practices, through which learners can link the content of the subject to the real content, i.e. establishing links between knowledge and its applications in their lives and giving learners the opportunity to gain experience through experimentation, cooperation and participation in groups that enhance learners' understanding, and then transfer this acquired knowledge to new situations (Ali & Mustafa, 2015, p93). Situations should be as related as possible to the learner's daily life and interests. It is useful to identify interesting and attractive activities, because there is always a problem in teaching science due to a possible failure in the scientific relationship between the content and the learner's daily life events. Contextual learning is a model for overcoming this failure and through it the question "Why should we learn this" can be answered (Ultay, N & Gungoren & Ultay, E, 2017: 51).

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2.1.1 Elements of the contextual approach to teaching and learning

The contextual approach includes a set of elements :

A- Constructive synthetic study: Constructivism is the philosophy of contextual education and the learning approach, as the teacher transfers knowledge to the learner and the learner learns step by step from the limited context and builds their own knowledge to find deep understanding through the learning experience, as information is built through comprehension and correct use, i.e. by integrating new knowledge with what has settled in cognitive systems and is appropriate with new information (Nida, 2009,p24).

B- Research (investigation): It is a process based on induction and scientific discovery based on systematic thinking, as contextual teaching is closely related to scientific discovery that indicates taking the correct steps to reach the study objectives, which is concerned with the participation of learners in all scientific procedures in which organized planning is manifested to reach new information or to prove previous information, as research procedures build scientific mental abilities in learners on which they build all their movements.

C- Interrogation (question): Contextual teaching is based on interactive dialogue with questions and answers between the elements of the educational environment, and the question is extremely important to reach an objective research of science, to search for information and to confirm what has been learned and to direct attention to unknown aspects, and it has a major role in investigation, detailing and scrutiny so that new information is more reliable, meaning that the question is not monopolized by the teacher only, but is also asked by the learners.

D- Learning community: Contextual teaching gives great importance to making learning a social process, as it indicates that the result of teaching and learning results from performing a task with other learners, gathering and cooperation between learners can lead to exchanging experiences, solving problems and creating better learning. The more the groups differ in abilities, information, understanding, talents and tendencies, the better the learning result will be.

E- Information visualization: It is a process of approximating the scientific material, i.e. communicating and approximating information by visualizing it in images that can be simulated, where the educational

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process is transformed from abstract formalism that makes science meaningless words to a sensory educational process (senin, 2015, p73)

F- Thinking (reflection): Thinking plays an important role in contextual education and learning, as it is reconsidering, analyzing and surveying what has been learned, and it also means retrieving what was learned in the lesson from educational events and facts, the effect of which is reflected in the cognitive structure of learners, and at the end of each class, the learner is given time for the reflection process, which is manifested in forms of questionnaires, verbally or in writing, or through reports, or to express their feelings and suggestions, and through discussion or conclusion.

G- Correct evaluation: It is the process of collecting information and data that show the development of learners through tests and in different ways and measuring their knowledge and skills, and evaluation must be continuous, comprehensive and integrated. (Nida, 2009, p20-22)

2.1.2 Characteristics of contextual education and learning

Johnson (2002) stated that the characteristics of CTL are:

A- Making a meaningful connection Learners can learn the materials that interest them, because the materials are acquired based on the context of their real lives.

B- Doing a great job Learners can link what they have acquired from the school subjects with the various contexts that still exist in the real world.

C- Self-regulated learning the purpose of self-regulated learning is the ability of learners to learn regularly so that they can obtain knowledge as much as possible. This is because the role of learners in contextual education and learning is to find information when they learn.

D- Collaboration is essential and is a feature of contextual education and learning through which a group discussion is conducted, to benefit from the information, experience and skills of each other.

E- Critical and creative thinking It focuses on the way learners can think critically if they find a problem in order to get the best solution. In addition, they can be creative when there is a task that needs creativity

F- Emphasizing that learners still need the help of others such as adults who have more experience than young people, so learners must respect adults.

G- Reaching a high level of contextual education and learning characteristics, which can motivate learners to get more study frequency.

