



ARTÍCULOS

UTOPIA Y PRAXIS LATINOAMERICANA. AÑO: 25, n° EXTRA 1, 2020, pp. 305-315
REVISTA INTERNACIONAL DE FILOSOFÍA Y TEORÍA SOCIAL
CESA-FCES-UNIVERSIDAD DEL ZULIA. MARACAIBO-VENEZUELA.
ISSN 1316-5216 / ISSN-e: 2477-9555

The Impact of Fishbone Strategy in the Achievement of Chemistry and Visual Thinking Among the Seven Grade Students

El impacto de la estrategia de la espina de pescado en la aprobación de química y el pensamiento visual entre los estudiantes de séptimo grado

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Este trabajo está depositado en Zenodo:
DOI: <http://doi.org/10.5281/zenodo.3774648>

ABSTRACT

The current research aims to know the effect of fishbone strategy on achievement of chemistry and visual thinking among middle school students, the research sample consisted of 89 students divided into two experimental groups consisting of 44 students who studied fishbone strategy, and a control group that consisted of 45. A student studied in the usual way; the two groups were rewarded in a number of variables, and the researcher built two tools for the research: the first is an achievement test consisting in 30 paragraphs, and the second is a visual thinking test consisting in 18 paragraphs.

Keywords: Chemistry, fishbone, seven grade, students, visual thinking.

RESUMEN

La investigación actual apunta a conocer el efecto de la estrategia de espina de pescado en la aprobación de química y el pensamiento visual entre los estudiantes de media básica, La muestra de investigación consistió en 89 estudiantes divididos en dos grupos experimentales que constaron de 44 estudiantes que estudiaron la estrategia de espina de pescado y un grupo de control que consistió en 45. Un estudiante trabajó de la manera habitual, y los dos grupos fueron recompensados en una serie de variables; el investigador construyó dos herramientas para la investigación: la primera es una prueba de rendimiento que consta de 30 párrafos, y la segunda es una prueba de pensamiento visual que consta de 18 párrafos.

Palabras clave: Espina de pescado, estudiantes, pensamiento visual, química, séptimo grado.

Recibido: 05-02-2020 • Aceptado: 30-02-2020



INTRODUCTION

The school is the tool that education depends on in achieving its goals. Modern education seeks to provide a rich environment in order to form the human personality of students and raise the level of quality of education and attention in improving the academic achievement of our students through developing their mental capabilities. But the widespread adoption of the usual method of teaching has led to a decrease in visual thinking in particular, and the researcher believes that the modern strategy is necessary from In order to raise the level of achievement and visual thinking among students, and based on the foregoing, the research problem can be determined by the following question: (What is the effect of fishbone strategy on the achievement of chemistry and visual thinking among middle school students)?

Teaching science in general and chemistry in particular is an urgent need in light of the great technological and cognitive progress witnessed at the present time, and the men of education have paid attention to teaching methods and strategies, their models and their improvement in a way that is compatible with modern scientific and educational theories and in line with the great technological and cognitive progress (Hariri, 2011, p.314)

Interest has increased in how to teach students by using strategies that focus on meaning and quality instead of filling in the mind with a huge amount of knowledge that results in educational wastage in different stages of education (Al-Huwaidi, 2005, p.225). She has confirmed many studies and research in methods and ask. Teaching reveals its effectiveness in improving student achievement and developing many skills and types of thinking, and the modern era calls for keeping abreast of what is new in teaching methods and strategies, especially those that meet the needs of students and the requirements of the educational process (Ahmed, Majed, 2018, p.279). Several studies have confirmed In teaching methods to its effectiveness in improving and attaining students and in developing many types of thinking (Abdul-Saheb, Suzan 2014, p.116), the researcher thus outlines the importance of her research with the following: -

- 1- Adopting a relatively recent strategy that relies on active learning.
- 2- The research provides information about fishbone strategy and the importance of using it in providing visual thinking.
- 3- The authors of the curriculum benefit from benefiting from the research results, including the content of chemistry for the intermediate stage, positions that make the learner active and a positive participant.

The research aims to identify:

1. The effect of fishbone strategy on achieving chemistry among middle school students
2. The effect of fishbone strategy on visual thinking among middle school students.

Hypotheses

1- There are no statistically significant differences at the level (0,05) between the average score of the academic achievement test for chemistry between students of the experimental group that studied according to fishbone strategy and the average score of female students of the control group that studied according to the usual method.

