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Research Article

The Effect Of The Logical (Mathematical) Intelligence Strategy On The Achievement Of The Fourth Preparatory Students In Physics

Ass. Prof. Dr. Zainab Ali Hadi and Ali Majid Bressem

almno252689@gmail.com
Al-Mustansiriya University / College of Basic Education

Abstract:

The current research aims to identify the effect of the logical intelligence strategy (mathematical) on the achievement of the fourth preparatory students in physics, and in light of this, the researcher formulated the following null hypothesis:

- There is no statistically significant difference at the level (0.05) between the average grades of the experimental group students who study physics according to the logical intelligence strategy (mathematical) and the average grades of the control group students who study the same subject in the usual way in the achievement test.

The study sample, which was chosen by the intentional method, consisted of (30) students of the fourth scientific grade, and they were randomly distributed into an experimental group consisting of (15) students, and a control group consisting of (15) students, the two research groups were rewarded with the variables (chronological age calculated in months, intelligence test (Raven), previous information test, previous achievement in physics).

In his study, the researcher used a tool, which is the achievement test in physics of the type of multiple-choice component (40) items, the validity and reliability of the test were verified, the researcher used the following statistical methods (Mann-Whitney test for two independent samples, difficulty coefficient equation, discrimination coefficient equation, efficacy equation of wrong alternatives, chi-square (ch^2), Keuder-Richard 20 equation, Cooper agreement equation, impact size equation (η^2)) through the (SPSS) program, and after the end of the experiment, the research tool was applied and the data were treated statistically using Mann Whitney for two independent samples, and the study concluded:

- There are statistically significant differences at the level (0.05) between the mean scores of the students of the experimental group that studied according to the logical intelligence strategy (mathematical) and the control group that studied according to the usual method in the achievement test and in favor of the experimental group.

In light of the results, the researcher presented a number of recommendations and suggestions.

Research problem: Physics is one of the scientific subjects that includes different topics and needs diverse and appropriate teaching strategies, and the efficiency of the teacher that communicates information and deals with the data of the subject in a way that provokes students' thinking and attracts them to enjoy studying physics, which has an impact on the achievement level of students (Al-Hayhy, 2018: 5).

This requires a shift from rote learning to learning that depends on thinking, methods of facing problems and providing solutions to them, and the use of modern teaching strategies that make the learner the focus of the educational process.

Physics education still faces great challenges, represented in the difficulties students face in the contents of physics and in teaching strategies, and the lack and quality of the modern technological means used, and the results of physics tests and the extent of understanding of physics is getting worse year after year for students, and as high schools in Iraq suffer there are many problems related to the educational process, especially in physics, which leads to low achievement of students in general tests (Al-Alwani, 2018:3).

One of the reasons for this decline in the achievement level of high school students is what was indicated by the study of (Al-Hijami, 2004), the study of (Shabib, 2017) and (Al-Alwani, 2018), which confirmed that teachers use traditional strategies in teaching physics and the lack of knowledge of the physics teacher with strategies Modern teaching, which made the student feel bored and frustrated, as this led to a decrease in achievement, so this study attempts to identify the logical intelligence strategy (mathematical) and how to employ it in teaching physics and its relationship with achievement, and the researcher formulated the problem of his research by asking the following question:

What is the impact of the logical intelligence strategy (mathematical) on the achievement of the fourth high school students in physics?

research importance:

The physics of the basic sciences that have an impact significantly in most other sciences, and because of this science from a profound impact in the modern era technology and special sciences in the fields of medicine, space and communications, given the importance of physics to be interest in ways taught and developed, through the use of strategies and models of teaching and that make the role of the learner is a positive role in the educational situation (Salama et al., 2009: 18).

The modern view of teaching science in general and physics in particular has sought to employ science in practical life, so educators' attention is currently focused on both content and teaching strategies as they are among the basics of teaching, which made educators search for the best methods and strategies in which physics is taught (Nashwan, 2001: 55).

Recently, modern teaching strategies and methods based on their preparation and based on scientific and educational theories have appeared that contributed to the development of the educational process, and the most important of these theories is the theory of multiple intelligences (Zaytoun, 2002: 189).

The theory of multiple intelligences is one of the modern trends that, since its emergence, have revolutionized the field of educational practice, in which it has changed teachers' view of their students and clarified the appropriate methods for dealing with them according to their mental abilities (Al-Shehri, 2016: 637).

It presented a set of innovative teaching strategies that enable the teacher to translate the subject he is teaching according to the types of intelligence, and among these strategies used is logical intelligence (Ibrahim, 2011: 29).

