The Effect of the (E.D.J.A) Model On Analytical Thinking Among First-Year Intermediate Students In Physics

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KEYWORDS

[E.D.J.A model], analytical thinking skills, physics, first intermediate

ABSTRACT

The research aims to identify the effect of the [E.D.J.A] model on analytical thinking among first-year intermediate students in physics. The experimental design was adopted for the experimental and control groups with the post-test, where the sample size reached (70) students, distributed among (36) for the experimental group and (34) for the control group, and to achieve the goal of the research, the researchers built a test for analytical thinking skills consisting of (36) items with three alternatives, according to the three analytical thinking skills. After applying the test to the two research groups, the researchers analyzed the results. It became clear that the students of the experimental group outperformed the students. The control group was according to the (E.D.J.A) model in analytical thinking skills, and the size of the effect of the (E.D.J.A) model was large on analytical thinking skills. In light of this, the following conclusion was reached that teaching according to the (E.D.J.A) model contributed to improving the analytical thinking skills of the students in the class. The first is average in physics. .

1. Introduction

Physics is one of the abstract academic subjects that requires a high effort on the part of the teacher to convey it to the students. In return, they may have difficulty understanding it, because it requires focus, attention, and observation. Many recent Iraqi studies and research have indicated that there is a decline in students' achievement in physics in the middle stage, including : A study by (Al-Anbaki, 2022), and a study by (Saud, 2023), as they confirmed that the usual teaching method used in teaching physics was characterized by presentation and reconnaissance on the part of the teacher, and reception, passivity and submission on the part of the student, so it does not contribute to creating real learning. It became clear to the researcher that the largest sample of teachers confirmed that there is a decline in the level of achievement of first-year intermediate students in physics. In addition, the methods they use in teaching do not develop analytical thinking. Therefore, the researcher decided to use the (E.D.J.A) model in the field of teaching physics, which may It helps students increase their academic achievement in physics and their analytical thinking, and thus the research problem is represented in answering the following question: (What is the effect of using the (E.D.J.A) model on first-year students' achievement in physics and their analytical thinking Second: The importance of research:

Research Importance

Human societies revolve in the orbit of change and development imposed by most of the technical data of the era in terms of change and development, and its result was the human aspiration to keep pace with the wheel of scientific progress by benefiting from these data to the maximum extent possible, and thus technology, its forms, and all its types have become a basic requirement of this era, A distinctive feature of it, and we can see the impact of this distinctive feature of the era in every field of life, especially the field of education, as it is the most important, even basic, for life, and the most influential and affected by the change and development resulting from technology, because it is an integrated system, designed to create a normal human being who interacts with his environment in a way The best (Mbu Saidi and Suleiman, 2018: 19).

It is the responsibility of education to develop the student's skills and develop his abilities through which he can deal with the outcomes of this scientific revolution and adapt to its results. This can be

achieved by paying attention to the student as he is the focus of the educational process, so that he is able to think in a scientific way, analyze different situations, and be able to research. He obtains information himself from its various sources, and employs it in his daily life. The goal of competent education is not merely to understand a particular material and be able to retrieve it or perform some of the procedures included in it, but it includes expanding and examining experience, and this does not happen automatically, but requires mental thinking and the use of mental processes that It stimulates the thinking required to obtain and scrutinize information . (Al-Khawaldeh, 2019: 223). All of this distinguishes physics from other subjects. As it enters into all areas of life, it investigates the laws of nature and its phenomena, and works to introduce changes to them. The purpose of teaching physics in the academic stages is to provide the student with basic information that helps to understand the natural phenomena that occur around him, as well as to provide him with accuracy of observation and method behavior. Scientific models that link results to causes and reality to theories that rely on induction, comprehension, and deduction. Therefore, modern teaching models must be applied in presenting concepts to students to keep pace with the developments that occur in this era, which is characterized by the spread of knowledge and the accumulation of various life problems (Fahd, 2020: 5).

The (E.D.J.A) model is an educational model based on active learning, as it is based on presenting the educational situation collaboratively by raising an educational problem and directing students to solve it analogously, using previous experience.

Learning occurs better when students deal with problems that increase their motivation to learn through their attempts to find a solution to these problems collaboratively, and this is what is approved by constructivist theory, which emphasizes that the student is an active being who processes, stores, and retrieves information continuously, and by giving him directed freedom of thought. The teacher can discover the solution to the educational problem himself, and all of the above is based on the student's previous knowledge, with learning occurring in a collaborative process, so that when the student faces a problem, he builds his knowledge better when he carries out a purposeful discussion with his colleagues or brainstorming directed by the teacher, and this leads to increase his abilities and raise his academic achievement (Al-Atawi, 2020: 261).

Analytical thinking is considered one of the most complex cognitive activities, and it results from the student's ability to divide or analyze the problem and enable him to be able to solve the situations and problems that he faces in various aspects of his life. It is a cognitive activity that refers to internal processes such as the process of processing information, which is a process that cannot be It can be observed and measured directly, and it can even be deduced from the student's apparent behavior. (Al-Kadhim, 2019: 51)

Third: Search Objectives

The research aims to investigate the impact of the (E.D.J.A) model on:

- Analytical thinking among first-year intermediate students.

