

How to Cite:

Al-Mousawi, M. T. M., & Buttail, N. S. (2022). The effectiveness of the global café strategy in the formal thinking of fourth-grade students in biology. *International Journal of Health Sciences*, 6(S6), 570–586. <https://doi.org/10.53730/ijhs.v6nS6.9641>

The effectiveness of the global café strategy in the formal thinking of fourth-grade students in biology

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Abstract---The current research aims to identify the impact of the global café's strategy on formal thinking among fourth-grade students in biology, as the research sample included two groups, one of which was the experimental group, which included (35) students, and the other the control group included (62) students, the researchers chose (Qalaat Sukkar High School) affiliated to the General Directorate of Education in the governorate of 1 Qar randomly, from the research community, as the two researchers adopted the experimental research method as a method to conduct their research, which includes an independent variable, the strategy of the global café and a variable dependent on formal thinking, the researchers chose the experimental design to control the research variables, Before starting the application of the experiment, the researchers rewarded the two research groups to obtain accurate results with the following variables: (the chronological age of the students calculated in months, formal thinking, the previous biological information test, the Otis Lennon intelligence test). When making parity between the two research groups, the researchers prepared the research requirements of plans, objectives and tests for the two research groups, and upon completion of the application of the experiment, the researchers applied their research tool to the two research groups, and after analyzing the results statistically, the researchers obtained data for the two research groups, and these data were processed statistically by The t-test for two independent samples, and the results showed that the students of the experimental group outperformed the students of the control group according to the strategy of the International Cafe in formal thinking.

Keywords---global café strategy, formal thinking.

Introduction

Definition of search

The research problem

The current era is witnessing a tremendous development of information, knowledge and successive scientific innovations in the field of science in particular, so the requirements of this speed of development and successive variables in knowledge and information and the revolution of innovation and invention necessarily require the employment of this information in various areas of life by keeping pace with the rapid and successive developments in various fields. The various sciences, which forced the idea of the stability and inertia of knowledge to disappear from the dictionary of education forever, and then providing the learner with educational experiences and stimulating learning motivation and developing his scientific trends can only be achieved through education that consolidates science among learners as an idea, application, approach and axis that makes it an important aspect for members of society and a fundamental axis for life.

Because of the lack of studies in the field of formal thinking in biology compared to studies of mental aspects such as intelligence and academic achievement, for example, it is also noted that there is no serious attempt to build and develop measures of formal thinking, unlike what was found by intelligence tests, which led to great difficulties in studying this aspect of the organization. mental human being. Through the two researchers' briefing on a number of research and studies conducted in the field of teaching biology, and after discussing biology teachers, they noticed that there is weakness in most types of thinking, including formal thinking, which prompted the researchers to submit a questionnaire to survey the teachers' opinion that included a set of questions for the research problem and the answers were, (91%) of biology teachers do not adopt modern teaching strategies in teaching. (82%) of biology teachers do not take into account the different types of thinking, including formal thinking. Thus, the research problem was represented in answering the following question: What is the effectiveness of the global café strategy in the formal thinking of fourth-grade students in science in biology.

The importance of research

The communications and information revolution that the world has witnessed in the past two decades has led to cultural changes whose effects are increasing daily on all societies of the world and still represent one of the most important transformations that have affected and will affect the formation of the society of the current century and then the features and orientations of cultural educational institutions. Scientific education aims to provide learners with a set of experiences and knowledge necessary for the individual to be aware, educated and able to keep pace with contemporary life. The school and the experiences gained through it, seek in many aspects to refine the human self and instill values in the hearts of learners. As the curricula are one of the most basic components of the educational system and the most effective means in achieving its educational goals and objectives within the community, and given that

education is a human, social and cultural process that occupies the environment of a community of human societies, it is necessary that there be a relationship of honesty, interaction and belonging between education and its environment. Reflected on the engineering of the educational process and its determinants in terms of philosophy, objectives, methods, methods, educational policies, tools and others. (Al-Khawaldeh, 2004: 11).

