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The İmpact of Edelson's Model of Analogical Thinking among Fourth Preparatory Students in Biology

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Abstract

The aim of the current research is to identify (The impact of Edelson's model of analogical thinking among fourth preparatory students in Biology) and to verify the validity of the following hypothesis:

1. There is no statistically significant difference at the level of significance (0.05) between the average scores of the experimental group students who studied according to the Edelson model and the average scores of the control group students who studied according to the usual method of analogical thinking in biology, the current research community is represented by the students of the fourth year of preparatory school in Al-Nomaniya Secondary School for Boys, which is affiliated to the Wasit Education Directorate, and the number of students was chosen intentionally, the number of students was (300), the research sample was chosen by simple random sampling. Class (16) represented the experimental group that was studied according to the Edelson model, where the number of students was (15) and class (11) represented the control group that was studied according to the usual method, whose number of students was (15) students. The experiment was applied in the first semester of the academic year 1020-2021. It took (10) weeks, with a class per week for each group, and the academic content was determined in the first five semesters of biology, the behavioral objectives were analyzed, amounting to (170) behavioral objectives in the light of Bloom's classification of the cognitive domain according to levels (remember, understanding, analysis, application,

installation, evaluation) to achieve the goal of the research, the researcher prepared (40) items to measure analogical thinking, which are situations that each item contains two alternatives and with weights (zero one). After applying the Eta square equation, the impact size was (0.77), therefore, the impact size of Edelson model in the Analogous Thinking Test has a high impact in favor of the experimental group, the average ranks of the experimental group were 22.50 and the total ranks of 337.50, while the average ranks of the control group reached 8.50 and the total ranks of 127.50, where the value of the calculated Mann Whitney test was 7.500 and the Mann and Tenney tabular value 23, with a degree of freedom of 28, which means that it is significant at a significance level of 0.05 in favor of the experimental group.

Keywords: *Edelson's model, analogical thinking.*

Chapter One: Research Problem

One of the indicators that the researcher noticed is the lack of interest in raising the level of thinking in general and analog thinking in particular, and that the educational revolution in the world now focuses on paying attention to the thinking of the learner by all available and possible means, as they destroy the main objectives of the educational process, analogous thinking is one of the highest levels of thinking, as it works on cognitive development through the cognitive link between two concepts according to Piaget's theory (Goswami:1998), and the weakness of the practice of analogical thinking, which is one of the highest levels of thinking in the educational learning process, led to a generation that was unable to be a thinker and creator. Therefore, the current research came to identify the extent of the reflection of (The impact of Edelson's model of analogical thinking among fourth preparatory students in Biology) meaning that raising The level of thinking of the learner has become one of the main objectives of the educational process, as long as the goal is of such importance, it is necessary for those concerned and those in charge of the teaching process to pay attention and focus on that in order to create and produce the learner who is the thinker and the creator who is the best nucleus for building his country (Al-Barqawi, 2014:13)

Thus, the research problem is represented in answering the following question: (What is the impact of the Edelson model on the analogical thinking of the fourth preparatory students in biology?)

Chapter Two: Research Importance

The current era is witnessing rapid development and rapid changes in all branches of human knowledge and its scientific and technological applications. Learning is the first nucleus of this development, the changes nowadays are often characterized by radical changes and do not stop at a specific field. Science has become a huge force that overlaps in all branches of life, which imposed a great responsibility on education to prepare human cadres with the ability to think soundly to face technological progress (Shuber et al.: 185:2005), and that the academic level is not only a product of the educational process, but it is considered a measure in light of which the academic level of learners is determined (Al-Salakhi, 2013: 73). Accordingly, analogical thinking develops in the learner as he progresses in the school stage despite its presence in children in the primary stage, where it begins with tangible and

concrete things until it is integrated in adolescence (the stage of formal operations) (Al-Hashemi: 2016: 12)

Analogous thinking is important for learners in the academic aspect, as well as the life aspect; because it is based on linking previous experiences with subsequent experiences in the educational situation, which increases the learner's self-confidence, so he can make judgments and decisions related to him in order to ensure success in the task entrusted to him and also helps him to raise the level of sense of responsibility and control. (Al-Amawi, 2009: 75)

Thus, many models and strategies emerged, including the Edelson model, which is a learning model based on the constructivist theory that gives the opportunity for learners to develop their experiences in realistic situations they are exposed to, the Edelson model goes through three steps,

The First Step: The Arousal of Motivation

This step focuses on the need for the learner to acknowledge the desire for new knowledge by presenting a confusing situation.

