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The Effectiveness of the controversial experimental approach in chemistry achievement and the nature of scientific knowledge for fifth scientific grade students

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Abstract

The aim of the research is to know the effectiveness of the experimental dialectical approach in the level of academic achievement in the subject of chemistry and the nature of scientific knowledge of fifth-grade students in a scientific manner. In order to achieve these goals, the researcher applied the experimental approach with the two equal independent groups. The number of its members reached (70) students, who were divided into two groups, one of which was a number of (35) studied in the usual way, and a pilot group of (35) studied using the experimental dialectical approach, parity was carried out between the two groups of research in the variables) Keep in chemistry, the nature of scientific knowledge), and to apply the research experience, the research tools are designed and are the achievement test, and a questionnaire (scale) the nature of scientific knowledge (prepared by the researcher) and after verification of the stability and validity of the tools and their arbitration by experts and arbitrators specialized in chemistry science and methods Teaching chemistry, the experiment was applied in the second semester of the academic year 2018-2019, as the two experimental research groups were taught according to the experimental dialectical approach and the control group according to the usual method. One of the research tools was applied before and after, and to test the validity of the assumptions, data was collected, and then statistically analyzed using the appropriate statistical means, and the research reached several results, most notably: 1- The effectiveness of the experimental dialectical approach in raising the level of achievement of the chemistry subject for fifth-grade students.

2- The effectiveness of the experimental dialectical approach in developing and improving the students 'understanding of the nature of scientific knowledge, and in light of the research results, the researcher recommended several recommendations, including: Applying the experimental dialectical approach to teaching chemistry because of its clear impact on acquiring chemical concepts and developing the skills of laboratory experiments associated with it.

Key words: Experimental dialectical approach, academic achievement, the nature of scientific knowledge.

La Efectividad Del Controvertido Enfoque Experimental En El Logro De La Química Y La Naturaleza Del Conocimiento Científico Para Estudiantes De Quinto Grado Científico

Resumen
El objetivo de la investigación es conocer la efectividad del enfoque dialéctico experimental en el nivel de rendimiento académico en el tema de la química y la naturaleza del conocimiento científico de los estudiantes de quinto grado de manera científica. Para lograr estos objetivos, el investigador aplicó el enfoque experimental con los dos grupos independientes iguales. El número de sus miembros llegó a (70) estudiantes, que se dividieron en dos grupos, uno de los cuales estudió (35) de la manera habitual, y un grupo piloto de (35) estudió utilizando el enfoque dialéctico experimental, paridad se llevó a cabo entre los dos grupos de investigación en las variables) Mantener en química, la naturaleza del conocimiento científico), y para aplicar la experiencia de investigación, las herramientas de investigación están diseñadas y son la prueba de rendimiento, y un cuestionario (escala) la naturaleza de conocimiento científico (preparado por el investigador) y después de la verificación de la estabilidad y validez de las herramientas y su arbitraje por expertos y árbitros especializados en ciencia y métodos de la química Enseñanza de la química, el experimento se aplicó en el segundo semestre del año académico 2018- 2019, ya que los dos grupos de investigación experimental fueron enseñados de acuerdo con el enfoque dialéctico experimental y el grupo de control de acuerdo con el método habitual. Se aplicó una de las herramientas de investigación antes y después, y para probar la validez de los supuestos, se recopilaron datos

y luego se analizaron estadísticamente utilizando los medios estadísticos apropiados, y la investigación alcanzó varios resultados, en particular:
1- La efectividad del enfoque dialéctico experimental para elevar el nivel de logro de la asignatura de química para estudiantes de quinto grado.
2- La efectividad del enfoque dialéctico experimental en el desarrollo y la mejora de la comprensión de los estudiantes sobre la naturaleza del conocimiento científico, y a la luz de los resultados de la investigación, el investigador recomendó varias recomendaciones, que incluyen: Aplicar el enfoque dialéctico experimental a la enseñanza de la química debido a Su claro impacto en la adquisición de conceptos químicos y el desarrollo de las habilidades de los experimentos de laboratorio asociados.
Palabras clave:
Enfoque dialéctico experimental - logro académico - la naturaleza del conocimiento científico.

Chemistry science is considered one of the most important sciences known to mankind, as its learning and its application contribute to the production of the most important chemicals that are included in many products and industries, and then teaching and learning this material and focusing on developing its teaching methods and its application represents the development of society as a whole, and chemistry science needs methods and strategies Distinctive for delivering students in the desired way and establishing them in a sound and professional scientific manner, especially in the preparatory stage where they are considered qualifications for students to enter in university majors (chemical, scientific, and medical) that need scientific knowledge (science and skill) in chemistry.

One of the problems of the current research lies in the low level of academic achievement of students in scientific subjects, especially in chemistry, as many studies have proven this, including studies (Al-Ahmad, 2000) (Al-Absi, 2001), (Hani, 2013), and students also need to build knowledge Scientific and clear and deep in the context of the content of chemistry courses, and the researcher reached this through her work and experience in teaching chemistry, as many relevant studies have proven, including the study (Al-Jasmi, 2014) and Al-Zoubi (2016), and the researcher also sees the students' need for strategies Non-traditional teaching raises awareness of the nature of scientific knowledge and imparts learning of a subject Chemistry is just an attempt to communicate chemical information from formulas, compounds, chemical elements and concepts in a way that