The researchers believe, after reviewing the structural strategies and models, that the excitement of formal thinking in the learners falls on the teacher and his appropriate choice of the appropriate teaching strategy with the educational situation that enables the learners to absorb the study material and increase interaction within the classroom. The strategy involves the participation of all students in one class, as well as increasing the learners' ability to give a summary of what is being circulated and discussed within the group. The (global café) strategy is one of the active learning strategies. The idea of the strategy, according to the nomenclature, is to prepare the classroom in the image of a café. The learners sit in small groups around tables. The starting point must be a clear goal and is divided into different sub-topics that are discussed at different tables. The learners are invited To join the dialogue table that is in line with their circle of interest and interests, and communication with others takes place, opinions and ideas are exchanged, and a new collective experience and knowledge is reached. Some learners remain at the same table while some move from one table to another. This tool is more useful as it enables them to Understanding and linking complex topics and issues, which leads to the effectiveness of small groups in building consensus. (Robers et al., 2015: 22-23). Based on the foregoing, the importance of the research is summarized as follows:

- The research seeks to test the global café strategy as a new attempt in teaching biology to get out of the approved framework for teaching biology and in response to local and global trends in the educational field that stress the need to pay attention to teaching methods that are based on the constructivist theory and are appropriate for teaching biology.
- The research is the first attempt in Iraq and the Arab world (within the limits of the researchers' knowledge) in which the strategy of the world café is applied in biology, and its results are expected to help learners discover the interrelationship of biology in daily life and thus benefit from it in solving life problems.
- The research may contribute to revealing the formal thinking abilities of the learners and bringing them into effect and increasing the positive and active role of the learner in the classroom.
- It can help teachers to identify the learner's level of formal thinking.
- It may contribute to providing some recommendations that help curriculum planners, educational supervisors and specialists in the educational process to include experiences related to formal thinking in biology books to be reflected in the development of the educational system.

There is no statistically significant difference at the level of significance (0.05) between the average scores of the students of the experimental group who will study biology according to the strategy of the global café, and the average scores of the students of the control group who will study the same subject according to

the usual method in the formal thinking test prepared for the purposes of this research.

Fourth: The limits of the research: The current research is determined by:

- Human limits: - Fourth grade students of science at Qalaat Sukar High School for Girls affiliated to the General Directorate of Dhi Qar Education / Qalaat Sukar Education Department, for the academic year (2021-2022).
- Spatial boundaries: - Preparatory and secondary public day schools in Qalaat Sukar District - Dhi Qar Governorate.
- Time limits: - The second semester of the academic year (2021-2022)
- Cognitive limits: - It includes the topics of the biology book for the fourth grade of science for the second semester, which are (Chapter Eight: Adaptation of plants and animals with lifestyles in the environment, Chapter Nine: Relationships between living organisms, behavior and environmental succession, Chapter Ten: Environmental pollution).

Research objective and hypothesis

The current research aims to identify the effectiveness of the global café strategy in the formal thinking of fourth-grade students in science in biology. To achieve the goal of the research, the researchers formulated the following null hypothesis: There is no statistically significant difference at the level of significance (0.05) between the average scores of the students of the experimental group who will study biology according to the strategy of the global café, and the average scores of the students of the control group who will study the same subject according to the usual method in the formal thinking test prepared for the purposes of this research.

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Defining Terms

The global café strategy: define it

is a simple but impactful conversational process that helps learners engage in constructive dialogue, build personal relationships, foster collaborative learning and discover new possibilities at work. (Tan, Brown, 2005: 83)

The researchers define it procedurally as

It is one of the active learning strategies that are adopted in the teaching of biology for the fourth scientific grade in order to create a spirit of cooperation and participation among students and motivate them to focus in giving answers to the questions posed and to reach the optimal answer.