Logical intelligence (mathematical) refers to an individual's ability to use numbers or logical behavior, the operations of this type of intelligence include classification, inference, hypothesis testing, generalization, and arithmetic treatments, the owner of logical intelligence takes care of focusing on deductive reasoning, deduction, and scientific thinking, in addition, it includes discovering and realizing relationships, then applying and forming them (Zayer et al., 2017: 104). The importance of the current research is in the following:

1- Providing an opportunity for physics teachers to get acquainted with teaching procedures using the logical (mathematical) intelligence strategy and the methods of its application, and then employing them in schools.
2- Presenting the logical (mathematical) intelligence strategy as a relatively recent conception of human intelligence, through which it is possible to explain the individual differences between students and raise their achievement level.
3- The current study may open the way for the application of modern strategies in the field of physics teaching, and the construction of modern teaching-learning strategies by specialists in building curricula.

Research aim: The current research aims to know the effect of the logical (mathematical) intelligence strategy on the achievement of fourth-grade high school students in physics.

Research hypothesis: In light of the research objective, the researcher formulated the following null hypothesis:

- There is no statistically significant difference at the level of significance (0.05) between the average grades of the experimental group students who study physics according to the logical intelligence strategy (mathematical) and the average grades of the control group students who study the same subject in the usual way in the achievement test.

Define terms:

The logical intelligence strategy (mathematical) was defined by (Miraj, 2013) as a strategy that can be learned by categorizing and placing in categories, logical puzzles, calculations, scientific thinking, designing and conducting experiments, translating problems into mathematical relationships and a logical sequential presentation of the study material (Miraj, 2013: 42).

The second chapter: literature and previous studies

The first axis: the literature of research

1- The foundations and roots of the theory of multiple intelligence

The roots of the theory of multiple intelligences go back to (1979) when the Van Leer Foundation at Harvard University asked the American psychologist Howard Gardner and a group of his colleagues in the field of human and philosophical history, natural sciences and humanities to conduct a scientific investigation with the aim of evaluating scientific knowledge and mental abilities of The implementation

of this research led to the formulation of the theory of multiple intelligences by Gardner (Ibrahim, 2011: 51).

Gardner provided a more precise definition of intelligence as a biological and psychological capacity to process information that can be activated in a cultural environment to solve problems or create products of value in culture (Gardner, 1999: 33-34).

The principles underlying the theory of multiple intelligences:

1. Intelligence is teachable. It is a continuous interaction between biological and environmental factors. Intelligences are teachable, they change and grow (Baum, 2005:22).
2. Each person has eight intelligences, and they work together in ways unique to each person.
3. Most people can develop each of the eight intelligences to an appropriate level of competence, if given encouragement, enrichment, and appropriate instruction (Armstrong, 2006:11).
4. These patterns are integrated within the individual, not one of them works alone, each type depends on the other (Mi'raj, 2013: 18).

Multiple intelligences forms.

1- Linguistic intelligence 2- Spatial-visual intelligence 3- Physical-kinesthetic intelligence 4- Personal intelligence 5- Musical intelligence 6- Social intelligence 7- Natural intelligence 8- Logical intelligence (mathematical).

Logical (mathematical) intelligence: is the ability to analyze problems logically, perform arithmetic operations, and verify issues scientifically, and logical-mathematical intelligence appears among physicists, chemistry and mathematics scientists (Gardner, 1999:42).

It includes the ability to think logically in the connection between things, actions, and ideas, and knowing cause and effect, this intelligence gives you the skills to create strategies, explore, examine, and act on things, Physicists, mathematicians, and technologists work tirelessly to explore and exploit the limits of science, by experimenting with hypothesis and logical thinking (Fleetham, 2006: 28-29).

Logical (mathematical) intelligence is distinguished from the rest of the other intelligences in that it is concerned with using numbers efficiently and with the ability to think logically, this intelligence has stages that keep pace with the child's physical development stages since his inception, it can be said that students who have logical intelligence have the talent to solve problems and have a high ability to think, they ask questions logically and can agree on the logic associated with the sciences (Khaffaf, 2011: 90).

They are attracted to logic and inference, they are distinguished in investigation and scientific processes, they learn better through logic and there are some common characteristics they have, they can easily perform physical calculations in their minds and deduce mathematical relationships, they are fascinated by scientific experiments and organize things by category, they search for logical explanations and wonder how things work, they are usually methodical, think in a logical and systematic order, and are skilled in mental arithmetic problems (Al-Hayhy, 2018: 14).

Sub-Strategies Involved in Logical Intelligence (Mathematical)

1- Strategy of accounts and quantities.