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H- Using correct assessment methods is useful in order to obtain meaningful goals (Elaine, 2002, p24)

2.1.3 The importance of contextual education and learning:

The importance of contextual education and learning lies in the following :

A- It makes learning realistic, especially in science, as it is effective in transferring and building basic scientific concepts.

B- It allows learners to participate in exploratory activities, especially in science and mathematics, which makes them build knowledge correctly.

C- It makes the learning process interesting through the examples used that are familiar to learners, lifestyle, geography, environment, etc.

D- Contextual education and learning stimulate the brain, by linking academic content to the context of daily life.

E- Makes learners self-organized, learners who develop their individual interests and work in groups or individually, because the learner enjoys learning by doing practical activity.

F- Contextual education and learning motivate the learner to take responsibility for his own learning and link knowledge and apply it to various contexts of their lives.

G- It makes it easier for the learner to remember or understand information captured from their own experience in the context of life. (osayimwense, 2017, p 6)

The researcher believes that most learners in schools obtain a lot of information and knowledge that has no impact or benefit in their daily lives, because it is difficult to link what they have learned to reality in their lives, as most teaching methods in classrooms do not touch the real reality of learners.

2.1.4 Contextual learning steps

A- Relating, which is the stage of linking with the real world, and means learning in the context of life experiences or pre-existing knowledge.

B- Experiencing is the stage of learning through experiences, i.e. the step of practical training on experiences inside the classroom, and it is a method of learning through exploration, experimentation, invention and activities, and it also includes preparing reports, projects, solving problems and assignments.

C- Applying is the stage of application, i.e. using concepts in new situations, and it is a learning process through using new concepts in new and real situations, to enable understanding of concepts with examples, which

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increases learners' motivation to understand. Learners apply new concepts when participating in practical activities to solve problems and specific projects or through realistic tasks and exercises related to real concepts.

D- Cooperating is the stage of cooperation that involves learning in the context of participation, interaction and communication with other learners, and it is a method of cooperation that involves learning in the context of participation, interaction and communication with other learners to enhance knowledge, and in which experiences are exchanged and cooperative skills are developed in solving problems related to new knowledge.

E- Transferring, i.e. the stage of learning transfer, is meant as a teaching method that is based on using acquired skills and knowledge in new contexts or situations, helping learners to deal with unfamiliar situations that were not covered during the lesson, i.e. it emphasizes the ability to benefit from acquired knowledge in a new context. (Michael, 2001, p3-11); (Ultay, E, 2012, p234) The following table shows the steps of each stage of contextual learning

2.2 Scientific thinking

Thinking has many patterns, including scientific thinking, which is considered one of the most important basic mental and cognitive processes because it plays a role in motivating the learner and preparing him to face the problems he encounters in different situations, whether educational or life-related. (Ahmed, 2013, p14), scientific thinking is not specialized thinking in a specific subject, but it can be directed in addressing all the subjects and issues that we face (Nadia & Montaha, 2012, p44), and scientific thinking, as educators see it, is purposeful behavior directed in an objective manner towards studying a problem in all its dimensions with the aim of reaching the changes that clarify the relationships contained in the problem, then giving judgments related to the problem, and scientific thinking is characterized by certain characteristics represented by the belief that everything has a cause and that it is an integrated and purposeful process related to the human being, and it is a mental activity that the human being uses in addressing the problem that he faces in his daily life and in researching and investigating the problem with an organized scientific methodology and reaching its solutions and scientific thinking is defined as a mental process that requires the learner to have previous knowledge and experience so that he can take organized steps

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and procedures that remove confusion and bewilderment from achieving his goal (Kamal, 1994, p94), importance that can be summarized as follows:

1- Providing the opportunity for students to think positively because thinking leads them to new ideas
2- Preparing the learner to compete for educational opportunities, jobs and privileges.
3- Thinking understands the surrounding phenomena.
4- Scientific thinking solves various problems, whether from a scientific or life perspective.
5- Thinking gives things new meanings as the individual discovers secrets that he did not know
6- Acquiring new knowledge and replacing old knowledge with it.
7- Develops students' tendencies and interests towards scientific subjects.
8- Helps students acquire the appropriate directions for them.
9- Helping the learner move from the stage of acquiring knowledge to the stage of employing it in investigating the treatment of real problems in the real world.
10- Developing the concept of self, feelings of belonging and a sense of responsibility towards society (19. Raad and Suha, 2015, p72)

