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The Effectiveness Of Employing The Magnet Poles Strategy In Developing Exploratory Thinking Among Second-Intermediate Class Female Students

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Abstract
The research aims to study the effectiveness of employing the "Magnet Poles" strategy in developing exploratory thinking among second-intermediate female students. The research sample was selected from students at Al-Kholoud Girls' Secondary School in Babil Governorate/Al-Hashimiyah District. The sample included two groups: the experimental group, which numbered (33) students, and the control group, which numbered (34) students. I adopted an experimental approach with partial control for the two equivalent groups, taking into account the application of the independent variable (the "Magnet Poles" strategy) to the experimental group, while the control group followed the traditional method. Equivalence between the two groups was determined based on several variables: (chronological time, academic achievement, intelligence, experience, and the exploratory thinking test after implementing the experiment). The effectiveness of the strategy was measured using exploratory thinking tests as a research tool. The results showed a clear superiority of the experimental group in exploratory thinking compared to the control group, which illustrates the effective impact of the "Magnet Poles" strategy in enhancing exploratory thinking skills among female students.

Keywords: *Magnet poles strategy, Exploratory thinking, Female students and Second-intermediate class*

I. INTRODUCTION

Problem statement

Physics is still taught using stale teaching methods and approaches, lacking interaction and vitality. The dominant pattern is one of recitation by the teacher and indoctrination by the students, with an absolute reliance on memorization and parrot-like problem-solving, without providing space for educational activities and pedagogical situations that foster exploratory thinking. I have observed that this approach draws students into a superficial and passive understanding of the subject and does not contribute to achieving the true goals and deep understanding of physics teaching. Based on this, I decided to use the magnetic poles method to develop exploratory thinking, applying it to second-year intermediate school students as a practical experiment to identify the impact of this method on educational development and learners' achievement of better evaluations. This may help this group of students attain and benefit from the necessary educational level, and train them effectively in mental activities, thus increasing their exploratory thinking. From the above, the problem of the current research can be summarized in the following question:

1. What is the effectiveness of employing the Magnet Poles strategy in developing exploratory thinking among second-intermediate class school students?

The Significance of the Study

The importance of the research lies in improving the quality of education and its outcomes in light of the application of a modern teaching method that makes students feel comfortable and passionate about the subject matter (Ibrahim, 2019: 109). This method is important for keeping pace with the knowledge explosion and technological advancements, and for keeping pace with the demands of the era, as it is the center of learning in science education (Al-Asadi, 2020: 73).Based on the adoption of constructivist theory, which builds self-directed learning through interaction with its surroundings, this creates an integrated educational environment characterized by interdependence between student and teacher, creating active learning, taking the role of the educational process as its starting point, and making the student an active focus of the lesson, in line with the desire for scientific reception, as an effective means of building knowledge, in light of interaction with diverse educational environments (Al-Shammari, 2011: 29).Employing the magnet poles strategy in exploratory thinking contributes to classifying information into main and secondary elements in an innovative way. This enhances academic achievement and develops the ability to think flexibly, which results in a deeper understanding of the subject from multiple perspectives. It also helps in restructuring questions, facilitating the presentation of comprehensive summaries and concepts, and linking the academic material to real-life areas. This contributes to building knowledge on previous experiences rather than on memorization (Sejnost & Sharon, 2016: 64). Exploratory thinking, as an active learning model, empowers students to actively explore educational concepts, recycle knowledge, and organize it (Mohsen, 2011: 106). This thinking is based on the principle of self-learning, which promotes intellectual independence and makes the school's role one of guidance rather than transmission of information (Al-Janahi, 2019: 68).

Based on the above, the importance of the research can be summarized as follows:

1. To the researcher's knowledge, this is the first local study examining the effectiveness of the "Magnet Poles" strategy in developing exploratory thinking among second-intermediate class school students.
2. This method allows for flexibility, raises the level of education, and keeps pace with modern requirements.
3. It develops students' personalities and enhances the integration of their mental abilities and cognitive activities in a gradual and systematic manner.

Aim of the Study

The research aims to identify the effectiveness of employing the "Magnet Poles" strategy in developing exploratory thinking among second-intermediate class school students.