2- Strategy of classification and tab.
3- Strategy of socratic questioning.
4- Strategy of detection guides.
5- Strategy of scientific thinking.

Chapter Three / Research Methodology and Procedures

First: Experimental Design: The current research includes one independent variable which is the logical (mathematical) intelligence strategy and a dependent variable which is achievement, therefore, the researcher adopted the experimental design with partial control for the experimental and control groups. It includes conducting equivalencies and post-tests for academic achievement according to Table (1).

Table (1): Experimental design of the current research

Group	Equivalence action	Independent variable	Dependent variable	Tool
Experimental	*Chronological age of students in months * Previous information * IQ test (Raven)	Logical intelligence strategy (mathematical)	achievement	achievement test
control	* Previous year's grades for Physics	the usual way		

Second: The research community and its sample:

1- **Research community:** The research community is represented by secondary and high schools for boys in the education of Dhi Qar Governorate for the academic year (2020-2021 AD).
2- **Research sample:** The research sample was divided into:

First: the sample of the statistical analysis:

A- School sample: Four schools were selected by simple random method as in Table (2).

Table (2) the names of the schools that represented the sample of statistical analysis

S	**School names**	**The number of fourth scientific students**
1	**Walid Al-Kaaba Preparatory**	**130**
2	**Al-Ghadeer High School**	**40**
3	**Al-Yarmouk Preparatory**	**98**
4	**Sayed Al-Belagha'a Preparatory**	**210**
Total		**478**

B- Student sample: (200) students were selected from the school sample population by simple random method, as shown in Table (3).

Table (3) The number of students of the statistical analysis sample

S	School names	The number of fourth scientific students
1	Walid Al-Kaaba Preparatory	55
2	Al-Ghadeer High School	40
3	Al-Yarmouk Preparatory	45
4	Sayed Al-Belagha'a Preparatory	60
Total		478

Second: the sample of the experiment

If the researcher chose Al-Izza Secondary School for Boys intentionally, which is one of the schools affiliated to the Qalaat Sukar District Center, he visited the chosen school and found that it contains two divisions, and the number of students reached (30) students by (15) students in each division, the experimental group that was studied according to the logical (mathematical) intelligence strategy, and the group (B) represented the control group that was studied according to the usual method.

Third: The equivalence of the two research groups: The researcher was keen to make a statistical equivalence between the experimental and control groups in some variables that affect the results of the experiment, as the equivalence was made with the variables (chronological age of students in months, previous information, intelligence test (Raven), degrees of the previous year for physics).

Fourth: Controlling the relevant extraneous variables: The researcher identified the variables that may affect the results of his current study, such as (adjusting the variables and differences in the selection of the sample members, the accompanying accidents, the dropout (experimental waste), the measurement tool).

Fifth: Experimental Procedures: The researcher tried to identify some experimental procedures that could affect the course of the experiment, as follows (to ensure the confidentiality of the research, subject teacher, class distribution, school building, teaching aids, the duration of the experiment and its time)

Sixth: Preparing the research requirements

1- **Determining the scientific material:** The scientific material of the research sample was specified in the first four chapters of the physics book, which is prescribed by the Ministry of Education for the fourth grade scientific (2020-2021).
2- **Formulation of behavioral objectives:** He formulated behavioral objectives based on the content of the scientific material, and their number reached (150) behavioral objectives according to Bloom's

classification in the cognitive domain of levels (remembering, comprehension, application, analysis, installation, and evaluation), the researcher presented it to experts with expertise and competence in the field of teaching methods of science, measurement and evaluation, as the chi-square (χ^2) was used to analyze the arbitrators' responses and some of the objectives were linguistically modified in the light of opinions and observations, the calculated chi-square value ranged (6.231-13) and by comparing it with the tabular value of (3.84) with a degree of freedom (1) and at its significance level (0.05), the results showed the validity of all behavioral purposes.

3- **Preparation of teaching plans:** (14) teaching plans were prepared for each of the two research groups, according to the behavioral objectives and the content of the prescribed course, as the plans of the experimental group were prepared according to the logical (mathematical) intelligence strategy, and the plans of the control group according to the usual method.

Seventh: The research tool: One of the requirements of the current research is to prepare a tool to measure the dependent variable, which is the achievement test, the researcher formulated the test items according to their indicators in the specification table, and the multiple-choice formula was adopted, consisting of (40 items) the achievement test items were distributed among the six levels of the cognitive domain, and in order for the test prepared by the researcher to be honest and achieve the goal for which it was designed, the apparent validity and content validity were verified by presenting it to a group of specialists in educational psychologists and after analyzing the methods of measurement and evaluation of science teaching The calculated chi-square values ranged between (4.455 - 11) for the apparent validity and compared with the tabular value of (3.84) at a significance level of (0.05) and with a degree of freedom (1). The results showed the validity of all items of the achievement test.