2.2.1 Scientific thinking skills

1- Observation: It is an organized and intentional attention to phenomena, events and things; In order to discover its causes and laws, it requires conscious planning from learners, and therefore needs training and practice, and requires the use of different senses or scientific tools and devices, and to be accurate and precise, it must be recorded immediately after observation, and is one of the basic skills necessary to learn other thinking skills, and it is also necessary for both reasoning and classification skills (Ayesh, 2010, p133).
2- Classification: A person can deal with information and observations easily and simply by classifying them, i.e. placing them in groups based on the common characteristics that this information or things possess (Al-Damman, 1993, p3).
3- Conclusion: it is also known as the transition from the general to the specific, so the conclusion is the students' mental ability to reach partial results as a result of the existing observations and training students to conclude helps him interpret the observations he obtains through scientific

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experiments and reach the reasons for the occurrence of these observations (Ayesh, 1993, p114)

4- Prediction: Prediction is considered one of the goals of science as it helps a person to control phenomena and circumstances and control them and in order to do so, it is necessary to predict what will happen based on the observations and experiences related to the phenomenon. Mar Zanoa knows that the process of predicting certain results from a specific situation based on the information available to students and the feedback related to the validity of that information and prediction is considered complementary. For understanding strategies (Mar Zanoa 1995, p131).
5- Measurement: Measurement includes comparison, where the researcher can compare between two or more phenomena by specifying specific standard units that can be observed on the two phenomena and coming up with general results. "Good" mentions that measurement is training students to use measuring tools, scales, and dissection tools, and it also includes comparing things using specific units (Yaqoub, 1984, p98).
6- Distinguishing variables: This process is known as identifying the independent variable and the dependent variable that were used in the experiment (guarantor,1993, p6).
7- Formulating hypotheses: It is a proposed solution or guess or possible explanation for the issue under investigation. Its proposal depends on the individual's abilities to subject it to mental and logical organization and discover relationships and links between observations or events. (Zain Al-Din, 2012, p55)

2.3 Previous studies

1- (Muhammad, 2010): "It is a study of the effect of the contextual approach in developing reading skills" The sample size was (40), the study relied on the experimental research method, used the reading achievement test, the study proved the superiority of the experimental group over the control group, i.e. when teaching students according to specific strategies that work to develop reading skills among students.
2- (Fatkhul, 2016): The study aimed to study the effect of contextual teaching and learning on the outcomes of natural science education, the study used quantitative research, the study was applied in primary schools for the fifth grade of primary school, and the results were that education according to the contextual approach obtained a percentage of 94% of good learning

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activities, and the study recommended the importance of generalizing education with the contextual approach to various sciences in education.

3- (Kofan & Alham, 2022): The study aimed to identify the relationship between scientific thinking skills and achievement among eighth-grade students in the science subject. The researchers used the descriptive correlational approach, and the research sample was 400 students. The research tool was chosen by testing scientific thinking skills. Among the research results, there is a statistically significant correlation between the research variables among eighth-grade students in the science subject.

3. Research methodology

3.1.The experimental design of the research

It includes the independent variable (contextual learning and teaching) and (the usual method), and the dependent variable (scientific thinking), so the researcher used the experimental design with partial control of two equivalent groups, one experimental and the other control.

3.2.Research community and sample

The current research community represents all fifth-grade science students in government daytime (secondary and preparatory) schools affiliated with the General Directorate of Education in Dhi Qar Governorate for the academic year (2022-2023), in which the number of fifth-grade science classes is not less than two classes. As for the research sample, the researcher intentionally chose (Al-Nasr Intermediate School for Boys) in Dhi Qar Governorate to conduct his research

3.3.Equivalence of the two research groups

The researcher conducted statistical equivalence between the experimental and control groups in some variables that affect the results of the experiment. Although the researcher selected the two groups using the random drawing method, and although the students of the research sample are from a largely similar social and economic background and study in the same school, he was keen to conduct equivalence in the following variables: (chronological age calculated in months, grades of the second course of the previous academic year, intelligence test, previous information test). The researcher conducted equivalence between the two research groups in the variables mentioned above.