Hypothesis

To achieve the research objective, the researcher formulated the following null hypothesis: (There is no statistically significant difference at the level of (0.05) between the average scores of students in the experimental group who received instruction in physics using the magnetic poles strategy, and the average scores of their counterparts in the control group who studied the same subject using the traditional method, on the exploratory thinking skills test.)

Limitations

The research was limited to a set of defined limits, as follows:

1. Spatial Limits: Government daytime intermediate and secondary schools for girls located within the Hashemite District of Babil Governorate, administratively linked to the General Directorate of Education in Babil.
2. Human Limits: The sample included only second-intermediate students.

3. Temporal Limits: The research was conducted during the second semester of the 2024-2025 academic year.

4. Cognitive Limits: The researcher relied on the concepts and scientific content contained in the physics textbook for the second-intermediate class issued by the Ministry of Education - General Directorate of Curricula. For the academic year (2024-2025), specifically in the fourth, fifth and sixth semesters, according to the edition approved by the authoring committee.

Definitions of the Keywords

1. **Effectiveness**: (Youssef, 2020) defines it as: "The continuous ability to create a tangible positive impact, demonstrated by providing more commendable results and continuous constructive influences" (Youssef, 2020: 45).

2. **Operational definition of effectiveness**: The extent of the positive impact that the Magnetic Poles strategy has on the achievement and exploratory thinking of second-intermediate class school students when compared to students in the control group. This impact is measured using statistical results extracted from the scores of the exploratory thinking test. The Magnetic Poles strategy was defined by Moss & Iapp (2010) as: "An organized method aimed at supporting students in providing effective educational and teaching activities that contribute to controlling the course of the educational situation in a thoughtful and sound manner, including achieving educational goals within a clear and organized educational framework" (Moss & Iapp, 2010). **Operational definition**: One of the active learning strategies, applied during the lesson to help Second-intermediate physics students organize and categorize main information into sub-ideas, and it also contributes to enhancing students' engagement with educational situations.

3. **Exploratory Thinking**: (Al-Khader, 2019) defines it as: "A set of mental and cognitive processes that reflect the learner's desire to acquire new experiences. It is characterized by seriousness, which motivates the learner to question and interpret phenomena, establish relationships between them, and uncover unfamiliar elements in various educational situations" (Al-Khader, 2019: 68). **Operational Definition**: A pattern of higher-order thinking that contributes to the development of the student's general mental abilities and enables her to analyze educational situations by classifying and critiquing information, and distinguishing between what is relevant to the context and what is not, based on the use of key skills (criticism, understanding relationships, prediction in light of data, and formulating hypotheses), as measured by the student's scores on the exploratory thinking test.

II. Theoretical Framework and Previous Studies

1. Constructivist Theory

Constructivist theory, in its simplest form, is an evolution of cognitive theory, transforming external factors in education into internal factors related to the student. Examples include prior knowledge, motivation, and thinking patterns, among others (Abdul Amir and Atef, 2020: 9).

2. Active Learning

This is the cognitive approach to the effectiveness of the educational process. It aims to engage students in collective and collaborative work, so that they become participants in the construction of knowledge, rather than mere recipients (Abu Al-Hajj, 2017: 25). It contributes to transforming students into active processors who interpret information and reflect on its use in their daily lives in a distinctive and useful manner (Al-Shon, 2017: 86).

3. The Magnet Poles Strategy

The "Magnet Poles" strategy relies on drawing or pasting a magnet on the learning board. Students identify the main concepts from a scientific text and write them on the poles. The teacher then adds subsidiary and random information that is not related (Ambou Saidi et al., 2019: 366). This method is considered an effective method for raising achievement and developing thinking through the sensory organization of information, and it has proven effective in various educational situations (Urquhart & Montee, 2005: 12).

1. The teacher draws a drawing or pastes a diagram of a magnet in the center of the board, identifying the main words on the poles.
2. The main facts or information covering the lesson topic are written, and each is placed on its respective pole.
3. The subsidiary information and facts are arranged so that they are distributed across the poles, with some linked to the red pole and some linked to the blue pole, while the other group of information is placed randomly.
4. Students are asked to retrieve relevant information and write texts related to the main concepts, using the cards distributed at the beginning of the lesson.

The researcher applied these steps to the second-intermediate physics course and found them appropriate for the students' nature and contributing to achieving the desired educational goals.