2- There are no statistically significant differences at the level (0,05) between the average degrees of the post-visual thinking test for the chemistry subject among the students of the experimental group that studied according to the fish bone strategy and the average score of the students of the control group that were studied according to the usual method.

Limits

1. Middle middle school students for day and middle schools in Baghdad / Karkh second education
2. The first semester of the academic year 2018-2019
3. Chapters 2, 3, and 4 (atoms, elements, and compounds, the composition and classes of elements, chemical reactions and their expression) from the book of science, third edition of the academic year 2018 CE.

Defining terms

(A) Fishbone strategy: Define it (Al-Bawi & Thani, 2016) as: -

One of the planning organizations that can be used to help students organize knowledge in their cognitive structure. They represent planned networks or illustrative graphics that are used to show the relationship between the main concepts and sub-concepts. (Al-Bawi and Thani, 2016, p.109)

Procedural definition: A set of educational procedures that focus on classifying the topic into a main concept and sub-concepts using the scheme of a final shape similar to the fish's bones in which the fish head represents the main concept and each sub-bone represents the sub-concepts.

(B) Visual thinking: he defined it (Afaneh, 2001) as: -

A mental ability related to the sensory-visual aspect, which occurs as a result of the mutual coordination of the forms and drawings that the learner sees, and the connection of old and modern information as a result of mental processes accustomed to the vision and the displayed drawing (Afaneh, 2001, p.24)

Procedural definition: It is a set of mental processes related to the sensory-visual side, and it is measured procedurally to the degree that students obtain in the visual thinking test prepared by the researcher for this purpose.

Theoretical background

The first axis: fishbone strategy:

This strategy is one of the planning organizations that can be used to help students in organizing knowledge in the cognitive systems and is an application of the Ozil theory in meaningful education (Al-Bawi wa-Thani 2016, p.109). This strategy is called in several names, including ((Ishikaawa Diagram or cause-and-effect diagram), and was developed by the Japanese scientist (Karu Ishikawa), who is one of the first Japanese pioneers in the field of quality (Lavi, 2016, p.14). The reason for calling it with this name is that the final form this scheme is similar to fish bones after removing meat. The fish head represents the main problem and every sub bone of the spine and represents the sub-elements of this problem (Babiyeh and Muhammad, 2014, p.145). Al-Dibsi states that this strategy is one of the modern learning strategies centered on the student and provides a tendency to work Active very seriously as a result of understanding how in which the content is handled (Al-Dabsi, 2012, p.245)

Fishbone strategic steps: -

1- Defining the problem to be studied accurately, and the problem is fixed to the head of the fish bone diagram.

2- The main causes are fixed on both sides of the scheme, and it is preferable to draw arrows for those main reasons and sub-shares that indicate the sub-causes for each major cause.

3- Applying the ideas that were generated according to the main causes filtering and stopping at every reason and question, what causes this reason? Then the answer is recorded as branches of these main causes and they are called the sub-causes (Ambo Saeed et al., 2016, p.535) and (Al-Bawi and Thani, 2016, p.110-111).

The second axis: visual thinking: -

Thinking is a mysterious concept that we cannot touch or see, for a person is born with the mind of a mind machine, which is the mind (Yusef and Mahd, 2016, p.137). The thinking process is distinguished as a human process and the process of learning and developing requires distinguished efforts from many parties in different stages of life, which are related to the genetic aspects and the environment in terms of different fields: physical, social, cultural and civilization.

Thinking is a topic that is directly related to the lives of individuals and societies, and it helps to help individuals adapt to the surrounding environment and works to keep societies, their growth and development (Khalil, 2007, p.111).

Visual thinking

Today we live in a society full of visual messages, from printed visual messages to picture messages, and the experience that a person acquires is a visual experience starting from the pictures he sees on TV, and ending with the imaginary image he imagines inside his human mind.

Both (Ammar and Najwan, 2010) define it as a system of operations that translates the individual's ability to read the visual form, convert the visual language that that form carries into verbal (written or spoken) and extract information from it (Ammar and Najwan, 2010, p.21).

The importance of visual thinking

Its importance in the educational process is due to achieving the following benefits:

- 1- Developing the visual language skills of students.
- 2- Helping students to create new images and mental imaginations
- 3- Developing the ability to solve problems by defining visual concepts.
- 4- Helping students to understand, organize and synthesize information in school subjects, and help them to innovate and produce ideas.
- 5- Developing the ability to understand the secret messages surrounding the educational process members from each side as a result of scientific and technological progress

(Ammar Longwan, 28, p.2010)

Which provided the visual thinking of the main requirements for teaching science in general and chemistry in particular, because of the vital role it plays in helping students understand specific scientific concepts.