3.4.Controlling extraneous variables

Although the researcher verified the equivalence of the two research

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groups in some variables that he believed affected the course of the experiment, he tried to avoid the effect of some extraneous variables on the course of the experiment. The following are some of these variables and how to control them: (Incidents accompanying the experiment: The experiment in the research was not exposed to any emergency or accident that would hinder its progress, Experimental extinction: No student was interrupted or transferred throughout the experiment, Selecting the sample: The two research groups were chosen intentionally and the equivalence of the two groups was confirmed, Maturity factor: Given that the duration of the experiment was uniform between the two research groups and the closeness of the ages of the students in the two groups, the growth that occurs will return to the individuals of the two groups at the same level, so this factor did not have an effect on the research, The effect of experimental procedures: The researcher worked to limit the effect of experimental procedures that could affect the dependent variable during the course of the experiment).

3.5.Preparing research requirements

The scientific material that the researcher teaches to the students of the two research groups during the experiment period (first semester) of the academic year (2022-2023) AD was determined. The scientific material included studying the periodic table and the chemistry of transition elements and solutions. The researcher prepared 30 plans for the experimental group that studies according to (contextual learning and teaching) and the same for the control group that studies according to (the usual method).

3.6.Research tool

The steps of the research tool (scientific thinking test) were prepared, which are as follows:

1. **Determining the objective of the test:** The test consists of seven skills for scientific thinking.
2. **Reviewing the literature and previous studies:** The researcher reviewed many studies in scientific thinking
3. **Determining the test areas**: After reviewing many studies that dealt with scientific thinking, the most important areas that the test measures were determined, which are observation, classification, inference, prediction, measurement, distinguishing variables, and formulating hypotheses.
4. **Preparing the test instructions:** The test instructions are a guide that

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guides the respondent on how to answer, so the researcher was keen for the instructions to be clear and easy and included how to answer the paragraphs with examples and in a manner that is consistent with the level of the fifth scientific students so that they can answer the test easily, and urged the students to answer all the test paragraphs without leaving, and the test consists of (7) parts, and each part consists of (5) multiple-choice questions, and each question consists of the main sentence followed by (4) possible answers, the student must choose only one answer.

5. **Test correction:** The test consists of (35) paragraphs, with one point given for each correct answer and zero for each wrong or omitted answer, so the total score for the test is (35) points as the highest point, and (zero) as the lowest point, with a theoretical average of (17.5) points.
6. **Apparent validity of the test:** To ensure the validity of the test, its paragraphs were presented to a group of arbitrators specialized in educational and psychological sciences, and they were asked to verify the paragraphs, drawings and figures and estimate their suitability and suitability for measuring each type of the three abilities, as well as their suitability for the Iraqi environment. Based on their opinions and observations, some linguistic terms were modified, and thus the apparent validity of the test was extracted after the arbitrators agreed at a rate of 100%.
7. **Exploratory application of the test:** The exploratory application was carried out on a sample of students from outside the research sample. The exploratory application was carried out in two stages:

A. **The first exploratory application:** The test was applied to a sample of (30) students from the fifth-grade biology students (from outside the research sample) in order to identify the clarity of the test paragraphs and the instructions for answering these paragraphs, as well as identifying the time required to answer the test paragraphs. The time taken to answer the test paragraphs was calculated by monitoring the time the first student finished, and after each student finished, the time for answering was recorded. Then the average time was calculated. It was found that the time taken to answer was approximately (43) minutes. Thus, the researcher relied on this time for the test in applying the test to the students of the research sample when conducting the experiment. In addition, the test instructions and paragraphs were clear, so the researcher kept the instructions and test paragraphs without change.

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B. **The second exploratory application:** After the researcher confirmed the clarity of the test paragraphs and the instructions for answering its paragraphs and calculating the time taken to answer the test paragraphs, the researcher applied the scientific thinking test again on a exploratory sample (outside the research sample) consisting of (100) students from the fifth scientific grade. The purpose of this application is to conduct a statistical analysis of the test paragraphs and verify their validity after knowing the difficulty coefficient and discriminating power. After correcting the students' answers, they were arranged and the highest (27%) of the sample scores were chosen to be the upper group and the lowest (27%) of the sample scores were chosen to be the lower group. Thus, the total number of students in the upper group reached (27) students and the total number of students in the lower group reached (27) students.