makes the student receptive only so it is soon to forget that by simply moving to a new lesson or perhaps after the end of his school day to a real interaction that involves questions and discussions and the exchange of ideas and opinions at the same time as performing laboratory experiments Which helps to link between theoretical information and practical reality, concepts, equations ... and others are established in the minds of students, and this can be achieved in the experimental dialectical approach.
Accordingly, the research problem stems from his endeavor to answer the following question:
- What is the effectiveness of the experimental dialectical approach in obtaining chemistry and the nature of scientific knowledge among fifth-grade students?
research importance :
The importance of the research is due to the following:
First: theoretical importance:
1- The research presents a literary review of the experimental dialectical approach, and as such it contributes to enriching the literature of the educational field, where we note a clear decrease in the use of this approach in teaching, especially in scientific subjects.
2- The research deals with the effectiveness of the entry on two dependent variables, namely attainment, and the nature of scientific knowledge (a variable that is not much addressed in Arab and local research despite our need to know the nature of the acquired scientific knowledge) among our students.
3- The importance of the research also lies in the fact that it is the first research of its kind (according to the researcher's knowledge) that examines the effect of the experimental dialectical approach on achievement and the nature of scientific knowledge.
Second: The Applied Importance of Research:
1- The applied significance of the research is due to the fact that it applies teaching using the experimental dialectical approach in teaching chemistry and thus has a scientific lead in this matter
2- The applied side of the research explores the nature of scientific knowledge that fifth-grade students gain during their learning of chemistry.
3- Research tools for application may be used in future research related to the same variables
4- The research draws the attention of educators, curriculum specialists, teaching methods and science teachers to the importance of the experimental dialectical approach in teaching scientific subjects.

5- The teacher's guide presented within the research and which includes teaching plans designed in the light of the experimental dialectical approach, is a guide for chemistry teachers to apply this entrance to other topics.

research aims :

The research seeks to achieve the following goals:

• Knowing what are both the independent variable (experimental dialectical approach) and the two dependent variables (achievement - the nature of scientific knowledge).

• Knowing the effectiveness of the experimental dialectical approach in achieving the chemistry subject for fifth-grade students.

• Knowing the effectiveness of the experimental dialectical approach in the nature of scientific knowledge for fifth-grade students.

research assumes :

To verify the research objectives, the following hypotheses have been developed:

- There is no statistically significant difference at the level of significance (0.05) between the average scores of female students of the experimental group that were studied according to the experimental dialectical approach and the average score of female students of the control group that studied according to the usual method in the academic achievement test in chemistry.

- There is no statistically significant difference at the level of significance (0.05) between the average scores of female students of the experimental group that were studied according to the experimental dialectical approach and the average score of female students of the control group that were studied according to the usual method in the scale of the nature of scientific knowledge.

search limits :

The objective limits: The research deals with the variables: the experimental dialectical approach (independent variable), academic achievement in the chemistry subject (dependent variable), and the nature of scientific knowledge (dependent variable).

Time limits: The research was applied in the academic year 2018-2019 (second semester)

Spatial limits: The research was applied in one of the morning high schools affiliated to the General Directorate of Education for the Second Karkh /

Baghdad Governorate.
Human frontiers: The research was applied to a sample of fifth-grade students in the Shatt Al-Arab Secondary School for Girls.
Identify the most important search terms:
Introduction to teaching: Both (Shehata and Zeinab, 2003, 261) define it as a group of postulates or assumptions and assumptions that are recognized as valid among the specialists in teaching, which are related to each other by close relationships, some of which are related to the nature of the material learned, and some are related to the teaching / learning processes, The teaching entrance is more general than the method, as it contains more than one method that all of them link together a set of foundations, concepts and principles, even though these methods are combined with one approach.
It is procedurally defined in this research as "a set of methods, strategies and activities based on one basis which is the use of controversy and discussions in addition to practical experiences."
Experimental Controversial Entry:
the controversial experimental approach
It is one of the recent teaching approaches that relies on the use of debate based on dialogue and discussion, and the use of learning-based experimentation with meaningful discovery (Khalil, 2009, 77)
Jad Al-Haq (2017) defines him as "the actions of the student's mind through the Socratic dialogue and the realization of the hand through various laboratory activities, to form direct experiences to collect evidence and arrive at the various facts and information to be learned, and to provide an opportunity for him to express his ideas and information that he reached and defend using the evidence The theory and process that clarify his point of view in a collaborative way between him and his colleagues (Jad Al-Haqq, 2017, 60)
It is procedurally defined in this research as "an approach that relies on encouraging female students to participate in dialectical discussions through mutual dialogue through which they express their thoughts and concepts and also learn about the ideas of others, while engaging these students in practical activities and experiences that help them to access scientific information in a realistic and realistic manner." At the same time as the discussions. "
Academic achievement :
Al-Hersh (2005) defines him as the set of concepts, knowledge, and terms that the student learns (acquires) for his passage of experience through the teaching process, and achievement is measured by the student's score

obtained in the achievement test (Al-Hersh, 2005, 22).
Allam 2006 defines him as "the degree or level of success achieved by the student in a general or specialized field of study as it represents the acquisition of knowledge and skills and the ability to use them in current or future situations and is the ultimate outcome of learning (Allam, 2006, 123)
It is procedurally defined as "the amount of female students' knowledge (scientific concepts, principles and laws) and skills (mental, performance, and social) in chemistry for the fifth academic year during their learning period by applying the proposed teaching entrance and measured by the achievement test prepared for this purpose."
The nature of scientific knowledge:
Both Danny and Moussaoui (2016) define her as "knowledge based on knowledge in collecting her data".
Al-Najdi and others define it 2003 as "the product of human activity, from facts, concepts, laws, principles, rules, generalizations, and theories, and from what accumulates daily new knowledge product." (Najdi et al., 2003, 38)
Meichtry 1999 defines her as "the product of the human processes of science and their social contexts" (Meichtry, 1999,281)
It is procedurally defined as: the scientific knowledge acquired by female students in the subject matter of chemistry, represented by theoretical information and practical skills during the teaching period, according to the experimental dialectical approach, and is measured by the degree they obtain in the scale of the nature of scientific knowledge.
Theoretical framework :
First: the experimental dialectical approach:
The experimental dialectical approach is one of the modern approaches to teaching science, which is concerned with the involvement of students in effective activities to provide them with skills and good practices for various methods of thinking (Khalil, 2009, 76)
The dialectical approach is generally defined by the dictionary (Enclopodia 2012). It is an educational philosophy that differs from the traditional system of teaching where teaching takes the form of problem solving and hypothesis testing (Encyclopedia, 2002).
Walker and Zeidler, 2007, pointed out that there must be an overlap between participation that means learning science and the discussions of this science, which is called the challenge of science and accordingly emerged the experimental dialectical approach that combines the debate about scientific ideas to be acquired and scientific experiments and activities.