4. Exploratory thinking

Exploratory thinking is a mental process that begins with partial observations and their analysis with the goal of arriving at general concepts and a broader understanding. It relies on induction, whereby the individual moves from the specific to the general to enhance their ability to infer and discover relationships, contributing to the gradual construction of knowledge (Mohsen, 2022: 159).

Previous studies

Among the most prominent previous studies relied upon in this research are:

Table (1): Studies that used the magnetic poles strategy as an independent variable and exploratory thinking as a dependent variable

Name of researcher and year of study	Place of study	Purpose of study	Study stage	Sample size and gender	Study subject	Research tool	Statistical methods	Most important results

Al-Shammari, 2022,	Iraq	The research aims to investigate the effect of the magnet poles strategy on the achievement of the social studies subject among second-intermediate students	Intermediate school	intermediate stage (62) students	social studies	academic achievement...	The statistical package (spss) version (21) was used	The students of the experimental group outperformed the students of the control group
Al-Ghazali, 2022	Iraq	The research aims to investigate the effectiveness of the z-strategy on the achievement of second-intermediate school students in history and their exploratory thinking	intermediate school	74 students	History	achievement and exploratory thinking test	T-test for two independent samples, chi-square, Pearson's correlation coefficient, Spearman's coefficient, difficulty coefficient equation, and item discrimination power equation.	Students in the experimental group outperformed students in the control group.

Aspects of Benefiting from Previous Studies

1. Utilizing previous studies and sources in constructing the theoretical framework for the variables.
2. Comparing the results of the current research with the results of previous studies to clarify the differences and similarities.
3. Employing the theoretical frameworks of previous studies to support the theoretical framework of the research.

III. Research Methodology and Procedures

This section addresses the scientific procedures followed to achieve the objective of the current research. It includes the appropriate methodology, experimental design, and the steps followed in selecting and constructing the research sample, as well as verifying its validity and reliability.

Research Methodology

The researcher adopted the experimental method in this research, due to its compatibility with the nature of the study. This method allows for identifying the effect of the independent variable by controlling other existing variables.

Experimental Design

This research used a partially controlled experimental design, which consists of two groups: one experimental and the other control. The experimental group was subjected to the independent variable, while the control group was not exposed to this variable. The resulting effect was measured using an appropriate tool at the end of the experiment, and the application was carried out in the exploratory thinking test shown in Table (2).

Table (2) represents the experimental design for the current research.

Groups	Statistical Equivalence	Independent Variable	Dependent Variable	Measurement of Dependent Variable
Control group	1.Chronological time. 2. Intelligence 3.Previous achievement. 4. Prior knowledge. 5.Exploratory thinking test	1.The conventional method Magnet poles strategy	Achievement Exploratory Thinking	Achievement test Exploratory Thinking test
Experimental group				

Research Community

The current research community was determined from all second-intermediate female students for the academic year (2024-2025) in intermediate and secondary schools, totaling (24) schools, within Babil Governorate/Al-Hashimiyah District, based on official data from the annual statistics issued by the Babil Education Directorate.

Research Sample

The study sample was selected as follows:

1. School Sample: To implement the experiment, Al-Kholoud Girls' Secondary School was selected using a lottery method. It was found that it contains four second-intermediate classes.

2. Female Student Sample: This sample was determined by randomly selecting two classes from among the second-intermediate classes. The number of female students reached (67), after excluding students who failed, as this might have affected the research results, as they studied the same subjects. Their number reached (5) students. Table (3) shows the details.

Table (3) shows the distribution of the sample across the two categories.

Group	Number before exclusion	Failures	Number after exclusion
Experimental	36	3	33
Control	36	2	34
Total	72	5	67

Equivalence of the two research groups

The researcher sought to find equivalence between the two groups as follows:

Table (4): shows the statistically significant differences between the equivalence variables of the two groups.

Variable	Group	Number	Mean	Standard Deviation	Degrees of Freedom	Calculated t-value	Tabular t-value	Significance (0.05)
Chronological Time	Experimental	33	166.30	4.09	65	0.45	2	Not Significant
	Control	34	165.82	4.60				
Intelligence	Experimental	33	30.61	5.95	65	0.35	2	Not Significant
	Control	34	31.12	5.89				
Previous Achievement	Experimental	33	63.15	14.66	65	1.35	2	Not Significant
	Control	34	68.21	15.97				
Previous Knowledge	Experimental	33	9.33	2.35	65	0.49	2	Not Significant
	Control	34	9.65	2.87				
Exploratory Thinking	Experimental	33	12.91	3.05	65	1.20	2	Not Significant
	Control	34	13.91	3.75				

Internal and External Validity

Internal validity is affected by several factors, such as maturity, history, waste, selection, measurement tools, and others. The researcher also took care to consider external validity elements, which include: maintaining confidentiality when implementing the experiment, a consistent curriculum, the subject matter, the number of classes allocated, and a suitable classroom environment.