8. **Statistical analysis of the test paragraphs:** The statistical analysis of the paragraphs aims to verify the accuracy of the psychometric properties of the test itself, and the statistical analysis process is one of the basic steps for its construction, and that adopting paragraphs that are characterized by good psychometric properties makes the test more valid and reliable, so the researcher extracted the psychometric properties of the scale as follows:

A. **Discrimination coefficient for paragraphs**: After arranging the students' answers in descending order and choosing a percentage of (27%) for each of the upper and lower groups, the discriminating power of the scientific thinking test paragraphs was then calculated, and using the t-test for two independent samples to verify the significance of the differences between the average scores of the students of the two groups (upper and lower), and for each paragraph, it was found that the test paragraphs had a discriminating power ranging in value between (6,512-10,296), and it became clear that all values are higher than the tabular value, which is equal to (2,000) at a significance level of (0.05) and a degree of freedom of (52), and thus all test paragraphs are significant Statistically.

B. **Construct validity (internal consistency):** The researcher calculated the validity of the test paragraphs for each component of the scientific thinking test through:

9. **The relationship between the paragraph score and the total test score:** The correlation of the paragraph with the total test score is an indicator of the validity of the paragraph, which is at the same time an indicator of the

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homogeneity of the paragraph in measuring this behavioral phenomenon. To verify the correlation coefficient of the score of each test paragraph with the total test score, the researcher used (Pearson's correlation coefficient), and it was found that the values of the Pearson's correlation coefficient calculated for the test paragraphs were all significant when compared to the value of the critical value coefficient of the correlation coefficient of (0.19) at a significance level of (0.05) and with a degree of freedom of (98), and thus the test paragraphs were kept

10. **The relationship between the paragraph score and the total field score:** This validity was achieved by calculating the correlation of the paragraphs with the field to which they belong by using Pearson's correlation coefficient, and they were all significant (valid) compared to the tabular value at a significance level of (0.05).
11. **The relationship between the field score and the total test score:** The score of each field must be correlated with the total test score. The correlation coefficients between the score of each field and the total test score were calculated using Pearson's correlation coefficient, and they were all statistically significant at a significance level of (0.05).
12. **Test reliability:** The researcher used the Cronbach's alpha method to calculate the reliability coefficient, as the average of the internal correlation coefficients is the best estimate of the average reliability coefficient. The reliability coefficient was found to be equal to (0.8103), which is a good reliability coefficient. If the reliability coefficient value is (0.67) or above, it is good.
13. **The test in its final form:** The test in its final form consists of (36) test items.

4. Results and Discussion

To verify the second null hypothesis which states (there is no statistically significant difference at the level (0.05) between the average scores of the experimental group students who will study chemistry using contextual learning and the average scores of the control group students who study chemistry in the usual way in (the scientific thinking test), the researcher built a test for scientific thinking skills and applied it to the experimental and control research groups. After applying the test twice, the first at the beginning of the experiment in the equivalence of the two groups and the second in the post-test at the end of the experiment, the researcher

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corrected the papers of the two groups and recorded the scores of the students of the two groups, the arithmetic mean of the scores of the students of the experimental and control groups, the standard deviation and variance were calculated, and then the t-test was applied for two independent samples as shown in the tables listed below: Table (3) Results of the scientific thinking test for the two research groups for the equivalence of the two groups

Table N˚1. Results of the scientific thinking test for the two research groups

the group	the number	SMA	Standard deviation	variance	degrees of freedom	T value		Statistical significance (0.05)
						calculated	Tabular	
Experimental	**30**	**16.63**	**4.580**	**20.976**	**58**	**-0.937**	**2.000**	**Statistically significant_**
control	***30***	***16.63***	***5.660***	***32.033***				

. We note from the table, after processing the data statistically and relying on the t-test for two independent samples, that the arithmetic mean of the experimental group in the scientific thinking test when there is equivalence between the two groups is (16.63) with a standard deviation of (4.580) and a variance of (20.976), compared to the arithmetic mean of the control group in the same test, which is (16.63) with a standard deviation of (5.660) and a variance of (32.033), and the calculated t-value was (-0.251), which is less than the table value, which is (2.000), which means that the two groups are equivalent in this variable. Table (5) Results of the scientific thinking test for the control group