The experimental dialectical approach depends on the combination of the dialectical method that depends on the debate based on dialogue and discussion and which encourages students to express their opinions and observations, and the practical method that relies on carrying out practical experiments with a view to obtaining knowledge or solving the problem (Othman, 2008, 29)

Characteristics of the experimental dialectical entry:

The experimental dialectical approach focuses on active experiences with simple real experiences and facilitates the interactive participation of students in the scientific context. Teaching is designed according to this entrance to enhance students' building of concepts through:

(1) Conceptual conflict, (2) constructive engagement, (3) verbal, written, synthetic, and mathematical analysis of experiments, (4) repeated exposing students to experiments to increase their level of knowledge (5) peer discussions, (6) philosophical dialogue with the teacher (Hake, 1992, 3)

Among the advantages of this entrance is that:

(A) Suitable for a large educational environment

(B) It is well accepted by students

(C) Easy to adjust to suit local communities

(D) Not expensive due to the presence of laboratory tools and facilities

(C) It can be combined with other teaching methods that involve effective activities, or with regular methods

(H) It gives a lot of fun to both the student and the teacher (Steph, 1991, 61)

Teaching using the experimental dialectical approach requires some conditions, including:

(1) An educational environment that involves discussion and dialogue

(2) A set of questions that measure students' understanding of different scientific concepts

(3) A teacher with the ability to conduct and conduct dialectical dialogue

(4) A laboratory for experiments

(5) Instruct teachers how to teach using this curriculum (Hake, 2002, 3).

Steps to implement teaching based on the experimental dialectical approach:

The application of the experimental dialectical approach to teaching involves several steps that combine discussion and controversy with experiment and laboratory practical procedures. Hake 1998 identified the following:

The first stage: the stage of setting goals and concepts, and it includes:

Create a dialectical dialogue that includes dialogue, questions and discussion

- Setting goals

Defining concepts

Asking questions designed to:

• Learn about students 'ability to predict some results through practical experience

• Ensure that students understand the steps to conduct experiments.

The second phase :

Plan and prepare for the experiment, define procedures and implement them, and include:

Divide students into various small groups.

- Using reports and making an outline of the experiment and writing the factors that affect the experiment.
- Writing notes, results, and scientific explanation of the results reached, then reaching the conclusion
- To reach ideas and results through conducting the experiment

The third stage: questions and evaluation of experiments, which is the preparation of a set of questions with a goal

- Knowing the achievements of students in experimental groups
- Knowing the steps followed by each group in performing the experiments.

Learn about the interpretations, results and conclusions reached.

Identify the difficulties and concepts that are still not clear to students.

- Help the teacher to know and define the steps of the dialectical dialogue in the next stage

The fourth stage: the dialectical dialogue:

In this stage, dialectical dialogue is also used to help students understand and learn concepts that they were unable to comprehend during the second stage. The third stage is an indicator for this stage, in addition to helping the teacher to know the steps that must be followed to ensure the students' understanding of the concepts.

Fifth stage: evaluation of the final results, which includes:

- A short review of what has been followed in the experimental groups

Preparing a test that addresses the concepts covered in the experiments and dialogue

- Discussion and questions that are necessary to prepare for learning new concepts in the following lessons (Khalil, 2009, 91: 93)

The teacher's role in teaching the experimental dialectical approach:
The teacher's role in teaching the experimental dialectical approach in defining the goals and choosing ways to achieve those goals, preparing the classroom stimulating environment for students, using various resources, dividing students into small cooperative groups, planning to conduct experiments accompanying the topic, formulating dialectical questions, asking and discussing them, can be summarized for students during their formation By experimenting, managing and participating in dialectical dialogue, organizing scientific concepts and linking them to an appropriate educational situation (Wattanakasiwich, 2010, 502) (Hake, 2012,6)
The student's role in the experimental dialectical entrance:
The student has an active role in the context of teaching at this entrance, as he becomes a participant in the educational process. His role can be summarized in:
Discussing and arguing, setting hypotheses, submitting his personal statements as it is said or leading, carrying out experiments and laboratory activities accurately to reach the desired results, analyzing the data reached, cooperating with his colleagues within the group, discussing ideas neutrally without tyranny of opinion (Abdel-Haq, 2017, 69 (Othman, 2008, 51)
The importance of the experimental dialectical approach in teaching chemistry:

Teaching chemistry needs an approach that combines the theoretical and practical side of it at the same time, where educators see that learning based on experience is the best way to gain and retain information, and that discussion, controversy, and exchange of questions and answers during experiments help to enhance learning and raise achievement in The student, and since the experimental dialectical approach combines learning through discussion and dialogue (argument) and learning by experiment and discovery (experimentation) it was evident that it would be an appropriate entry point for teaching chemistry.
Some scholars have also noted the importance of the experimental dialectical approach in teaching science in general. Nawal Khalil 2009 sees that the use of the experimental dialectical approach is of great importance in teaching science, as it is based on learning through the use of controversy and the conduct of experiments and activities based on discussion and dialogue, and thus it helps to Students participate in group activities that help them to self-orientate in learning, thinking and researching what they learn, and thus the student becomes the focus of the educational process, as he is an active participant in it, while the teacher is a mentor, guide and

facilitator for learning (Nawal Khalil, 2009, 23)
As for Hake, the pioneer in implementing this approach, he believes that its importance is due to the fact that it encourages students to participate in constructive discussions, in which students adopt the idea of teamwork to reach sound conclusions and solutions to scientific problems (Hake, 1998, 66)