Formal thinking defined it

Defined (Ryan, 2006) as the ability to use abstractions and generalizations, which enables prediction, planning and reaching conclusions. (Ryan, 2006: 88)

Chapter II

Theoretical background and previous studies

The first axis: theoretical background

The concept of constructivist theory

Constructivist theory began to gain wide popularity in the educational process, and was taken as a base for improving learning environments and enhancing its outcomes, as it motivates learners to form their own plans for the world by balancing their previous perceptions of the world and new knowledge. Ruey K. & Anas R. (2008:4). Despite this, the constructivist theory will not have a clear and specific definition by its theorists, and this may be due to several reasons, including, that the term constructivism is relatively new in the psychological, philosophical and educational literature, and the constructivist systems are not one group, which led to the lack of consensus among them on the definition specific to her. (Zaytoon, 2007) and (Abu Odeh, 2006) defined it as an educational theory in which the learner forms his own knowledge either individually or collectively based on his current knowledge and previous experiences, as the learner selects and transforms information and forms hypotheses such as making decisions based on the conceptual environment that enables him From doing this, with the presence of the teacher facilitator of the educational process. (Abu Odeh, 2006: 16-17). The International Dictionary of Education defines it as a vision in the theory of learning and child development based on the fact that the child is active in building his thinking patterns as a result of the interaction of his innate abilities with experience (Zaytoun, 2007: 17). In light of the foregoing definitions of the constructivist theory, the researcher believes that she has agreed on the following:

- The role of the teacher as a facilitator and assistant in constructing meaning.
- There is a correlation between structures or previous knowledge, current knowledge and the learning environment.

- Social negotiation or teamwork with peers is important for building knowledge.
- The learner builds his new ideas based on previous knowledge and experiences.

The constructivist theory of learning is derived from both Piaget's theory (cognitive constructivism) and Vygotsky's theory (social constructivism). This was confirmed by Ableton referred to in (Abdul Karim, 2000) in the structural theory derived from three areas:

- Developmental Psychology (Paget, 1987), which focused on the process of adaptation and imbalance.
- The consequences of Piaget's vision of cognitive psychology, in which he focused on the students' preconceived ideas from their life experiences and trying to change and modify them because they are not suitable for the system of mental structure schemas and these ideas appear when cognitive equilibrium occurs.
- Vygotsky's social constructivism (1978), which shifted the focus of attention to the social experience of the learner and the importance of language for transferring social experience to individuals and its role in the development of the central region of the brain (Abdul Karim, 2000: 204).

Strategies for constructivist theory

Several modern philosophies have emerged, each of which is a basis for teaching methods that depend in the educational process, and from these philosophies (the constructivist philosophy) from which several teaching methods are derived, upon which are based several strategies and various educational models, as constructivism is based on the philosophy that, if the plant makes (He builds) his own food. Isn't it more appropriate for the (educated) person to build his knowledge by himself? Perhaps the educational saying (I hear and forget, I see and remember, work and understand) may be the last part of it that represents the heart of constructivism, that is, education for the sake of understanding. (Zaytoon, 2007: 19 There are many strategies and teaching methods that are included in the educational literature, which are derived from the constructivist theory, including:

Global café Strategy

The concept of a global café

It is one of the active science strategies. This strategy is based on the existence of a task performed by all the students in the class, but everyone must participate in it through the process of moving the students of one group from one place to another place with the coordinator of the one group remaining immobile until he gives a summary of what the previous group presented Thoughts on the question given to her when the new group comes. (Ambo Saidi and Hoda, 2016: 55)

Formal thinking

(Al-Absi, 2010) indicates that formal, logical, formal thinking (abstract) is the process of using the rules of logic to reach conclusions from data or premises. Formal logic is a study of the logic of phrases according to their form, where phrases and logical linking tools are represented by symbols, and the results are applied to all phrases of the same form. (Al-Absi, 2010: 272). Define (Spring, 2008) the characteristics of formal thinking as follows:

- It performs the operations of logical links, including addition, separation, plurality...etc.
- It is affected by the culture and environment in which the individual lives.
- Develops a number of strategies and scientific methods to reach appropriate solutions.
- It is affected by an individual's mental abilities, including intelligence, maturity, individual experiences, and the surrounding environmental conditions. (Spring, 2008: 115)

The second axis: previous studies

After reviewing the educational literature, and by conducting a survey of scientific databases and search engines specialized in Arab and foreign studies, and correspondence with many Iraqi and Arab universities, they concluded that there are a number of previous studies that dealt with formal thinking as a dependent variable, and these studies are as follows:

- Al Jarjari study (2003): The study aimed to measure the effect of an educational program in developing formal thinking skills in the preparatory stage in the fourth preparatory grade.
- Al-Ahiti study (2008): The study aimed to identify the impact of the problem-solving method in developing the formal thinking of fourth-grade female students in mathematics.
- Al-Afoun Study (2016): The study aims to build an educational design according to divergent thinking strategies and to identify its impact on the qualitative achievement of physics for middle school students and their formal thinking.
- Al-Janabi Study (2018): The study aimed to identify the effect of the cube strategy on both achievement and formal thinking of first-grade intermediate students in mathematics.

Chapter III

Research Methodology and Procedures

First: Experimental Design

The selection of the experimental design is one of the important things that the researchers do, because it helps the researchers determine the factors surrounding the experiment, as the researchers can know what is happening and what they are doing, and since the current research includes two variables: the independent variable represented by the global cafe strategy, And the dependent

variable is formal thinking, so the experimental design with partial control was chosen, as shown in Figure (1).

Search tool	Dependant variable	Independent variable	Group
formal thinking test	Formal thinking	Global café strategy	Experimental
		The usual method	Adjuster

Figure 1. Experimental Design

The research community and its sample

Research community

It is all the elements or members, whether they are objectives, subjects, or individuals who wish to circulate the results of the study to them. (Al-Manazil and Adnan, 2019: 105). The research community consists of all fourth-grade students of science in Qalaat Sukar Preparatory School for Girls in Qalaat Sukar, which is affiliated to the General Directorate of Dhi Qar Education.

Research sample

The sample: is a model that includes a part or part of the units of the original community concerned with the research, and is similar to it, as it bears its common characteristics, and this part model enriches the researcher to study all the units of the original community and its vocabulary, especially in a difficult situation or the impossibility of studying those units. (Al-Jabri and Dawud, 2015: 151).

The researcher chose the research sample from the students of the fourth scientific grade in Qalaat Sukar High School for Girls affiliated to the General Directorate of Education in Dhi Qar / Qalaat Sukar for the academic year (2021-2022) intentionally for the following reasons:

- The school's proximity to the researcher's residence.
- The school administration cooperated with the researcher and provided all facilities to conduct the experiment.
- Convergence of the social and cultural level among the sample members, because the female students live in one area.
- The school contains (4) rooms for the fourth scientific grade, which allowed the researcher to choose two rooms in a random way to represent the two research groups (the experimental group and the control group).

Table 1
The distribution of the research sample to the experimental and control group

The number of students after exclusion	The number of excluded students	The number of students before exclusion	Hall	Group	T
35	4	39	1	Experimental	1
35	6	41	3	Adjuster	2
35	10	80	Total		

Third: Equality of the two research groups

The researchers were keen to make equivalence with the following variables: (the chronological age of the students calculated in months, the Otis Lennon intelligence test, the formal thinking test), and as shown in Table (2). Table (2) The arithmetic mean, standard deviation, and the computed and tabular T-values for the variable (chronological age, Otis Lennon intelligence test, formal reasoning test) for the two research groups

Statistical significance	The tow value of T		Freedom Degree	Contrast	Standard deviation	SMA	N.O	Group	Variable
	Tabular	Calculated							
Not statistically significant	2.03	0.938	68	75.77	8.70	190.14	35	Experimental	Chronological age
				116.88	10.81	192.34	35	Adjuster	
		1.147		6.38	2.53	16.03	35	Experimental	Intelligence Test (Otis Lennon)
				10.65	3.26	15.23	35	Adjuster	
		0.950		124.50	11.16	69.71	35	Experimental	formal thinking test
				132.07	11.49	67.14	35	Adjuster	

It is clear from the above table that the calculated value for each of (chronological age, intelligence test (Otis Lennon) and formal thinking test) amounted to (0.938, 1,147, 0.950), which is less than the tabular t-value (2), so the above variables were equalized for the two research groups (Controlled and Experimental).