The Second Step: Building Knowledge

This step focuses on building a structure for new knowledge in memory so that knowledge and integration can be achieved by linking new knowledge with old knowledge where that knowledge is organized, acquired and formed.

The Third Step: Purification and Refinement of Knowledge

This step focuses on organizing and purifying knowledge, linking it with other knowledge and enhancing it, which facilitates the retrieval of knowledge and its application (Al-Adili and Baara: 2007-211).

Analogous thinking is important for learners in the academic aspect and the life aspect because it is based on linking previous experiences with later experiences (Al-Amawi: 2009:

75). The process (analog thinking) consists of the process (demarcation or planning) of the different concepts that are present within the cognitive field, and this is called (the base), as well as the process (transfer or transfer) of that group of concepts into fields of knowledge and this is what It is called Target (Burstein, 1983: 17), (Gentner, 1985: p23).

The Foundations and Principles Adopted by the Theory

The structural theory adopted six foundations and principles through which to reach different solutions for symmetrical models:

First: Structural Consistency

Second: Relational Focus (Collins & Gentner, 1987, 126)

Third: Systematicity (Collins & Gentner, 1987: 128)

Fourth: No Extraneous Associations

Fifth: No Mixed Analogies

Sixth: Analogy is not causation (Collins & Gentner, 1987: 126-132).

From the foregoing, the importance of the research can be determined by the following points:

1. Introducing the Edelson model, which is one of the modern models that may contribute to improving the practice of analogical thinking processes.

2. The importance of analogical thinking as it is one of the important types of thinking that must be developed by learners.

3. Providing the educational library with references on the Edelson model and on analogical thinking.

4. **Research hypothesis:** To achieve the goal of the research, the following null hypothesis was formulated:

   1. There is no statistically significant difference at the significance level (0.05) between the average scores of the experimental group students who study according to the Edelson model and the average scores of the control group students who study according to the usual method of analogical thinking.

5. **Research limits:** The research is limited to students of the fourth year of preparatory school in the subject of biology in the Numaniyah Preparatory School for Boys affiliated to the Wasit Education Directorate for the academic year (2020-2021) for the first five semesters in the book of biology 10th edition for the year 2019.

6. **Defining terms:** The Edelson model: (Abdul Karim, 2003) defined it: "A model for organizing content and an educational learning model that depends on many contemporary learning theories and contributes to achieving science education standards, taking into account the basis of learning processes based on meaning and understanding in a rich environment, which can be used to strengthen the integration between intensive content and inquiry-based science education activities" (Abdul Karim, 2003: 499).

Analog Thinking

Define it: (Bransford & Stein, 1984) It is mental operations related to two processes of "aligning" represented in identifying concepts and topics that share a set of similar or analogous elements, and the "focusing" process of selecting corresponding concepts and topics according to the degree of similarity in the structure between them (Bransford & Stein, 1984: 124.

Procedural definition: The researcher defined analogical thinking: it is the ability of the learner to build a bridge between the previous concept and the new concept, which is the total score obtained by the fourth preparatory students on the items of the analogical thinking scale prepared by the researcher in his current research.

Previous Studies

Al-Ani: Watfa Hisham Abdel Hamid Muhammad Al-Ani: 2019, the study aimed to identify the effectiveness of the Edelson model for the fifth grade literary in the subject of philosophy and psychology and their cognitive skills, a master's thesis, the sample size amounted to (24) students, the researcher used the following statistical methods to reach the results, (Box Kai test Mann Whitney and the equation of difficulty and excellence and the Eta square to measure the size of the impact), where it reached results indicating the existence of statistically significant differences in favor of the experimental group between the average scores of the female students who studied according to the Edelson model in the experimental group and the average scores of the female students in the control group.

Sherry L. King, 2008, the study aimed to identify the impact of teaching by analogy on the abilities of first-grade students to analog thinking, College of Graduate Studies, Tennessee State University, a comparative quasi-experimental approach. The sample size was 200 students for the primary study. The researcher used statistical methods to reach the results (t-test) and (terra nova) national test, Pearson correlation coefficient and impact size) where the researcher reached the following results: There are statistically significant differences in the average scores of students who studied according to analog teaching on their abilities in analog thinking in favor of the experimental group on the average scores of students who studied according to the usual method, an unpublished PhD thesis. Middle Tennessee State University, USA.