The effectiveness of teaching in the experimental dialectical approach:
Numerous studies have proven the effectiveness of the experimental dialectical approach in teaching sciences with its branches, and in a study by Hake 1992 the experimental dialectical approach has proven its effectiveness in teaching sciences (physics) the researcher attributed this to several factors, most notably:
(1) Interactive participation of students who are motivated by structural thinking about experiences, which results in conflict with their previous concepts
(2) The Socratic (philosophical) method used by expert teachers who have a good understanding of the material and are aware of previous concepts and the mistakes and mistakes common among students.
(3) Attention to the interaction between the student and the teacher, and therefore there is a degree of individual teaching
(4) Employ real situations that enhance students' interests and increase knowledge conflict when they face experiences that are directly different from their concepts.
(5) Students work in cooperative groups with discussion among their classmates (Hake, 1992, 14).
Academic achievement :
The achievement in the subject of chemistry is the most important goal of learning that subject, as the amount of acquisitions of knowledge, skills and chemical information is closely related to reality, due to the overlapping of this science in various aspects of life. It is considered that raising the level of student achievement in the subject of chemistry requires many procedures represented in creating educational situations and using methods Teaching through which they do their part, and make the classroom environment exciting to think, in order to contribute to their deeper understanding of scientific content (Al-Shehri and Mehrez, 2017, 5). The researcher sees through her experience in chemistry teaching that there is a decrease in the level of student achievement in the subject and that they need new methods that support their retention of chemical concepts, for-

mulas and symbols and what is included in the course, and from here and after proving the positive effect of the experimental dialectical approach through reviewing previous studies, the researcher found the importance of an effective study using This approach is to raise and improve achievement in the chemistry subject.

Nature of scientific knowledge NSK:
The nature of scientific knowledge means the total beliefs held by the student about the nature of scientific knowledge and the nature of scientific processes by which it acquires and develops and these beliefs provide the student with criteria to judge the validity of scientific claims (Najdi, 2008, 26). Scientific knowledge is considered an end to the path of science and is the component resulting from dependence on its foundations His theories and laws in the sense that scientific knowledge stems from science and is its target (Meichtry 1999,69)
The researcher believes that in order to get acquainted with the nature of scientific knowledge, it is necessary to indicate its characteristics and what distinguishes it from the characteristics.
Characteristics of the nature of scientific knowledge:
The characteristics of the nature of scientific knowledge were discussed in many of the literature, and pioneers of educators specializing in science took care of them, so we find Showlater 1974 has used several terms to express the characteristics of the nature of scientific knowledge including: infinite - human - comprehensive - general - applicable - potential - historical - Unique - Applied (Showlter, 1974, 5)
While we find the two scientists known to study the nature of scientific knowledge and set the most prevalent metrics for it, Rubba & Andreson, they developed a model for the nature of scientific knowledge that illustrates six factors that determine the characteristics of scientific knowledge and are:
• Creative scientific knowledge: (Scientific knowledge is part of a person's creative production)
Scientific knowledge has nothing to do with ethics: it cannot be judged as good or bad
• Scientific knowledge is evolutionary: it is infinite and always evolves
• Scientific knowledge is codified: refers to attempts to simplify scientific explanations rather than their complexities
Testable: Scientific knowledge can be measured through practical tests
Comprehensive: scientific knowledge is an interconnected network of

laws, theories, and concepts (Rubba & Andrson, 1978).

As for Arab researchers, we find from the literature that they have discussed the nature of scientific knowledge in terms of philosophical aspects more than educational, for example (Al-Abed 2010) believes that the most important characteristics of scientific knowledge come from that knowledge that is based on evidence, and thus knowledge becomes unscientific if it does not It has evidence, and thus scientific knowledge becomes the one that guides the spirit of science, traces the effect of its method and relies on its foundations, relies on its sayings and meets its criteria (Al-Abed, 2010, 201)

While Naseer Al-Jubouri sees 2017 the most important characteristics of scientific knowledge as:

It is of a moral nature: that is, it is a tangible object that is thoughtful

Not enforceable: that is, they do not go away, and therefore when the individual acquires them they become inherent and cannot be removed from them

Tradable: in two domains circulated between people and traded over time from one generation to the next (Jubouri, 2017, 4-7)

The researcher believes that the nature of the scientific knowledge intended in the current research related to the study of chemistry is distinguished as:

- Applicable and practical experience

It can be transformed from merely ideas of a moral nature to visual information and ideas, such as changing the material from one color to another

It is related to the above information and is based on it.

It is subject to increase, as the student's daily receiving of lessons entails a clear increase in his scientific knowledge

Linked to student creativity, intellectual and experiential production

- Measurable through measurements, questionnaires and others

Measuring the nature of scientific knowledge:

Measuring the nature of scientific knowledge or, more precisely, measuring students 'understanding of scientific knowledge and its characteristics is an extension of the measures of the nature of science, as science is the basis of knowledge. The intention and we can differentiate between them by referring to the theory of scientific knowledge in the philosophy of science and the epistemology, but for the most common measure used to date in educational studies is the Rubba & Anderson 1976 scale, called the nature of scientific knowledge scale (NSKS) dge scale

We have indicated the six characteristics previously measured by the scale.

Then the two worlds led by Lederman & Meichtry 1990 and developed the scale, which became called the Modified Nature of Scientific Knowledge Scale (MNSKA).