Controlling extraneous variables

The extraneous variable is not included in the study design and is not under the researcher's control, but it affects the results of the study or the dependent variable in an undesirable way that the researcher cannot observe or measure (Hamza et al., 2016: 62). It is a fixation of the factors and variables that are

related to the phenomenon under study with the exception of the independent factor, and during the experiment a group of factors and variables that affect the research experience, specifically affect the dependent variable may be in favor or against, and to obtain good results, and to know the effect of the independent factor must Controlling the extraneous variables before conducting the experiment, meaning restricting all the variables except for the independent variable in order to isolate them and prevent their impact on the result. , classes), as the two research groups were taught according to the prescribed classes for physics, three classes per class per week, and according to the school administration's distribution of classes, which are shown in the following figure:

Tuesday	Monday	Saturday	Group
Fifth class	Sixth class	second class	Experimental
Sixth class	Fifth class	Third class	Adjuster

Figure (2) The distribution of biology weekly lessons among the students of the experimental and control groups. Before applying the experiment, the basic requirements for the experiment must be prepared, which are:

Determining the scientific subject

The researchers determined the scientific material that will be taught to the students of the two research groups during the duration of the experiment, so the chapters that are taught within the annual plan for the content of biology for the fourth scientific grade, during the second course, were included in a coherent and integrated manner with the objectives of each of those three chapters and unified with what The curriculum aims at it in general, as it was specified as follows (Chapter Eight: Compatibility of plants and animals with lifestyles in the environment, Chapter Nine: Relationships between living organisms, behavior and environmental succession, Chapter Ten: Environmental pollution). Noting that Chapter Seven has been deleted by the Ministry of Education.

Table 3
Subjects to be taught during the trial period

Title of the chapter	Chapter	T
Adaptation of plants and animals to the lifestyles of the environment	Eight	1
The relationships between organisms, behavior, and environmental succession	Nine	2
Environmental pollution	Ten	3

Formulating Behavioral Objectives

Determining educational goals allows for the possibility of controlling and evaluating the work of the learner and provides him with indicators that guide him during the learning process and give him an opportunity to perform. (Abdul-Amir and Rahim, 2015: 13). Therefore (180) behavioral objectives were formulated in the light of the three chapters of the Biology book for the fourth grade of

science.), and the researchers presented the behavioral objectives to a group of arbitrators with expertise and competence in the methods of teaching science, to express their views on the validity of the behavioral objectives and the extent to which they include the educational content and to determine the level measured by each behavioral objective, and based on the opinions of the arbitrators, the proposed amendments and reconsideration were taken into account. In some purposes, some of the purposes were modified with the level that measures them, as it settled in its final form (180) behavioral goals.

Preparing teaching plans

The teaching plan is defined in the scientific educational literature as: It is a set of written organizational procedures set by the teacher to ensure the success of the teaching process and to achieve the desired school educational goals. It is described as a guiding and guiding plan for the work of the teacher, and therefore it is not rigid rules or instructions that are applied literally, but rather it is a means to an end in itself, which must be flexible and ready for modification, change and development. (Al-Yasiri et al., 2015: 360). Within the context of the content of the scientific material for the last three chapters of the book of modesty for the fourth scientific grade, (50) teaching plans were prepared by (25) teaching plans for each of the two research groups (experimental and control). Two models of teaching plans were presented to a number of arbitrators and specialists in the methods of teaching science. Their observations were taken and some amendments were made to them to take the final version.