Experimental Requirements

To enable the researcher to implement the experiment, she must provide the necessary conditions, including the following:

1. Determining the Curriculum Content: The researcher determined the content of the physics curriculum for the second intermediate class according to the curriculum components for the second semester of the academic year (2024-2025), in line with the plan.

Table (5) shows the distribution of the curriculum across the lessons.

Chapter	Topic	Lessons
Chapter Four	Levers	5
Chapter Five	Wave Motion and Sound	4
Chapter Six	Light and its properties	7
Total		16

2. Behavioral Objectives: In preparing the objectives, the researcher relied on a thorough analysis of the scientific material, based on Bloom's six levels. The analysis resulted in (165) objectives in a preliminary format, which were presented to a number of referees. These objectives received more than (80%) approval, indicating their suitability for use in the teaching plans during the experiment.
3. Instructional Plans: The researcher developed (16) instructional plans for the experimental group, implemented using the "Magnet Poles" strategy. She allocated (16) plans to the control group, using the traditional method. These plans were distributed at a rate of two lessons per week for each group over the course of the study weeks designated for the experiment.
Eighth: Research Tool: To achieve the research objective, the researcher developed the research tool, the Exploratory Thinking Test.
1. Defining the Objective of the Test: This test aims to assess the level of exploratory thinking among the second-intermediate class female students in the experimental group after implementing the "Magnet Poles" strategy.
2. Defining Test Skills: The test included a set of exploratory thinking skills, namely:
(prediction, formulating hypotheses, understanding relationships, criticism, and identifying errors and fallacies).
3. Formulating Test Items: The researcher prepared the initial version of the test, including (35) multiple-choice items distributed equally across the targeted skills.
4. Formulating Test Instructions and Correction Mechanism: An opening page for the test was prepared, including instructions to be read before beginning to answer. The researcher ensured that the items were appropriate for the students' level. A solved example was also included, demonstrating the answers to the items and specifying the test time. The researcher adopted a correction model that awarded one point for each correct answer and zero for incorrect, omitted, or multiple-answer answers, with the final score being (35) and the lowest being (0).
5. Validity of Test Items (Apparent Validity): To ensure the quality of the wording and integrity of the items, the researcher presented (35) items from the test to a group of expert arbitrators in the field of physics teaching methods. After reviewing and providing their comments, the items that achieved an agreement rate of (80%) or more were approved, with the deletion of (5) items that did not meet the criteria. This brought the final number of items to (30), accompanied by an approved answer sheet.
6. First and Second Exploratory Applications:
A. First Exploratory Application: The researcher conducted the test on Sunday (12/8/2024) on a first survey sample consisting of (30) students from Al-Manar Intermediate School for Girls. It was found that all items were clear and understandable, with an average time of (39) minutes.
B. Second Exploratory Application: The researcher administered the test on Sunday (December 22, 2024) to a second survey sample outside the research sample, consisting of (100) female students from Kunuz Al-Ma'rifa Girls' Secondary School. The aim was to conduct a statistical analysis of the test items.
7. Statistical Analysis of the Test: After the second survey and correcting the answers by awarding one point for a correct answer and zero for an incorrect answer (including omitted and multiple answers), the researcher arranged the scores in descending order, determining a percentage of (27%) from the highest to the lowest to form the upper and lower groups. The following was calculated:
A. Difficulty Coefficient: Ranged between (0.43 – 0.59), and all items were acceptable.
B. Discrimination Coefficient: Ranged between (0.37 – 0.67), and all items were acceptable.
C. Efficacy of False Alternatives: Ranged between (-0.111 – 0.370), and was within the acceptable limits.

8. Internal Consistency: To determine the internal validity of the test, the researcher relied on the use of Pearson's correlation coefficient by measuring the correlation of each item with the total score on the second pilot sample. This revealed:

A. The relationship between the item and the total score: The results of the correlation coefficients showed that they ranged between (0.31 - 0.71).