This scale measures 4 major areas for students about the nature of scientific knowledge before and after the semester: development of scientific knowledge - testability - creativity - the unified nature of science (Meichtry, 1992, 395)

Researchers in Arab studies have sought to refer to these standards and adapt them for application in educational research.

As for the use of the experimental dialectical approach to develop students' understanding of the nature of scientific knowledge, we find that the use of experience develops scientific knowledge as Bacon sees one of the pioneers of the principle of applied in learning that scientific knowledge begins with a sensory experience that works by accurate observations and scientific experiments to enrich it (Hamayda, 2013, 6) This is in addition to the importance of controversy, discussion and asking questions in establishing the correct information while performing practical practical activities. This is confirmed by Lederman 2007 that scientific knowledge is influenced by the socio-cultural context.

Based on the foregoing, the role of the experimental dialectical approach in developing students' understanding of the nature of scientific knowledge and its characteristics is evident, especially because in the light of this entrance they express thoughts about their thoughts that may be wrong or correct at the same time as conducting the relevant activities, which results in an awareness of the characteristics of the above-mentioned scientific knowledge.

Previous studies :

First: Studies dealing with the experimental dialectical approach:

1- Hake 2012 study

Hake is the founder of the experimental dialectical entrance and has carried out several studies from 1992 until now, and we offer him a study aimed at using the experimental dialectical entrance in raising student achievement in acquiring scientific concepts. To conduct experiments, a number of students turn around with them and the teacher with them to combine discussion and experience, and topics such as speed, movement and others have been chosen. The experiment has proven that teaching scientific subjects through a combination of controversy and experience (experimental dialectical approach) is an effective way to gain scientific concepts and make students Y Crohn's scientific thinking, where students

of the experimental group grades increased by more than 0.6 after the application of teaching Uday entrance Dialectical demo.

2- Shafei Study (2015)

The study aimed to:

Learn about the effectiveness of teaching physics by using the experimental dialectical approach in developing obstetric thinking skills and the scientific sense of first secondary school students. The research followed the descriptive analytical approach and the semi-experimental approach. The sample consisted of 150 first-grade secondary students who were chosen randomly. The results of the research resulted in the effectiveness of teaching physics using the experimental dialectical approach in developing obstetric thinking skills and the scientific sense of first-grade secondary students.

3- Abdo Study (2017)

Research objective:

Determine the most important biological concepts that can be developed for first-year students

Identify the most important bio-ethical issues that can be raised among students of the first secondary class

The efficacy of the experimental dialectical approach is defined in developing some biological concepts for first year secondary school students

Research Methodology :

A sample of first-year students from Maadi Secondary School for Girls, affiliated to Maadi Educational Administration, consisted of (70) students, randomly selected, and the results of the research showed:

1- There are statistically significant differences between the mean scores of students of the experimental group (taught using the experimental dialectical approach) and the control group students (taught in the usual way) in the post-application to test biological concepts in favor of the experimental group

2- There are statistically significant differences between the mean scores of female students of the experimental group (which are studied using the experimental dialectical approach) in the pre and post applications to test biological concepts in favor of the post test.

Second: Studies dealing with the nature of scientific knowledge

Al-Waher and Hind Study (2007)

This study aimed to clarify the image of scientific knowledge among students in Jordan and the evolution of this image with the progress of stu-

dents at the academic level, in terms of areas of scientific knowledge and its goals and its ability to solve problems and their representation of reality and their health standards, and their ability to change, alter and develop. The study sample consisted of 592 male and female students from the seventh and nine basic grades, the first literary first, and the first secondary scientific, as well as the first year and the third academic year, and a questionnaire consisting of seven open questions about scientific knowledge was used, after verifying the criteria of honesty and consistency necessary for it.

The results indicated that the students are divided into three groups that include the first students of the seventh and ninth basic grades, and they are characterized by being technologists, and the third group includes the first and third year university students, and they are interpretive, and some of them carry constructive ideas, but it seems that logical positivistic ideas are more common to them . As for the students of the second group, which includes the first secondary scientific and literary grades, they are an intermediate between these two groups, as they are both technologists and interpreters, and they believe in the accumulation of scientific knowledge, and its ability to change and exchange.

The Najdi Study (2008), which aimed to investigate the effect of teaching chemistry based on modeling on the eleventh grade students 'understanding of chemical concepts, the nature of scientific knowledge, and on creative thinking skills to achieve the goal of the study. The material was prepared to fit a strategy based on modeling. A test was designed to measure the understanding of chemical concepts , And the scale of creative thinking, and a questionnaire consisting of open-ended questions to measure students' cognitive beliefs about the nature of scientific knowledge, and the study was applied to eleventh grade students in two high schools, one for females (50 students), and another for males (54 students) in the capital At Division and allocated Alhobeitin to be an experimental group, and the other control group, the experimental group and studied chemistry according oriented-based modeling, while the control group studied chemistry in the usual way. The study demonstrated that there are statistically significant differences in students' understanding of chemical concepts and the nature of scientific knowledge.

Comment on previous studies:

• All studies related to the experimental dialectical approach unanimously agreed on its effectiveness in teaching and learning scientific subjects and

in acquiring scientific concepts and thus improving students' educational attainment

• These studies also unanimously agreed that combining discussions and questions (controversy) with experimentation and practical activities is of great benefit in developing scientific skills and learning science

• Some studies have proven the effectiveness of the experimental dialectical approach in developing scientific investigation skills and higher thinking skills.

• Studies related to the nature of scientific knowledge have demonstrated the need for students to understand the nature of scientific knowledge and determine its characteristics

• Some studies have demonstrated the possibility of developing an understanding of the nature of scientific knowledge using appropriate teaching approaches and strategies

• All studies followed the experimental or quasi-experimental method (relying on two independent groups, one experimental and the other control)

• The current research benefited from previous studies in preparing research tools

Preparation of research requirements:

For the purpose of answering the research questions and to verify its hypotheses, the following steps were taken:

First: Defining the topic of the research, where the researcher chose the four chapters, as follows: (Chapter Five: Chemical Movements, Chapter Six: Acids, Bases and Salts, Chapter Seven: Polymers, Chapter Eight: Aromatic Hydrocarbons) determined in the chemistry curriculum for the fifth academic year of the second semester For the year 2018

- 2019 m.