The search tool

One of the important and basic matters that the researchers identify and build is the preparation of the research tools, and the research includes a dependent variable (formal thinking), and therefore the research tool is a test of formal thinking, and the following is a detail of the preparation of the tool:

Preparing the formal thinking test

Formal thinking is the dependent variable in the current research. Therefore, an appropriate scale must be prepared to measure this variable for the students of the basic research sample. The test was built in light of the following steps:

- Determining the objective of the test: The test aims to know the formal thinking of the research sample, who are the students of the fourth scientific grade.
- Determining the skills of formal thinking: Piaget, referred to in (Abd al-Rahim, 1986), sees that the formal processes go through two stages: in the first stage, the adolescent uses deductive thinking in solving problems, while in the second stage he uses inductive thinking, meaning that he can deduce the general from the specific. And the cause of the effect, and the second stage is one of the advanced and sophisticated stages in cognitive growth, and it includes formal thinking skills (proportional reasoning, reasoning related to controlling variables, synthetic reasoning, deductive reasoning, probabilistic thinking skill, logical measurement skill).

A test of formal thinking was prepared consisting of (30) test items of the type of multiple choice consisting of the original paragraph and three alternatives, one of which is correct and two of which are false to measure the levels of formal thinking among students of the fourth scientific grade. The test was presented to a number of experts and arbitrators in The field of education and its teaching methods, and through their directives, some paragraphs were modified to be ready for implementation.

Correction of the test

Before testing the scale exploratory, the researcher prepared special instructions for correcting it, as follows:

- One point is given to the student when he answers correctly for each paragraph.
- A grade of zero is given to the student when he answers a wrong answer to each paragraph.
- The answer is considered wrong if the paragraph is left unanswered or when more than one alternative is chosen.

Thus, the test score ranged between (zero) as the lowest degree and (30) as the highest degree.

The validity of the test

The validity of the scale is one of the basic characteristics necessary and required in the preparation of standards, and the honest scale is the scale that measures the trait that was developed for its measurement (Allam, 2019: 139), and the apparent validity of the formal thinking scale has been extracted, and it is as follows:

- Apparent honesty: The test is presented in its initial form to a group of arbitrators and specialists in the field of methods of teaching science, measurement, and evaluation. In order to express their observations about the validity of the paragraphs, their scientific and linguistic formulation, and their relevance to the level of fourth-grade students, after taking their observations, some minor modifications were made and some of them were deleted, and the percentage (100%-83%) and chi-square (18-8) were calculated and balanced with the tabular The amount of (3.84) and a degree of freedom (1) showed the results
- Structure validity: aims to determine the number of features and characteristics that characterize the test and their nature that essentially constitute a set of relationships or test marks (Melhem, 273: 2010). Apparent.

Applying the future thinking test to the exploratory sample

The first survey sample

The first stage: - The first exploratory application:

To verify the paragraphs of the formal thinking test and the time required for response, the test was applied to a first exploratory sample on Wednesday (12/1/2022) at the Zaytoun High School of the General Directorate of Dhi Qar Education / Qalaat Sukar Education Department, according to the task facilitation book, appendix (A - b) With the prior agreement with the concerned school administration to conduct the test, and when conducting the test, the researcher clarified some of the paragraphs that some students inquired about, and recorded the time that the students took to answer all paragraphs, as the time they took was calculated by the average time taken by the first (5) Female students and another (5) female students who finished answering the test.

The second stage: - the second exploratory application

The test was applied to a second exploratory sample after verifying the clarity of its paragraphs and instructions and knowing the time required to answer it. The sample consisted of (100) female students from Al-Zaytoun High School for Girls on Sunday (16/1/2022) to extract the psychometric characteristics of the test, and the researcher supervised its application In cooperation with the school of the subject in the school.

The effectiveness of the wrong alternatives: the effectiveness of the wrong alternatives was calculated for each of the test items according to the equation of the effectiveness of the wrong alternatives, and it was found that it ranges between (formality).