Previous studies

1) (Abu Adhera, 2015) study: The study aimed to identify the effect of using the fishbone strategy in teaching science in developing creative thinking skills for sixth-graders primary students in Taif Governorate, the study was conducted in Saudi Arabia, and the study sample consisted of (45) female students Primary Sixth Grade Primary. Distributed to two experimental groups that included (23) female students studied using the fish bone strategy and (22) female students within the control group studied in the usual way, and in light of the results the researcher found that there were statistically significant differences in developing creative thinking skills for the experimental group that studied the fishbone strategy. (Abu Adhera, 2015, p.293).

2) 1) Study (Hassan and Safaa, 2017): The study aimed to identify the effect of using the fishbone strategy in the achievement of students of the Department of Family Education and Technical Professions with the course of teaching methods, the study was conducted in Iraq, the sample consisted of (61) male and female students divided into two experimental groups It included (30) male and female students who studied using the fishbone strategy and (31) male and female students within the control group who studied in the usual way. The results showed that there were statistically significant differences in favor of the experimental group in the collection of teaching methods subject to the expense of the group studied in the usual way. (Hassan and Safaa, 2017, p.674).

3) (Saleh, 2017) study: It aimed to identify the effectiveness of the strategy of imagining the guide in developing visual thinking skills for eighth grade primary school students in science, the study was conducted in Yemen, the study sample consisted of (62) female students divided into two experimental groups that included (32) female students They studied using the fishbone strategy and (30) female students within the control were studied in the usual way. In light of the results, the researcher concluded that there are statistically significant differences in developing visual thinking skills for the group that studied the guided imagination strategy. (Saleh, 2017, p.54)

Procedures

First: experimental design

Experimental design means: planning the conditions and factors surrounding the phenomenon that we study in a specific way and observing what is happening, it is a plan and a work program for how to implement the experiment (Anwar and Adnan, 2007, 487). The experimental design with partial tuning and the experimental and control groups were chosen. As shown in chart (1):

Schem (1)

Post-test	Dependent variable	Independent variable	Valence	the group
Achievement test	Achievement	Fishbone strategy	Age, Intelligence, Science Test Previous Information	Experimental
		The usual way		Control

Second: The research community and its sample:

The research population was identified from the first intermediate class students of secondary schools affiliated to the Directorate of Education in the Baghdad / Karkh second governorate for the academic year (2018-2019). Asma Girls High School was intentionally chosen to represent the research sample, due to the availability of the appropriate educational environment and the approval of the administration to conduct the experiment and the cooperation of the six-year school (Rehab Ghaleb Hammouda) in teaching the subject. The research sample consisted of two (89) female students. The random selection was done by Division (B) to represent the experimental group, and (A) to represent the control group. No female student was excluded because there were no repeaters or repeaters, and accordingly, the final number of the research sample remained (89) students, by (44) students for the experimental group and (45) students for the control group as shown in Table (1).

No	Groups	Number
1	Experimental group	44
2	Control group	45
	Total	89

Third: Equalization of groups

The two groups were rewarded with variables of intelligence, chronological age, and previous information for the sixth grade of primary school.

External safety design

It means that the change in the dependent variable is due to the independent variable and not to another reason, and internal safety is achieved when the researcher makes sure that the foreign factors that compete

with the independent variable have been set in the experiment if it did not affect the dependent variable except the effect that the independent variable actually did (Muhammad, 2011, p.35).

Exotic variables that may affect the results of the current research, such as the academic subject, have been identified, as the science book has been identified for the first intermediate grade (first part) for the two research groups and the presentation of the study subject according to the appropriate teaching plans for each group and within a specified number of classes for each group and according to the school schedule, and the time period.

The period of application of the experiment was equal between the two research groups, which included the first semester of the academic year (2018-2019), and experimental extinction (wastage): it is the loss of some members of the research sample during the training period. (Melhem, 2000, p.363), and during the application of the experiment, there was no interruption or loss for some students between the two research groups. The physical conditions are the external characteristics and influences of the place where the experiment is being conducted from lighting, ventilation, and noise that affect the studied behavioral patterns or variables related to the research (Anwar and Adnan, 2008, 221). To adjust the external influences that may affect the variables related to the experiment, the classrooms were chosen for students. The two research groups have similar conditions in terms of lighting, ventilation, fixtures, and research tools, as the research tools were applied to the two research groups simultaneously.