Second: Preparing the teacher's booklet: The researcher prepared a booklet for the teacher that works as a guideline in teaching the proposed classes using the experimental dialectical approach, where the guide aims to explain how chemistry teacher uses the experimental dialectical approach to raise and improve achievement and learn about the nature of scientific knowledge of his students.

The booklet has been prepared by reviewing the literature and studies related to the experimental dialectical approach, especially in teaching science, which has been applied in foreign studies more than Arabic. The guide includes:

Introduction, the aim of the guide - the philosophy on which the guide is based - introducing the principles and stages of implementing the exper-

imental dialectical approach - distributing lessons according to the topics of the chosen classes - general objectives of the prescribed classes - instructions for the steps of teaching subjects by following the steps of the experimental dialectical approach.

The evidence was presented to a group of arbitrators specializing in the methods and methods of teaching chemistry to verify:

Appropriateness and validity of objectives - Appropriateness of methods and steps used in teaching with the principles and stages of the experimental dialectical approach, appropriate experiences and activities with the course and with the age and stage of study of students, choosing appropriate evaluation methods.

The teacher's booklet has been modified according to the opinions of the arbitrators, and then reaching the final image proposed in the research that was applied to the research sample

Third: Preparing the research application tools, which are:

1- Academic achievement in chemistry.

2- A questionnaire (scale) of the nature of scientific knowledge.

To prepare these tools, the researcher followed the following:

1- Academic Achievement Test in Chemistry:

After reviewing the previous studies related to the subject of this research and especially that included the tests as a tool for them, the researcher prepared the achievement test to measure the students 'achievement of the concepts and scientific chemical skills mentioned in the last four semesters of the textbook of chemistry for the fifth grade scientific, and I used the level of the study to measure Pilot and control) to be a post-test. To build the test and verify its validity and reliability, the following steps were taken:

A- Determining the goal of the test: The test aims to measure the achievement of fifth-grade students in the last four semesters of chemistry

B- Refer to the scheduled textbook and teacher's guide, and extract the main and sub-concepts, in which the general and specific goals are achieved.

C- Determining the behavioral goals of the test and it was determined according to Bloom's classification to (knowledge - assimilation - application - analysis - composition)

W - Preparing the specifications table and determining the relative weights based on the number of goals specified in the decision.

C- - Establishing a list of the concepts and skills taught by students in chemistry for the last four semesters of the textbook.

H- The test items were formulated to cover all concepts, skills and princi-

ples contained in the content of the subject matter of the experiment
X- The researcher considered the appropriate formulation of the paragraphs for the female age group, and the clarity and soundness of the Arabic and scientific language of these paragraphs.
D- The researcher put some necessary instructions for the students to follow before the start of the test, such as: the specified time period - the method of answering
The test correction key:
The researcher took into account the diversity of the test items to cover the Bloom classification, as mentioned above, so that the questions that measure knowledge achieve 31% of the test, absorption questions 28%, application 22%, 12% analysis, 7% of the composition questions, and the test may be from 40 paragraphs that give the answer Correct one degree.

• Validity of the test:
The test was initially presented to a number of arbitrators, experts, and specialists in measurement and evaluation, and in methods of teaching chemistry to verify the implications of the apparent truth of the test, and based on these opinions the test was prepared in its final form.
• Exploratory experience for the achievement test:
The test was applied in its initial form to a group of female students consisting of (90) female students from secondary school
A portal for girls from the fifth grade students, with the aim of:
1- Determine the time period for the test: the average score for the student's response time was calculated until the last student who completed the test, and it became clear that the appropriate period for it is "45" minutes
2- The difficulty factor was calculated for the test items, which ranged between (0.41 - 0.66), and
Also the coefficient of discrimination
(0.23 - 0.58) In addition to the effectiveness of the wrong alternatives to the paragraphs, which were represented by their negative values. Thus, the test items are acceptable.
Stability test:
In order to calculate the stability of the test, the Alpha Cronbach equation was used to suit its current test, and the value of its coefficient was (0.86) which is acceptable stability, since the ratio that indicates stability is estimated at (0.80) or more (Allam, 2000,543)
2- Identification (scale) of the nature of scientific knowledge:
The researcher reviewed the studies and literature related to scientific

knowledge, its characteristics and special fields which students are expected to have acquired while learning.

Many studies indicate that there are many tests, metrics and tools to know the extent of students' understanding of the nature of scientific knowledge, including the nature of scientific knowledge survey prepared by both Rubba & Andreson and the scale of the nature of scientific knowledge for Meichtry 1990, and the researcher relied on these studies along with Two Arab studies are; the study of Mahmoud Al-Wahr and Hind Al-Hamouri 2007 and the study of Najdi 2008 and then the researcher came out with a questionnaire to measure the students 'understanding of the nature of scientific knowledge, which consists of six main questions that measure the following:

How to obtain knowledge - the characteristics of scientific knowledge in the sense of how to distinguish students between scientific knowledge and others - change of scientific knowledge (meaning does scientific knowledge change by other factors such as the passage of time for example) - the difference of scientists in the development of scientific knowledge (in the sense of the difference of scientists' views on a specific scientific information) The extent of the creativity of scientific knowledge - the truth of scientific knowledge (i.e. is it reality or assumptions)?