Table N˚2. Results of the scientific thinking test for the control group

the group		the number	SMA	Standard deviation	variance	degrees of freedom	T value		Statistical significance (0.05)
							calculated	Tabular	
Pre-test		**30**	**16.63**	**5.660**	**32.033**	**58**	**5.754**	**2.000**	**Statistically significant**
Post-test.		***30***	***24.50***	***5.631***	***31.707***				**_**

We note in the table that the arithmetic mean of the control group in the scientific thinking test when the two groups are equal is (16.63) with a standard deviation of (5.660) and a variance of (32.033), compared to the arithmetic mean of the same group in the post-test which is (24.50) with a standard deviation of (5.631) and a variance of (31.707), and the calculated t-value is (5.397) which is greater than the tabular value which is (2.000), thus the superiority of the control group in the post-test is clear.

Table N˚3. Results of the scientific thinking test for the experimental group

the group	the number	SMA	Standard deviation	variance	degrees of freedom	T value		Statistical significance (0.05)
						calculated	Tabular	

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Pre-test	**30**	**16.30**	**4.580**	**20.976**	**58**	**10.495**	**2.000**	**Statistically significant_**
Post-test.	***30***	***(28.97***	***(4.767***	***32.732***				

We note in the table that the arithmetic mean of the experimental group in the scientific thinking test when the two groups are equal is (16.30) with a standard deviation of (4.580) and a variance of (20.976), compared to the arithmetic mean of the same group in the post-test which is (28.97) with a standard deviation of (4.767) and a variance of (32.732), and the calculated t-value is (10.495) which is greater than the tabular value which is (2.000), thus the superiority of the experimental group in the post-test is clear.

Table N˚4. Results of my research group in the post-test of scientific thinking

the group	**the number**	**SMA**	**Standard deviation**	**variance**	**degrees of freedom**	**T value**		**Statistical significance (0.05)**
						calculated	**Tabular**	
Experimental	**30**	**28.97**	**4.767**	**22.50**	**58**	**3.316**	**2.000**	**Statistically significant_**
control	***30***	***24.50***	***3.631***	***31.707***				

It is noted in the table that the arithmetic mean of the experimental group students' scores is (28.97) with a standard deviation of (4.767) and variance of (22.723), and the arithmetic mean of the control group students' scores is (24.50) with a standard deviation of (5.631) and variance of (31.707), and the calculated t-value is (3.316) which is greater than the tabular t-value which is (2.000) at a degree of freedom of (58). Thus, it is clear that the experimental group is superior to the control group in the scientific thinking test. Therefore, the null hypothesis is rejected and the alternative hypothesis is accepted, which states: (There is a statistically significant difference at a significance level of (0.05) between the average scores of the experimental group students who study chemistry according to contextual learning and the average scores of the control group students who study the same subject in the usual way in the scientific thinking test). The researcher also used the square equation (Ita) to extract the effect size **(η2)** of the independent variable in the dependent variable (test Scientific thinking).

Table N˚5. Effect size of the independent variable on the scientific thinking variable

the independent variable	**dependent variable**	**effect size valueη 2**	**The magnitude of the effect**
contextual learning	**scientific thinking**	**0.159**	**middle**

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It is clear from the table above that the value of the effect size amounted to (0.159), which is an appropriate value to explain the effect size and by a large amount for the teaching variable (contextual learning) in scientific thinking and in favor of the experimental group. This means that the experimental group outperformed the control group that studied according to (contextual learning). Thus, this research agrees with the study (Al-Tamimi, 2018) and the study (Lira, 2018) in increasing scientific thinking among students in the experimental group with a difference in the independent variable. Interpretation of the results related to the null hypothesis: The results reached by the researcher show that the students of the experimental group who studied chemistry according to contextual learning outperformed the students of the control group who studied the same subject in the usual way in scientific thinking. The researcher attributes this to the following reasons**.**

1- One of the most important steps of contextual learning is linking previous experiences with new knowledge. Students work on analysis to extract the correlations between previous and new knowledge, as well as the ability to reason, analyze and evaluate ideas and situations, solve problems, and use many higher mental processes to build new knowledge, which develops analytical ability, which is one of the scientific thinking abilities

2- Students experiment by practicing manual and mental activities to discover new knowledge and link it to previous experiences, thus developing their creative abilities, which is one of the scientific thinking abilities.