Fourth: Research supplies

1- Scientific subject: - The scientific subject that will be taught in the first semester of the academic year (2018-2019) was defined and included the second, third and fourth semesters of the science textbook for the first intermediate grade I 3 / for the year 2018.

2- Formulating behavioral goals: - After reviewing the objectives of the article and analyzing the chapters (second, third and fourth), (110) behavioral purposes were distributed on three levels of Bloom (remembering, assimilation, application) and behavioral purposes were presented to a number of specialists in the field of teaching methods .

3- Preparing teaching plans: - The researcher prepared two types of experimental and control plans, and presented a sample of these plans to a group of specialists and found some minor modifications to them.

Fifth: Research tools:

Achievement test: - One of the research requirements is the preparation of an achievement test to measure the academic achievement of a sample in the science subject (chemistry part). Leave any paragraph unanswered because it will be considered wrong and the final achievement test has been prepared by preparing the test map (specifications table) table (2) shows that

Table (2): Achievement Test Specifications Table

items	Level of goals			Weight ratio %	No. of papers	the classroom
	Application %22	Comprehension % 38	remember %40			
	No. of items					
14	2	5	7	39	17	The second
7	1	2	4	27	12	the third
9	2	3	4	34	15	the fourth
30	5	10	15	100	44	Total

The sincerity of the achievement test: The researcher relied on the opinions of the arbitrators and their opinions were taken in order to amend the paragraphs, and accordingly, this test is considered an apparent sincerity, in addition to the application of the content sincerity because the researcher used the table of

specifications to set up paragraphs and thus achieved the truthfulness of the content, because it is through him that he is forced. The researcher is to distribute the questions of the subject with its various parts to all goals (Rawashdeh et al. 2000, p. 12).

Statistical analysis of the achievement test paragraphs: - The test was applied to an exploratory sample of the average first female students whose number reached (30 female students) and after correcting the answers, the female students' grades were arranged in descending order, and they were divided into two groups (15) the higher degree and (15) the lower level to find the ease and difficulty that ranged from what Between (0.73 - 0.32), the distinction between (0.68 - 0.40), and the coefficient of stability that adopted the retest method, it reached (0.87), and the average response time of all students was 60 minutes.

Visual Thinking Test: The researcher has prepared a test consisting of (18) paragraphs of a multi-type test, and the researcher was keen on formulating paragraphs in an easy language that suits the ages of students but requires focus and thinking, and I knew with the definition of Al-Basri on a number of specialists in teaching methods and psychology. And they agreed to the test items with some minor modifications, and thus the apparent validity of the test was found.

Statistical analysis of the visual thinking test: The researcher applied the test to an exploratory group consisting of (20) students from another medium without the research sample and after the correction and arranged in descending order and divided it into two parts to represent the upper and lower group and find the difficulty coefficients ranged between (0.75-0.50) and adopted the difficulty criterion between (0.80-0.20) (Al Nabhan, 2004, p.240). Discrimination coefficients were greater than (0.27) and this number is considered acceptable (Al-Zahir and others, 1999, p.13).

Stability of the test: The test was repeated on the same group of female students after the passage of (14) days of the experiment, and the stability factor was (0.80) and thus the final test consisted of (18) paragraphs, given one degree for the correct answer, and zero the wrong answer, and the time for the test (30) a minute calculates the average response time for female students.

Statistical means: A number of statistical methods were used in the research, including the K-test, the Pearson correlation coefficient, the difficulty, ease, and discrimination factor and the T-test for two independent samples, as follows:

1. Chi-square equation: used to find parental achievement of parents, as well as to find honesty of behavioral goals, achievement test and test of visual thinking skills.

It represents: X^2 = the square of Kay, E = the expected frequencies, O = the observed frequencies

2. T-test of two independent two-tiered samples: used to calculate parity between the experimental and control groups in some variables, as well as to test the first and second zero hypotheses.

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2} \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

3. Paragraph difficulty factor equation: It was used to calculate the difficulty factor for the objective paragraphs of the achievement test and the visual thinking skills test.