Tool stability:

To verify the consistency of the questionnaire of measuring the nature of scientific knowledge of fifth-grade students, the researcher applied it to an exploratory sample from outside the study sample consisting of (30) students of the same age group and school stage and with the same educational administration in Labaaba Girls 'Secondary, then the researcher re-applied it again after the passage of Two weeks, the students 'answers found 95% matching their first answers, which confirms the stability of the tool.

Resolution correction:

For the purpose of correcting the questionnaire, the researcher classified the students 'answers into two categories I agree - I do not agree that the answers (I agree) agree with the correct answer that reflects the nature of the six scientific knowledge mentioned above, and choosing I do not agree means students' lack of understanding of the nature of scientific knowledge, and then iterations have been calculated And the proportions of sound answers (choose I agree) and thus know the semantic differences between the experimental group and the control on a questionnaire (scale) the nature of scientific knowledge.

. Third: Research Application:
Selection of the experimental design: The semi-experimental design with partial control was used for two equal groups, which are (experimental and control) with post-test and appropriate for the purposes of research, whereby the experimental dialectical input represents the independent variable in the applied study of research, while representing both the achievement in chemistry and the nature of scientific knowledge The following two variables and diagram illustrate the design of the research:

Method for measuring the dependent variable	Dependent variable	**Independent variable**	Equivalence of the two groups	**set**
Academic achievement test in chemistry	Academic achievement in chemistry	**Teaching using the experimental dialectical approach**	Chronological age in months Previous information in chemistry	**test**
A measure of the nature of scientific knowledge	**The nature of scientific knowledge**		The nature of scientific knowledge	
		Normal way		**Control**

(Research semi-experimental design scheme)

research community:. Fifth-grade students in the Shatt Al-Arab Secondary School for Girls, for the second semester of the academic year 2018-2019.

The research sample: The research sample was chosen intentionally, and through the lottery, the Division (A) was chosen to represent the experimental group that will be taught according to the experimental dialectical entrance as the number of its students reached (35) students and Division B to represent the control group which will be taught in the usual way as the number reached Her students are (35) female students .... Female students who had failed were excluded from the two groups.
Experiment application:
The experiment was applied in the second semester of the academic year (2018-2019) by following the following steps:

1- Selecting the research sample and distributing it to the experimental and control groups.
2 - Verify the equivalence of the two groups (experimental - control): This was done through comparison with the following variables: chronological age in months, previous information in chemistry, and the nature of scientific knowledge. Where the difference between the mean of the two groups in the chronological age was calculated in months, using the (T) test for two independent groups and the following table shows that data:
Table of statistical significance for the difference between the mean of the experimental and control groups in the age of months in months

Significance level	Value t	Degree of free	standard deviation	SMA	No.	the group
No function	0.463	68	3.251	193.84	35	Experimental
			3.362	194.07	35	Control

It is clear from the previous table that the value of T is not statistically significant, as its calculated value (0.463) is less than the tabular (1.980) at the level of significance (0.05), which confirms that there are no statistically significant differences between the mean of the experimental group and the control group in the time-life variable in months , Which means the two groups are equal.
The difference between the mean scores of the two groups was calculated in a test of the previous information in chemistry, using the (T) test for two independent groups and the following table shows that data:
Table of statistical significance for the difference between the mean scores of the experimental and control groups in testing previous information in chemistry

Significance level	Value t	Degree of free	standard deviation	SMA	No.	the group
No function	0.103	68	3.75	14.51	35	Experimental
			3.22	14.42	35	Control

It is clear from the previous table that the value of T is not statistically significant, as its calculated value reached (0.103) is less than tabular (1.980) at the level of significance (0.05), which confirms that there are no statistically significant differences between the mean scores of the experimental group and the control group in testing the previous information In chemistry, before applying the research, which means the two groups are equal in this variable.

To ensure the equivalence of the experimental and control groups in relation to the second research tool represented in the questionnaire (scale) of the nature of scientific knowledge, iterations of sound answers were calculated on the six phrases that reflect the characteristics of scientific knowledge and then the calculation of percentages and knowledge if there are differences between the level of understanding the nature of scientific knowledge Between the two research groups and the following table shows that:

Table of repetitions and percentages of the experimental and control groups' responses to a questionnaire or measure of the nature of scientific knowledge (beforehand) for the purpose of equivalence

Test set		Control set		The word	No.
ratio	repeat	ratio	repeat		
%68	24	%65	23	There are resources through which to obtain scientific knowledge	1
%48.5	17	%51.4	18	There are characteristics of scientific knowledge that distinguish them from others	2
%77.1	27	%72	26	Scientific knowledge changes with the influence of factors such as the passage of time	3
%62.8	22	%60	21	Usually scholars disagree about scientific knowledge	4
%48.5	17	%45.7	16	(Different scientific opinions)	5
%54.2	19	%60	21	Access to scientific knowledge is a creative work	6

It is clear from the review of the previous table, the great convergence between the repetition of the answers of the experimental and control groups, which indicates the equality of the two groups in their understanding of the nature of scientific knowledge before applying the research experiment.
Show search results:
First - Results related to the first hypothesis of the research:
The first research hypothesis, which states:
- There is no statistically significant difference at the level of significance (0.05) between the average scores of female students of the experimental group that were studied according to the experimental dialectical approach and the average score of female students of the control group that studied according to the usual method in the academic achievement test in chemistry.
To verify the validity of the previous hypothesis, the researcher calculated the arithmetic averages and standard deviations, and the T value was calculated by using the (T) test for two independent groups, and the following table displays these data:
Table of mathematical averages, standard deviations and T values between the experimental group scores and the control group scores in the academic achievement test in chemistry

Significance level	Value t	standard deviation	SMA	No.	the group
function	**21.42**	**2.40**	**17.6**	**35**	Experimental
		1.51	**38.4**	**35**	Control

Looking at the previous table, we note that the level of significance (statistically significant), which confirms the existence of a statistically significant difference between the mean scores of the experimental group and the control group of the research sample in the achievement test of the chemistry (for the benefit of the experimental group), which means rejecting the first hypothesis, and indicates the effectiveness of teaching Using the experimental dialectical approach to raise the level of academic achievement in chemistry for fifth-grade students
Results related to the second research hypothesis:
The second research hypothesis, which states:
- There is no statistically significant difference at the level of significance

(0.05) between the average scores of female students of the experimental group that were studied according to the experimental dialectical approach and the average score of female students of the control group that were studied according to the usual method in the scale of the nature of scientific knowledge.