<h2 style="text-align:center"><mark>Chapter Three:</mark> Research Methodology and Experimental Design</h2>

Since the current research includes an independent variable, which is the Edelson model, and a dependent variable, which is analogical thinking, so the researcher used the design with partial control for two equal groups, one of them is the experimental group and the other is the control group with a scale of dimensional analog thinking scheme (1) illustrates this

Scheme 1.

Of the experimental design to single out the research sample

The group	Equivalence procedures	Independent variable	Dependent variable
Experimental	- Intelligence - Previous information -Analogue thinking	Teaching according to the Edelson model	Analogue thinking
Control		Teaching according to the usual method	

Second, define the community

1. **Research community:** It includes the fourth preparatory students in the Numaniyah Preparatory School affiliated to Wasit Education Directorate Government morning for boys for the academic year (2020-2021)

2. **Research sample**: The researcher chose the research sample represented by Al-Nomaniya Preparatory School for Boys by the intentional method, and the number of its students was (300) distributed among twenty classrooms, the experimental and control groups were randomly assigned, as the hall (11 and 16) represented the number of

students (15) for each group. Class (16) represented the experimental group that was taught according to the (Edelson) model, and class (11) the control group that was taught according to the usual method.

Third: Equality of groups: Although the research sample was chosen at random, which is the experimental and control group, their inequality is likely, because the equivalence of the two groups is important in order to obtain important results, therefore, the researcher was keen to equalize the two research groups before commencing the experiment with a number of variables that are believed to affect the results of the experiment, and thus work was done to equalize the two groups with the following variables (previous information, intelligence, analogical thinking).

Table 1.

Shows the statistical parameters of the equivalence of two groups

	Experimental group			Control group		
sample number		15		sample number		15
Statistical parameters	Analog thinking	Intelligence	Previous information	Analog thinking	intelligence	Previous information
Average rank	15.13	15.37	16.07	15.87	15.63	14.93
Total ranks	227	230.5	241	238	234.5	224
Calculated value of u	107	110.5	104	107	110.5	104
Tabular value u	23	23	23	23	23	23
Degree of freedom	28	28	28	28	28	28
Sing degree	0.818	0.934	0.721	0.818	0.934	0.721
Statistical significance	Not statistically significant			Statistical significance	Not statistically significant	

Not significant at the significance level (0.05)

Fourth: Adjusting the variables: the researcher believes that these variables are not subject to the researcher's control and that they may affect the results of the research or affect the dependent variable, and therefore they must be adjusted in order to obtain accurate results attributed to the independent variable away from any other factors and from these variables

(sampling selection, Experimental conditions, experimental extinction, experimental procedures, maturation-related processes).

Fifth: Research requirements: Determining the scientific subject: The researcher determined the scientific subject that will be taught to the students of the fourth year of preparatory school for the experimental and control groups, and it was represented in the first five chapters of the Biology book for the academic year (2020-2021) Tenth Edition 2019.

1. **The formulation of behavioral objectives:** After determining the prescribed material, the researcher formulated (170) behavioral objectives according to Bloom's classification in the cognitive domain for the six levels (remember, understand, apply, analyze, install, evaluate) and to ensure the validity of the objectives and their fulfillment of the scientific material, the researcher presented it to a group of arbitrators and experts, and after expressing Their opinions and directives have been modified, as their number reached in its initial form (170) for behavioral purposes. The researcher adopted the percentage (80%) and above as a criterion for judging the validity of behavioral purposes and apparent honesty.

2. **Teaching plans:** In light of the content of the chapters that the experiment is to be conducted on, and similar to the prepared objectives, plans were prepared for the experimental and control groups, which included (20) plans by (10) plans for each group, one lesson per week.