4. Paragraph discrimination factor equation: It was used to calculate the discriminatory power of the objective paragraphs of the achievement test and the visual thinking skills test

$$\frac{na + nd}{n} = \text{Difficulty factor}$$

5..Pearson correlation coefficient: used to calculate stability for the scale of mind habits.

$$r = \frac{n \sum (mg - \bar{mg})(s - \bar{s})}{\sqrt{[N - \sum (mg - \bar{mg})^2][N - \sum (s - \bar{s})^2]}}$$

(Al-Kubaisi, 2010, p.118), (Chalakah, 2019, p.504), and (Ahmed and Muhammad, 2019, p.1).
 Presentation and interpretation of results

RESULTS

- 1- Verify the first zero hypothesis which states that:
 There is no statistically significant difference at the level of significance (0.05) between the average score of the academic achievement test for chemistry among female students of the experimental group that was studied according to the fish bone strategy and the average score of female students of the control group that studied the way the usual.

To validate the hypothesis, the mean and standard deviation of the raw scores for the students of both groups in the achievement test were calculated. By adopting the T-test for two unequal independent samples, the calculated T value was found, Table (3). As illustrated in Table (3). That the difference is statistically significant at the level (0.05) and thus rejects the first zero hypothesis and accepts the alternative, that is, the effect of the fish bone strategy on the achievement of the experimental group students.

Table (3) T-test results of two independent samples for two groups in the achievement test

Groups	Students Nu.	mean	variance	The degree of freedom	T-test	Statistical significance at the level (0.05)	
Experimental	44	26.78	5.65	43	Calculated	tabular	significant
Control	45	29.82	5.71		9.375	2	

- 2- Verify the second null hypothesis which states that:
 There is no statistically significant difference at the level of significance (0.05) between the average scores of the post-visual thinking test for chemistry between students of the experimental group that were studied according to the fish bone strategy and the average scores of students of the control group that were studied according to the usual method.

To verify the hypothesis, the researcher used the T-test for two unequal independent samples. The calculated T-value was found in Table (4). It is clear from Table (4) that the difference D is statistically at the level of significance (0.05) and thus rejects the Zero hypothesis T and accepts the delusion, that is, there is a trace of fish bone strategy in the visual thinking of students of the experimental group.

Table (4) Calculated and tabulated T value and statistical significance of the experimental and control groups in mind habits

groups	Students Number	mean	variance	The degree of freedom	T- test		Statistical significance at the level (0.05)
					Calculated	tabular	
Experimental	44	25.62	5.21	43	7.347	2	Significant
Control	45	28.75	5.65				

Interpretation of the results:

The results of the research showed the superiority of the experimental group students who studied according to the fish bone strategy over the control group students who studied according to the usual method of achievement and visual thinking. This could be due to the following:

1- Taking into account the fishbone strategy, the individual differences between female students, which led to learning a positive impact and has a meaning for them.

2- Fishbone strategy stimulated female students to discuss and promote team work and exchange information and ideas between them, which helped develop their visual thinking.

3- The fishbone strategy has contributed to the development of female students 'visual thinking, and this result is logical, because the strategy and the procedures, principles, and plans that depend on it are an overstated method in developing thinking in general and visual in particular

4- The strategy emphasizes making the learner a focus of the educational process.

CONCLUSIONS

From the above, the researcher concludes the effect of the fishbone strategy in teaching, as this led to the effective impact in raising the academic achievement of first-year middle school students and visual thinking.

Adopting the fishbone strategy, which is one of the active learning strategies in teaching science in general and chemistry in particular.

Inclusion of the fishbone strategy, within the vocabulary of the curriculum methodology of teaching colleges.

Adopting the fishbone strategy in teaching chemistry to different levels of study because of its apparent effect in raising the level of academic achievement and visual thinking.

Carrying out similar studies on the subject of fishbone strategy in other study stages.

A study of a proposed effect of developing visual thinking.

BIBLIOGRAPHY

ABD-ALULSAHIBM. M.S. D. AHMED. (2014). "Positive thinking and its relation to self academic motivation and the trend towards teaching profession among the students of education colleges". *Journal of educational and psychological researches*. (41):113-142.

ABU ATHARA, SANAA MUHAMMAD DEIF ALLAH. (2015). The effect of using fishbone strategy in teaching sciences in developing creative thinking skills among sixth-graders of basic education in Taif Governorate, *Journal of the College of Basic Education, Assiut, Egypt*.

AFANEH, I. (2001). "The effect of using the visual approach in developing the ability to solve and keep mathematical problems among the eighth grade students in Gaza", the thirteenth scientific conference of the Egyptian Curricula and Teaching Methods, Curricula of Education, Knowledge Revolution and Contemporary Technology, Guest House, Ain University Shams, Volume 2: 3-52.