To verify the validity of the previous hypothesis, a measure (questionnaire) of the nature of scientific knowledge was applied dimensionally to the two research groups, then grouping the answers and calculating the frequencies and percentages of sound answers that express the level of understanding the characteristics and nature of scientific knowledge and the following table shows this:

Table of iterations and percentages of the experimental and control groups' answers on a scale (questionnaire) the nature of scientific knowledge in dimension

Test set		Control set		The word	No.
ratio	repeat	ratio	repeat		
%85.7	30	%65	23	There are resources through which to obtain scientific knowledge	1
17.42	25	%51.4	18	There are characteristics of scientific knowledge that distinguish them from others	2
%91.42	32	%72	26	Scientific knowledge changes with the influence of factors such as the passage of time	3
%82.8	29	%60	21	Usually scholars disagree about scientific knowledge	4
%71.42	25	%45.7	16	(Different scientific opinions)	5
%85.7	30	%60	21	Access to scientific knowledge is a creative work	6

It is clear from the previous table that the repetitions and percentages of female students 'correct answers in the experimental group who studied according to the experimental dialectical approach that reflects the nature of scientific knowledge have increased significantly compared to their degrees in the tribal application where the proportions of sound answers ranged (71.42% and 91.42%), while Almost no progress has been made in the frequency and proportions of female students of the control group that were studied according to the usual method after dimensional compared to before, that is, there are significant differences between the degrees of the experimental and control groups with respect to the correct answers on the scale (questionnaire) nature of scientific knowledge in favor of the group The experimental class, which means rejecting the second hypothesis, and this indicates the effectiveness of the experimental dialectical approach in raising awareness and understanding among students about the nature of scientific knowledge.

Interpretation of the results:

A- Results related to the first dependent variable (academic achievement in chemistry) :::

The results related to this variable showed that the experimental group that was studied according to the experimental dialectical approach had outperformed the control group that was studied according to the usual method with regard to the first dependent variable of academic achievement in chemistry, which indicates the effectiveness of this entrance in the achievement of chemistry and attributes the researcher This is for the following reasons:

- Previous educational studies, whether foreign or Arab, emphasize the importance of merging debates or discussions, asking questions and answers, and conducting practical laboratory experiments in students' acquisition of scientific concepts and their retention after leaving the laboratory (transmission of learning effect).

The portal works to engage female students in an interactive way in learning, which results in stimulating thinking for them and thus the speed of information acquisition.

- Female students see information in the form of real experiments, which has a clear role in their awareness of chemical issues, especially those that involve equations and activities.
- Designing the teaching plans according to the experimental dialectical approach and its stages leads to cooperation between the teacher and her students and between the student and her colleagues, which makes the stu-

dent a contributing and active element in the educational process, which has an effective effect in increasing achievement in the scientific subject (chemistry for the fifth grade scientific).

B - Results related to the variable of the nature of scientific knowledge :::

The results related to this variable showed that the experimental group that was studied according to the experimental dialectical approach had outperformed the control group that was studied according to the usual method with regard to the second dependent variable (the nature of scientific knowledge), which indicates the effectiveness of this approach in developing students' understanding of the nature of scientific knowledge The researcher attributes this to the following reasons:

- Teaching works by applying the experimental dialectical approach to transferring knowledge, information and ideas from theory to practice, from which students can realize the creativity of scientific knowledge, for example realizing the difference of opinion about scientific information and other nature of scientific knowledge and its characteristics
- Conducting activities and laboratory experiments in a real practical way helps students to know that scientific knowledge is a reality and not assumptions, and that it comes through study, examination and real experimentation.
- Previous studies indicate that the use of thinking with experimentation and discussion is the best way to access sound scientific knowledge and learn about its characteristics.

Conclusions:

In light of the results of the research, several conclusions were reached, including the following:

1- Teaching the experimental dialectical approach has a clear positive effect on the level of achievement in the chemistry subject and understanding the nature of scientific knowledge.

2- That the combination of verbal discussion and practical activities has a great impact in teaching chemistry and other subjects that include topics that need experimentation.

3- There is a clear relationship between the debate and the development of scientific knowledge.

4- The design of chemistry lessons according to the experimental dialectical approach led to the organization of the students' ideas in structured structural contexts and helped them to link between the concepts and topics of the subject matter and their previous information.

5- Teaching, according to the experimental dialectical approach of chem-

istry courses, helps to clarify and simplify that subject for female students, as chemistry is considered a difficult scientific subject for many of them, which results in facilitating the educational process for both (the student and the teacher).

Recommendations:

In light of the previous results, the research recommends the following:

1- Generalizing teaching using the experimental dialectical approach in the subject matter of high school chemistry, especially middle school (Fifth Scientific Grade) because of its positive impact on student achievement in that subject.

2- The necessity of applying modern teaching approaches that transform the student's role from a mere negative recipient of science to a positive, active and participant component, which enhances his self-learning and then raises achievement and knowledge acquisition.

3- The necessity to avoid traditional teaching methods and the imperative of involving the student in the educational learning process

4- Holding workshops and training courses for teachers to introduce the experimental dialectical approach

5- The necessity of reviewing the development of methods of teaching curricula and chemistry courses for the secondary stage.

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