- **The first exploratory application of the achievement test:** It was applied in its first exploratory stage on a sample of (40) students, the purpose of which is to know the clarity of the test instructions and the extent of understanding and clarity of the items of the achievement test for students and to calculate the time period required to perform the test
- The second exploratory application: The achievement test was applied to a statistical analysis sample consisting of (200) students whose purpose is to statistically analyze the items of the achievement test, which are represented by the difficulty of the item, the distinction of the item, the effectiveness of the wrong alternatives.

The methods used in the statistical analysis of test items

1- **Item difficulty coefficient**: Experts in constructing tests prefer that the difficulty coefficient of the items be between (0.20 - 0.80) so that the item is good (Kubiszyn,.Borich, 2013: 226-228)

When the researcher calculated the difficulty coefficient for each item, he found that it is between (0.31-0.73)

2- **Item discrimination coefficient:** After calculating the discrimination power of each item, the researcher found that it is between (0.30-0.70) and (Ebel: 1972) indicates that if the item discrimination coefficient is greater than 0.20, then the item has a good discrimination power (Sulaiman, 2009: 320)

3- **The effectiveness of the wrong alternatives:** after calculating the effectiveness of the wrong alternatives, the researcher found that the wrong alternatives range between (-0.07-0.35), and this indicates that all the wrong alternatives are effective. : 73).

The stability of the test: The value of the reliability coefficient when computed by the Kewder-Richardson equation was 20 (0.83). The test is considered stable if the value of the reliability coefficient is more than (70.0), and this indicates that the reliability coefficient is good (Al-Yaqoubi, 2015: 261).

Eighth: Statistical Means: The researcher used the Statistical Package for Social Sciences (SPSS) program to analyze the data.

Chapter four presents and interprets the results

First: Presentation and discussion of the results:

- Results related to the null hypothesis: there is no statistically significant difference at the level (0.05) between the average grades of the experimental group students who study physics according to the logical intelligence strategy (mathematical) and the average grades of the students of the control group who study the same subject in the usual way in the achievement test and for the purpose of verifying the validity of the hypothesis, the average ranks were calculated for the scores of the experimental and control groups in the achievement test, where the average ranks of the scores of the control group were (53.9), and the average ranks of the experimental group's scores were (47,21), for the purpose of identifying the significance of statistical differences, the Mann-Whitney test for two independent samples was used, and Table (4) illustrates this.

Table (4) The results of the Mann-Whitney test for achievement variable

Group	Number	Total ranks	Average ranks	Mann Whitney Value U.		Degree of freedom	Significance level at 0.05
				calculated	tabular		
Experimental	15	322	21.47	23	64	28	Statistically significant in favor of the experimental
Control	15	143	9.53				

It is clear from the previous table that the calculated Mann Whitney value was (23) which is smaller than the tabular amount (64) at the level of significance (0.05), thus rejecting the null hypothesis and accepting its alternative, this means that there is a statistically significant difference between the mean scores of the experimental and control groups in the achievement test in favor of the experimental group.

To show the size of the impact of the independent variable (the logical intelligence strategy (mathematical)) on the dependent variable (achievement), the researcher used the Ita square (η2), and the table (5) illustrates this.

Table (5) The value of the impact size (η2) and the size of the effect on academic achievement

The value of the tabular t	**Calculated tabular value**	**The value of the impact size η2**	**Impact amount**
2,048	**5.053**	**0.477**	**large**

It is clear from the above table that the estimator of the impact size is equal to (0.477) for the achievement variable, which is large and in favor of the experimental group.

Interpretation of the results related to achievement: The results indicated that there were statistically significant differences in favor of the experimental group that was studied according to the logical intelligence strategy (mathematical) when comparing the average ranks of its ranks with the average ranks of the control group that used the usual method, in the achievement test, this result can be attributed to the effectiveness of teaching using the logical intelligence strategy (mathematical), as teaching according to this strategy serves and suits the abilities and tendencies of students in scientific disciplines that are based on logic, abstraction, classification, and the use of numbers in a logical and sequential manner, this may be attributed to the students' positivity through the use of Socratic questions and self-disclosure guidelines that provided them with the appropriate climate for active and student-centered learning, help students on build concepts and generalizations in a cumulative way and solve arithmetic problems in a logical way, which contributed to increasing their achievement, the result of the current research agrees with the results of the study (Al-Rashidi, 2011) and the study (Al-Hayhy, 2018), which confirmed the superiority of the experimental group that was studied according to the logical intelligence strategy (mathematical) at the expense of the control group.