Scale stability

The stability coefficient was calculated in two ways:

- **The split-half method:** - The stability coefficient between the two halves of the test (odd and even items) was extracted using the Pearson correlation coefficient of (0.76), and it was corrected by the Spearman-Brown equation, so the stability coefficient after correction was (0.86), which is a high stability coefficient.
- **Keoder - Richard Son equation:** - The stability coefficient according to the Keoder - Richard Son equation was (0.88), and this indicates that it is a high stability coefficient.

Statistical Means

The researchers used the statistical package SPSS program for statistical analysis.

The fourth chapter
Presentation and interpretation of results
Ordinary formal reasoning test

The t-test was adopted for two unequal independent samples to show the differences between the mean scores of the experimental and control group students in the formal thinking test, as shown in Table (12). It is clear from the data in Table (12), that the students of the experimental group outperformed the students of the control group in the formal thinking test, as the arithmetic mean of the scores of the students of the experimental group was (24.37) with a deviation of (2.25), while the arithmetic mean of the scores of the students of the control group was (21.74) with a deviation A value of (3.64), and when using the t-test for two unequal independent samples for the two research groups (experimental and control), the results indicated that there is a statistically significant difference between the mean scores of the students of the experimental group and the average scores of the students of the control group in favor of the experimental group, as the calculated T value reached (3.533). There is a statistically significant difference at the level of significance (0.05) between the average scores of the experimental group students who are studying according to the strategy of the global café and the average scores of two students The control group studied according to the usual method in the formal thinking test.

Table 4

The results of the t-test for two independent samples of the two research groups on the formal thinking test of the experimental and control group

Statistical significance at the level of 0.05	T value		Freedom Degree	Contrast	Standard deviation	SMA	N.O of students	Group	T
	Tabular	Calculated							
Functional	2,03	3.633	68	5.06	2.25	24.37	35	Experimental	1
				13.26	3.64	21.74	35	Adjuster	2

Interpretation of the results

The results of the research shown in Table (4) showed the superiority of the experimental group students who study according to the strategy of the world café over the students of the control group who study according to the usual method in the productive thinking test, and the researcher believes that this result is due to the following reasons:

- The method of working in the classroom according to the steps of the global café strategy is based on cooperation between the researcher and the students and between the students themselves, examining the spirit of competition among the students and seeking to put forward good ideas for the solution, and this helped the students to open their prospects for research in different aspects of the problem and to reach multiple solutions This, in turn, can positively affect the mental habits of female students.

- Diversification in teaching methods and the use of multiple methods in explaining topics may contribute to the development of formal thinking among students.
- This result is due to the effectiveness of the Global Café strategy in developing problematic thinking in general, and this comes through the practice of the experimental group's students for the steps of this strategy in an organized and sequential manner and based on the principles of active learning, as it allowed the students of the experimental group to persevere, listen with understanding and think flexibly as well as think Beyond knowledge, striving for accuracy, questioning, posing problems, and applying knowledge, among others.

Conclusions

Based on the results that appeared, the researchers concluded the following: The effectiveness of the global café strategy contributed to raising the level of formal thinking among female students of the fourth scientific class.

Recommendations

In light of the results that have been reached, the researcher recommends the following:

- Holding training courses to train biology teachers for the different stages on the use of the global café strategy in teaching biology due to its effectiveness in academic achievement and formal thinking.
- Taking into account the inclusion of formal thinking in biology so that it becomes part of the subject taught by students.
- Emphasis on the adoption of modern strategies by biology teachers in which the student is the focus of the educational process, especially the global café strategy, which has proven its effectiveness by raising the achievement level of students.
- Issuing a pamphlet by those concerned with the educational aspect and distributing it to primary, middle, preparatory and secondary schools and including modern strategies in teaching, including the strategy of the global café, to view and apply them.
- Interest in including the biology curricula, especially in the preparatory stage, on questions and activities that develop formal thinking and help them develop thinking for students.