3- Students use new knowledge in new contextual situations, and cooperate with each other in groups to solve problems, and transfer the impact of learning in new situations and contexts leads to an increase in the ability to use and employ knowledge, which develops their practical abilities, which is one of the scientific thinking abilities.

5. Conclusions:

In light of the experiment conducted by the researcher, the results he obtained, and the reasons that resulted from the research, the researcher reached the following conclusion : Teaching fifth-grade biology students the subject of chemistry according to contextual learning had a positive effect in raising their level of scientific thinking.

6. Recommendations:

After presenting and interpreting the results, the researcher recommends the following :

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1- The necessity of adopting contextual learning in teaching chemistry for middle and preparatory stages
2- Contextual learning has proven to be characterized by certain characteristics, so specialists in the field of curriculum development can benefit from the results of this research and apply it in schools.
3- The necessity of enlightening science teachers, especially chemistry teachers, to use the scientific thinking test on their students and to pay attention to developing it by using scientific thinking abilities in the teaching process.
4- The necessity of introducing chemistry teachers to modern teaching strategies, including contextual learning, as it contributed to increasing the achievement of fifth-grade students in science and scientific thinking.

7. Suggestions

After presenting and interpreting the results, the researcher Suggestions the following:

1- Conducting more similar studies in other sciences at different educational stages.
2- Using contextual learning to measure its impact on other dependent variables such as thinking, scientific sense, and acquisition of scientific concepts, etc.
3- Preparing proposed programs to develop students' scientific thinking abilities and knowing the extent of their impact on raising their academic achievement.
4- Conducting studies to measure the effectiveness of proposed programs in scientific thinking on students' analytical, creative, or practical abilities

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أثر التعلم السياقي في تنمية التفكير العلمي لطلبة الصف الخامس العلمي في مادة الكيمياء

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ملخص:

يهدف البحث التعرف أثر التعلم السياقي في التفكير العلمي لطلبة الصف الخامس الاحيائي في مادة الكيمياء، ولتحقق من الهدف وضع الباحث الفرضية الصفرية التي تنص : لا يوجد فرق ذو دلالة إحصائية عند مستوى الدلالة (0.05) بين متوسط درجات طلاب المجموعة التجريبية الذين سيدرسون وفق التعلم السياقي ومتوسط درجات طلاب المجموعة الضابطة الذين سيدرسون وفق الطريقة الاعتيادية في اختبار التفكير العلمي, ولكي يتحقق منها طبق تجربتهِ في الفصل الدراسي الاول من العام الدراسي (2022 – 2023)، إذ تكونت عينة البحث من (60) طالباً من طلاب الصف الخامس العلمي في اعدادية النصر للبنين ، وتم توزيعهم بصورة عشوائية الى مجموعتين بواقع (30) طالباً في كل مجموعة ، وقد كوفئت المجموعتين في المتغيرات الآتية : العمر الزمني , اختبار التفكير العلمي, درجة الكورس الثاني من العام الدراسي السابق في مادة الكيمياء ، و اختبار المعلومات السابقة ، وفي ضوء الأهمية النسبية للمحتوى والاغراض السلوكية ، تم الاعتماد على اختبار التفكير العلمي المعد من قبل الباحث، بعد عرضه على مجموعة من الخبراء والمختصين وقد تحقق الباحث من خصائص الاختبار السايكومترية للاختبار، استمر تطبيق التجربة حتى نهاية الفصل الدراسي الاول، وفي نهاية التجربة طبق الاختبار على المجموعتين ، بعد ذلك حللت النتائج وأظهرت تفوق طلاب المجموعة التجريبية الذين درسوا على وفق التعلم السياقي على المجموعة الضابطة الذين درسوا بالطريقة الاعتيادية في متغير التفكير العلمي.

الكلمات المفتاحية: التعلم السياقي، طلاب الصف الخامس العلمي، التفكير العلمي