Seventh: Analog Thinking Scale

After reviewing the analogical thinking literature and reviewing previous studies, the researcher did not find an appropriate scale to measure analog thinking, and thus the researcher built and prepared a scale for analog thinking according to the definition (Qatami: 2013:255), which is what we perform mental operations when we use information in one field (Source Or analogy) to help solve a problem in another field, which is (the goal), in addition to the existence of a process (transfer or transfer) of information into fields of knowledge, which is (the goal) and therefore, the system of relations is maintained for each of the knowledge and vocabulary of (the base) and the knowledge and vocabulary of (the goal). (Holyoak & Thagard, 1989:295) The researcher built (40) items representing positions, which are known as (the base), and the number of alternatives was two, which represent what

is known as (the goal) and with weights (zero, one). For that, the researcher followed specific practical steps to build the test as follows:

1. The researcher's dependence on psychometric measurement in constructing the Analogous Thinking Test
2. Adopt the logical or rational approach and the experience approach, in addition to benefiting from the opinions of the arbitrators
3. The researcher adopted two alternatives for each item.

Experiment with clarity of instructions: for the purpose of ensuring the clarity of the wording of the items of the analogical thinking scale and the answer time. The researcher presented the scale to the members of the exploratory sample to show the extent of the clarity of the instructions in the scale, as well as the clarity of the items, and the determination of the time taken to answer. The time taken to answer is (43) minutes.

Statistical Analysis of the Analog Thinking Scale İtems (Second Exploratory Sample)

First: Construction Validity Procedures: The Construction Validity İndicators were Extracted in Two Ways

A. Discriminative power of the items: It is the ability of the item to distinguish between the higher and lower levels of individuals for the trait that it measures (Shaw; 1967: 97). The researcher relied on the percentage of the experimental and control groups, which amounted to (41) students for each group out of the total exploratory sample amounting to (157).) Since the scale items are binary (1, zero), the correlation coefficient (phi) was adopted to detect the discriminatory power. If the items were honest, the strength of the relationship was direct and significant, and to detect the significance of the relationship, the researcher used the (chi-square) and when comparing the calculated value of the chi-square test with the tabular value at the degree of freedom (1) and at the significance level (0.05), which is (3.84), we find that all the items are distinct and were not any item where its number was (40) is excluded.

B. The internal consistency of the Analog Thinking Scale items (the relationship of the item with the total score of the items). The researcher verified this indicator by finding the relationship between the degree of each item and the total degree of the Analog

Thinking Scale using the Point Passerbal correlation coefficient, this is because the degrees of correction of the scale are binary (0.1) correction of items in which all items are significant when compared with the critical value of the correlation coefficient of (0.098), the level of significance (0.05) and the degree of freedom (398).

C. Apparent validity: The apparent validity of the scale was calculated by presenting the scale in its initial form to a number of arbitrators and specialists in education, psychology and teaching methods, where the percentage ranged from (85% - 100%) as the test is considered honest if the percentage of agreement ranges from (0.20 -0.80), and using the chi-square, it turns out that all the items are statistically significant, and thus all the (40) items were retained.

D. Structured validity indicators: where the researcher was able to verify the validity of this indicator for the validity of the above by analyzing the items statistically and calculating their discrimination coefficient, the discriminatory power of the scale items was calculated by showing the degree of correlation of each item with the total score (217: 1988, Anastasi).

Second: The Stability Measures for the Analog Thinking Scale

A. Kewder-Richardson Method 20

To verify the scale's stability, the researcher tested a random sample of (80) students from the statistical analysis sample, and using the Richardson Code equation (20), the reliability coefficient reached (0.88), which is a very good stability coefficient.

Chapter Fourth

This chapter includes five axes, starting with the presentation of the results that have been reached and ending with the proposals as follows: -

The first axis: There is no statistically significant difference at the level of significance (0.05) between the average grades of the experimental group students who study according to the Edelson model and the average grades of the students of the control group who study according to the usual method in dimensional analog thinking, where the average ranks of the experimental group in analogical thinking reached (22.50) and the total ranks reached

(337,50), while the average ranks of the control group reached (8.50), and the total ranks (127,50), which constitutes an apparent difference by calculating the average ranks And the total ranks in the performance of students in analogical thinking in favor of the experimental group Table (2)

It shows the statistical parameters to find the differences between the experimental and control groups in analogical thinking according to the Mann Whitney test Table (2).

Table 2.