Suggestions

To complement the current research, the researcher suggests conducting the following studies:

- Conducting a similar study to reveal the relationship between the global café strategy and clever thinking.

- Conducting a similar study on samples including males and females to identify the effectiveness of the global café strategy in formal thinking in relation to the gender variable.
- Conducting a descriptive study to know the formal thinking skills of biology teachers and their students.
- Conducting a comparative study between the global café strategy with other active learning strategies in biology.
- Conducting a study to determine the extent to which students of faculties of education possess formal thinking skills.
- Conducting other studies that depend on the same research variables in other study subjects such as (mathematics and physics) for other academic levels.

References

1. Hamza, Hamid Muhammad, Nasreen Hamza Al-Sultani, Ibtisam Jaafar Jawad Al-Khafaji, (2016): Research Methods in Education and Psychology. Amman: Dar Al-Radwan for Publishing and Distribution.
2. Al-Khawaldeh, Muhammad Mahmoud, 2004, Foundations of Building Educational Curricula and Designing Educational Books, Dar Al Masirah Publishing, Amman.
3. Robers, Norbert, Anna Kohler, Anne Kroc and Betarix Austin, 2015, Foundations of Facilitating Dialogue, 1st Edition, Berghof Foundation, Berlin, Germany.
4. Rayan, Muhammad Hashem, 2006, Thinking skills, quick wit, and training packages, Hanin House for Publishing and Distribution.
5. Zeitoun, Kamal Abdel Hamid, (2007), Teaching Science to Understanding, a Constructivist View, 1st Edition, World of Books Library, Cairo.
6. Abu Odeh, Salim, 2006, the effect of using the constructivist model in teaching mathematics on developing and maintaining the skills of systemic thinking among seventh grade students in Gaza, (unpublished master's thesis), The Islamic University, Gaza.
7. Abd al-Karim, Sahar Muhammad, 2000, The effectiveness of teaching according to Piaget-Vygotsky's theory in the collection of some physical concepts and the ability to think inferential formalism among first-year secondary students, the Egyptian Association for Education, an unpublished master's thesis, the Fourth Scientific Conference on Scientific Education for All, Ain Shams University , volume (1), Cairo.
8. Ambo Saidi, Abdullah bin Khamis and Huda bint Ali Al Hosani, 2016, Active Learning Strategies, 1st Edition, Dar Al Masirah, Amman.
9. Al-Absi, Muhammad Mustafa, 2010, Realistic Evaluation in the Teaching Process, Dar Al-Masira, Amman.
10. Al-Manizil, Abdullah Falah and Adnan Yousef Al-Atoum (A), 2010, Research Methods in Educational and Psychological Sciences, 1st Edition, Dar Ithraa, Amman.
11. Abdel-Amir, Abbas Naji and Rahim Younes Crowe, 2015, Teaching Mathematics - Concepts, Strategies - Applications, 1st Edition, Dar Al-Ayyam, Amman.
12. Al-Yasiri, Nidaa Muhammad Baqer and others, 2015, Curricula, its foundations, theories, organizations, components, evaluation, development,

- enrichment, and teaching plans, 1st Edition, Zamzam Publishers and Distributors, Amman.
13. Tan, S . and Brown , J. 2005, The World Café in Singapore , Creating a Learning Culture through Dialogue , *Journal of applied Behaviors Science* , vol.41, no. (1), pp: 83-90.
 14. Ruey K.& Anas R. ,2008, contractivism theory based learning :atotal quality approach , development project report.
 15. Widana, I.K., Dewi, G.A.O.C., Suryasa, W. (2020). Ergonomics approach to improve student concentration on learning process of professional ethics. *Journal of Advanced Research in Dynamical and Control Systems*, 12(7), 429-445.
 16. Widana, I.K., Sumetri, N.W., Sutapa, I.K., Suryasa, W. (2021). Anthropometric measures for better cardiovascular and musculoskeletal health. *Computer Applications in Engineering Education*, 29(3), 550–561. <https://doi.org/10.1002/cae.22202>