- AHMED, S.D & AZIZ, M.S (2018). The Effect of Cognitive Modeling Strategy in chemistry achievement for students. *Opción*. (34):276-294.
- AHMED, S.D. & HAFEDH, M.R. (2019). "The Effectiveness of Jigsaw Strategy" in the Achievement and Habits of Mind for the Scientific 10th Grade Students (Distinguished Schools) in Chemistry. *Transylvanian Review*. 17(44): 12277-12293.
- AL NABHAN, M. (2004). *Fundamentals of Measurement in Behavioral Sciences*, 1st edition, Dar Al-Shorouk for Publishing and Distribution, Amman, Jordan.
- AL-BAWI, M.I. & THANI HUSSEIN (2016). *Models of Modern Strategies in Teaching and Evaluation*, Dar Al-Kutub Wa-Dawa Baghdad, Baghdad.
- AL-DABSI, A. (2012). The effect of using the fish strategy in developing scientific concepts in the subject of sciences (an experimental study on the fourth basic class pupils in the governorate of Damascus countryside), *Damascus University Journal*, 28 (2) and Mishq.
- AL-HUWAIDI, Z. (2005). *The teacher's guide in building achievement tests*
- AL-KUBAISI, A.W.H. (2010). *Applied Statistics in Social Sciences*, 1st edition, Egypt Foundation, Iraqi Writers Forum, Lebanon.
- AL-RAWASHDA, I. et al. (2000). *Teacher's Guide to Building Achievement Tests*, Ministry of Education, General Directorate of Examinations, Amman.
- AL-ZAHIR, ZAKARIA MUHAMMAD, TAMERJIAN JACQUELINE & ABDEL-HADI JAWDAT EZZAT. (1999). *Principles of Measurement and Evaluation in Education*, Dar Al-Thaqafa, Amman.
- AMBO SAEEDI, ABDULLAH BIN KHAMIS, & HODA BINT ALI AL HOSANIA. (2016). *active learning strategies 180 strategies with practical examples*, Dar Al Masirah, Amman.
- AMMAR, MUHAMMAD EID HAMID & NAJWAN HAMID AL-QABBANI. (2010). *Visual Thinking in the Light of Education Technology*, New University House, Alexandria.
- ANWAR, HUSSEIN ABD AL-RAHMAN & ADNAN HAKKI SHIHAB ZANGANA. (2007). *Methodological patterns and their applications in human and applied sciences*, Al-Wefaq Printing Company, Baghdad.
- BABIYEH, B. & BABIYEH, M. (2014). The effect of using the fishbone strategy in developing the skill of problem solving for Taif University students in the Islamic Culture course, the *International Educational Journal*, 3 (1): 142-162.
- HARIRI, R. (2011). *cooperative learning and effective learning skills*, 1st edition, Dar Al-Manhajj Publishing and Distribution, Amman.
- HASSAN, F.A. & SAFAA MUHAMMAD NAMIK (2017). The effect of the fishbone strategy on the achievement of students of the Department of Family Education and Technical Professions in Teaching Methods, *Journal of the College of Basic Education* (6), Al-Mustansiriya University, Baghdad.
- KHALIL, K.M. (2007). *Divergent Thinking Skills*, Al-Manhajj House for Publishing and Distribution, Amman.
- LAVI, F.Y. (2016). The effect of using the fishbone strategy in developing scientific concepts and basic science processes for third-graders in basic sciences, Master Thesis, College of Educational Sciences, Al-Quds University, Jerusalem.
- MELHEM, S.M. (2000). *Measurement and Evaluation in Education and Psychology*, Al-Masirah, Publishing and Printing House, Amman, Jordan.
- MUHAMMAD, A. (2011). *Experimental Psychology*, 1st edition, Al-Adnan Library for Printing, Publishing and Distribution, Baghdad.

SALIH, A. (2017). "The effectiveness of the imagination-oriented strategy in developing the skills of Al-Basri in science for eighth grade students in Yemeni schools", *Journal of Social Studies*, 23 (2).

SHALKAHM, H. (2019). "The Effect of S.N.I.P.S Strategy on the Achievement of Fifth Grade Students" in *Geography. Journal of educational and psychological researches*. 16(63):495-522.

YOUSSEF, OTHMAN HUTHAM & MOHD MOSSADEGH. (2016). "Modern trends in teaching", *Dar Al-Manhaj for Publishing and Distribution*, Amman.

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