B. The relationship between the item and its subordinate skill: The values of the correlation coefficients ranged between (0.45 - 0.83).

C. The relationship between the skill and the total score: The values ranged between (0.75 - 0.85).

Since all of these values are statistically significant at the (0.05) level, as they exceeded the table value (0.195), this indicates the validity of the internal structure and does not require deleting any item.

9. Reliability: The researcher verified the reliability of the exploratory thinking test using two methods:

A. Reliability by internal consistency: The Kuder-Richardson equation (KR-20), which is used for binary (true/false) tests, yielded a reliability coefficient of 0.90.

B. Reliability by test-retest method: The test was administered twice, with a two-week interval (December 8, 2024 and December 22, 2024) to a sample of (30) students from Al-Manar Intermediate School for Girls. The reliability coefficient was 0.89.

10. Final Form of the Test: After verifying the psychometric properties of the test items, the final form was approved, consisting of (30) items, with scores ranging from (0-30). Thus, the test was ready for application to the study sample of second-intermediate class school students.

Statistical Methods

For statistical analysis and data processing, the researcher used the programs (EXCEL 2016) and (SPSS 21).

IV. Presentation and Interpretation of Results, Recommendations, and Suggestions

Presentation of the Results

The results revealed no statistically significant difference at the 0.05 level between the average scores of the experimental group students who received physics lessons using the magnetic poles strategy and the average scores of their counterparts in the control group who studied the same subject using the traditional method on the exploratory thinking test. To verify the results, an independent samples t-test was used to compare the average scores of the two groups. This was achieved by calculating the arithmetic means and standard deviations for each group.

Table (6): Results of the t-test for the two groups' scores on the exploratory thinking test

Group	Number	Mean	Standard Deviation	Degrees of Freedom	t-test		Significance Level (0.05)
					Calculated	Tabular	
Experimental	33	20.09	2.88	65	6.30	2	Significant in favor for the experimental
Control	34	14.94	3.72				

The results in Table (6) showed that the average scores of the experimental group students were higher than their counterparts in the control group, with the experimental group's average score reaching 20.09 compared to the control group's average score of 14.94. The calculated t-value was 6.30, which is higher

than the tabular value of 2.00 at a significance level of 0.05. This confirms the effectiveness of the "Magnet Poles" strategy in enhancing the development of exploratory thinking skills among students.
Effect Size Calculation: To calculate the effect size resulting from the implementation of the "Magnet Poles" strategy in developing exploratory thinking skills, the Eta squared coefficient was used, reaching 0.38, indicating that the effect size is very large and reflects the strong impact of the strategy on the experimental group's performance.

INTERPRETATION OF THE RESULTS

1. The achieved results are attributed to the interactive learning environment provided by the "Magnet Poles" strategy, based on dialogue and the exchange of ideas, which provided students with broader opportunities to acquire exploratory skills.
2. This strategy helped enhance exploratory and analytical thinking skills by motivating students to discuss ideas and discover relationships between scientific concepts.
3. The "Magnet Pole" strategy is an active and effective teaching method, as it gives students the freedom to analyze scientific content and identify interconnected relationships between concepts. This contributes to developing exploratory thinking skills and promoting in-depth thinking.

CONCLUSIONS

1. The results indicated that implementing the "Magnet Poles" strategy had a clear impact on developing exploratory thinking skills among second-intermediate class school students.
2. The "Magnet Poles" strategy contributes to creating an active classroom environment that encourages students to reflect, discuss, and ask questions, which helps build deeper knowledge and express their understanding in a distinct and clear way of thinking.

RECOMMENDATIONS

1. It is recommended that the "Magnet Poles" strategy be widely used in teaching science subjects, given its proven effectiveness in developing exploratory thinking and enhancing interaction among students. 2. Teachers are advised to adopt this strategy due to its ability to activate students' roles, as it relies on stimulating exploratory thinking by asking questions, linking concepts, and verifying hypotheses interactively.

SUGGESTIONS

1. Conduct future studies to measure the impact of the "Magnet Poles" strategy on developing exploratory skills among intermediate school students in other science subjects.
2. Conduct comparative studies between the "Magnet Poles" strategy and traditional methods for developing exploratory thinking and acquiring physics concepts.

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