Second: Conclusions: The results of the current research showed that the logical intelligence strategy (mathematical) has a positive impact on the academic achievement of the fourth scientific students in physics.

Third: Recommendations: In light of the results of the current research, the researcher recommends the following:

- The necessity of encouraging physics teachers to use the logical intelligence strategy (mathematical) in teaching physics, given what the study indicated of its effectiveness on achievement.
- Curriculum planners take into account the logical intelligence strategy (mathematical) when designing curricula, and provide the teacher's guides on how to teach according to the logical intelligence strategy (mathematical) to implement these curricula.
- Physics books include activities that take into account logical intelligence (mathematical).

Sources:

1. Al-Hayhi, Aya Ahmed Alyan (2018): The effect of using the logical-mathematical intelligence strategy in teaching chemistry on the achievement and motivation of first year secondary school students in Zarqa Governorate, (unpublished master's thesis), College of Educational Sciences, Middle East University, Jordan.
2. Al-Alwani, Muhammad Daham Yassin (2018): The difficulties of teaching physics in the preparatory stage from the point of view of teachers in Anbar Governorate / Iraq (unpublished master's thesis), College of Educational Sciences, Middle East University, Jordan.

3. Salama, Adel Abu Al-Ezz, and Samir Abdel Salem Al-Khuraisat, Ghassan Youssef Kotait, Walid Abdel Karim (2009): General Teaching Methods - Contemporary Applied Treatment, 1st Edition, Dar Al-Thaqafa, Amman
4. Nashwan, Yaqoub Hussein (2001): The New in Science Education, 1st Edition, Dar Al-Furqan, Amman, Jordan
5. Zeitoun, Kamal (2002) Teaching Science to Understanding: A Constructive Vision, 1st Edition, World of Books for Printing, Publishing and Distribution, Cairo, Egypt
6. Al-Shehri, Fatima bint Saeed (2016): The effectiveness of a study unit based on some strategies of the theory of multiple intelligences in developing logical-mathematical intelligence among high school students in Tabuk, Saudi Arabia, Journal of the College of Education, Al-Azhar University, Issue: 168
7. Zayer, Saad Ali, Inside the Sky of Turki, Issa Ammar Jabbar and Munir Rashid Faisal (2017) Contemporary Educational Encyclopedia, Part One, 1st Edition, Dar Al-Safaa for Publishing and Distribution - Amman, Jordan
8. Ibrahim, Nabil Rafeeq Muhammad (2011): Multiple Intelligence, 1st Edition, Dar Safaa for Publishing and Distribution - Jordan
9. Al-Miraj, Samir Attia (2013): Multiple Intelligences and the Motivation to Learn, 1st Edition, The Arab Office for Knowledge, Cairo, Egypt.
10. Armstrong, Thomas (2006): Multiple Intelligences in the Classroom, translated by Dhahran National Schools, 1st Edition, Dar Al-Kitab Al-Educahi for Publishing and Distribution, Saudi Arabia.
11. Al-Khafaf, Iman Abbas (2011): Multiple Intelligences An Applied Program, 1st Edition, Dar Al-Manaraj for Publishing and Distribution - Amman, Jordan
12. Al-Rimawi, Omar Talib (2017): Building and Designing Psychological and Educational Tests and Measures, 1st Edition, Dar Amjad for Publishing and Distribution, Amman, Jordan.
13. Al-Yaqoubi, Haidar (2013): Evaluation and Measurement in Educational and Psychological Sciences: An Applied Vision, 1st Edition, Al-Murtadha Center for Social Development – Iraq.
14. Suleiman, Amin Ali Muhammad (2009): Measurement and Evaluation in the Human Sciences: Its Foundations, Tools and Applications, 1st Edition, Dar Al-Kitab Al-Hadith, Cairo, Egypt.
15. Baum, Susan, Julie Viens, Barbara Slatin(2005) : Multiple Intelligences In The Elementary Classroom , 1st Ed , Teachers College, Columbia University , New York , USA
16. Fleetham, Mike(2006) Multiple Intelligences in Practice: enhancing self-esteem and learning in the classroom , 1sted , MPG Books Ltd, Cornwall, UK
17. Gardner , H .(1999)..Intelligence Reframed, Multiple Intelligences for The 21 century. New York, NY: Basic Books
18. Kubiszyn, Tom ,Gary Borich(2013) Educational Testing And Measurement: Classroom Application And Practice,10th Ed, Donnelley Jefferson City, USA