The group	Sample number	Average rank	Total ranks	Calculated Mann Whitney (w) value	Tabular Mann Whitney (w) value	degree of freedom	(Sig) degree	Indication
Experimental	15	22,50	337,50	7,500	23	28	0,000	function in favor of empirical
Control	15	8,50	127,50					

Significance at the significance level (0.05)

The arithmetic mean of the experimental group was 31.933 and the standard deviation was 4.131, while the arithmetic mean of the control group was 22 and the standard deviation was 4.140 for the two groups, and the calculated T value between the experimental and control groups in the Analogous Thinking Test was 8.989 at a degree of freedom of 28, and after applying the ETA square equation, the impact size was (0.77). Therefore, the impact size of the Edelson model in the Analogous Thinking Test has a high impact for the experimental group.

Interpreting the Results of the Null Hypothesis by Analogical Reasoning

The results proved that the students of the experimental group who studied biology for the fourth grade of preparatory school, according to the Edelson model, outperformed their peers in the control group who studied according to the usual method in the average scores of the dimensional analogue thinking scale. Statistically significant superiority at the level of significance (0.05). The result of the superiority of the students in the experimental group

over the students of the control group in the Analog Thinking Scale is attributed to the impact of the independent variable, which is the Edelson model.

Conclusions

The researcher reached several conclusions, including:

1. Teaching according to the Edelson model had a significant impact on improving the level of analogical thinking for the fourth-grade students in preparatory school in biology in the experimental group at the level of analog thinking for the control group who studied according to the usual method.

Recommendations

The researcher recommended the following:

1. Those in charge of the education process and specialists in this regard, such as a ministry or directorates of education, must adopt modern teaching methods, models, strategies and methods that would contribute to raising the scientific and cognitive level of students. Especially in the countries that have made advanced leaps in the educational field, which directly affected the reality of the societies of those countries at all levels through holding seminars and development courses or reproducing experiences in the educational field in those countries suitable for application in the local environment of the country.

2. Enriching the study materials with educational situations and activities that raise the level of thinking, especially analogical thinking, and the use of methods, models and strategies that help raise the level of thinking, including the Edelson model for learning.

Suggestions

1. Introducing effective teaching processes and methods based on understanding and building knowledge and information. Encouraging analogical thinking, including the Edelson model.

2. Preparing a teacher's guide that explains the processes of analogical thinking and the methods and methods that work to develop this thinking.

References

Al-Barqawi. Jalal Aziz Farman (2014). *Creative thinking is a science and art,* Dar Al-Radwan for Publishing and Distribution, Amman, Jordan.

Shuber, et al. (2005), *Fundamentals of Teaching,* 1st Edition, Dar Al-Manhaj for Publishing and Distribution, Amman.

Abdel Karim, Sahar Mohamed (2003). The effectiveness of a program based on educational requirements for the use of pre-service science information on changing their perceptions of the contemporary nature of science *The Seventh Scientific Conference Towards Better Scientific Education, Egyptian Association for Scientific Education / Cairo - Egypt.*

Al-Adili, Abdel Salam and Baara Hussein Abdel Latif (2007). *The effectiveness of the learning-for-use model in the acquisition of the desired chemical concepts by students of the upper basic stage in Jordan,* Volume 22 / Issue 85 / December

Al-Amawi, Jihan Ahmed (2009). *The effect of using the role-playing method in teaching reading on the development of contemplative thinking among third-grade students in the College of Education,* the Islamic University of Gaza, an unpublished master's thesis.

Qatami, Youssef Mahmoud (2013). *Cognitive Learning and Teaching Strategies,* 1st Edition, Dar Al Masirah for Publishing and Distribution, Amman, Jordan

Al-Hashemi, Ali Hassan Rabie (2016). *The effect of teaching by wave imagination with the analogical thinking strategy in the achievement of environmental science subject,* PhD thesis, College of Education for Pure Sciences - University of Baghdad

Anastasi, A. (1988): *Psychological Testing,* 6th Ed., New YorkMacmillan Publishing Company

Burstein, M, H (1983): *Concept formation by incremental analorical reasoning and debugging,* U. S

Collins, A, M and Gentner, D (1987): *How People construct metal Models,* Cambridge University Press U, K

Edelson, D.C. (2001). Learning-for-use: A framework for the designoftechnology-supported inquiry activities. *Journal of Research in Science Teaching,* 38(3), 355-385.

Gentner, D, and Landers, R (1985): Analogical Reminding, U, K

Holyoak, K, J and Thagard, P (1989): *Analogical mapping by constraint satisfacation,* cognitive science, u. s.a.

Joyce, B. R. & Weil, M. (1980). *Models of Teaching. Englewood cliffs,* NJ : prentice – Hall.