Fourth: Two Research Hypotheses

In order to achieve the research goal, the researcher developed the following two null hypotheses:

- There is no statistically significant difference at the significance level (0.05) between the average scores of the experimental group students who will study physics according to the (E.D.J.A) model and the average scores of the control group students who will study the same subject in the normal way in the analytical test.

Fifth: Search Limits

1. . Human limits: first-year middle school students.1
2. Spatial boundaries: middle and secondary schools of the Najaf Education Directorate .

3. Time limits: The second semester of the academic year (2023-2024).
4. Cognitive limits: Physics book for the first intermediate grade, represented by (F4, heat) and (F5, the effect of heat on materials).

Sixth: Define terms: Define Terms

The Effect was defined by :1

(Magdy, 2019) that: "The ability of the worker who is the subject of the study to achieve a positive result, but if this result fails and is not achieved, then the worker is one of the direct causes of negative repercussions" (Magdy, 2019: 14).

Operational definition: The amount of change caused by the (E.D.J.A) model in the learning outcomes of first-year intermediate students in physics, and it is measured by the Cohen square equation by identifying the increase or decrease in their average scores in achievement and analytical thinking.

The (E.D.J.A) model was defined by :2

(Al-Rifai, 2022) that it is: "an educational model based on directing students towards educational situations in the form of collaborative, analogous groups, raising an educational problem, and encouraging them to solve it using their previous experiences" (Al-Rifai, 2022: 32).

Procedural definition: A model used by the researcher in teaching the prescribed physics classes to first-year intermediate students (experimental group). It consists of the following steps: (excitement, dialogue, clarification, application), to help students raise their academic achievement and provide them with information and skills to reach the coherence of the lesson topics. To solve problems and think analytically.

Analytical Thinking was defined by :3

(Popescu, 2020) that it is: "organized, sequential, and sequential thinking with fixed steps in its development as analytical thinking proceeds through stages defined by standards" Popescu, 2020: 21). .

Procedural definition: A form of thinking that depends on a set of mental processes, which is represented by the ability of first-year intermediate students to carry out a set of special activities when facing problems, and to break them down. It has been identified with specific skills: (the skill of visual analysis of data, the skill of analyzing patterns sequentially, the skill of analyzing patterns sequentially, the skill of Choosing alternatives, verbal reasoning skill, and the relationship of the part to the whole) prepared by the researcher for this purpose.

Physics is known to everyone:4

(Al-Barrak, 2023) It is: "the science that is concerned with studying natural phenomena so that the student can know the interpretation of the natural phenomena that occur to him through experimentation and measurement using tools that differ depending on the type of phenomenon" (Al-Barrak, 2023: 20).

Chapter Two (Theoretical Framework and Previous Studies)

The first axis: Theoretical Framework

First: Constructivist Theory

Its concept:1

Active learning is a means of educating students so that they go beyond their role of passive listening so that the student takes some guidance and initiative in implementing activities in the classroom. It is thus learning that directs students in positive directions that will allow them to discover and work with others to understand the curriculum by forming small groups for discussion. Role-playing, making

projects, and asking questions, to ensure that students teach themselves in their education process on their own and under the supervision of their teachers (Abu Al-Haj, 2017: 25); In this sense, active learning emphasizes the active participation of students in the educational process taking place, so that they are an active processor of the information they receive, and work with it within their daily lives and not John Piaget (born August 9, 1896 - died September 16, 1980) was the eldest son of the Swiss Arthur Piaget and the Frenchwoman Rebecca Jackson. He was a Swiss psychologist and philosopher who developed the theory of cognitive development in children in what is now known as genetic epistemology. In 1965, Piaget established the Center for the Theory of Genetic Knowledge in Geneva and its chair until his death in 1980. Piaget is considered the pioneer of the constructivist school of psychology.

In the negative future, active learning is a form of learning, in which students participate in some activities that push them to think and reflect on the information provided to them and the method they will follow when using this information. (Saadah, 2018: 32).

Third: Model (E.D.J.A):

Its concept:1

This model is considered one of the models of active learning that is affiliated with the constructivist theory. It is an educational model that is based on presenting the educational situation collaboratively by raising an educational problem and directing students to solve it analogously using previous experience, as learning occurs better when students deal with problems that increase their motivation to learn. Through their attempts to find a solution to these problems in a cooperative manner, and this is what was approved by the constructivist theory, and by combining this with the most important principles of active learning, which emphasize that the student is an active, effective being who presents information and is given freedom of thought directed by the teacher, he can discover the solution to the educational problem himself, all that Priority is based on the student's previous knowledge, with learning occurring in a collaborative process, so that when the student faces a problem, he builds his knowledge best when he engages in a purposeful discussion with his colleagues or brainstorms directed by the teacher (Al-Sultani, 2021: 153). The (E.D.J.A) model enables the student to think actively in order to achieve what was established for him, of successive and specific ideas that the student links to a specific time or place and supports them with his belief and expectation until they become a reality and a reality that awaits him in the same place and time. It includes a wide range of activities that participate in the elements The basic principles, which encourage students to apply the things they learn, and the (E.D.J.A) model can be used to encourage students to engage in thinking with their peers or small groups, and also make them busy in expressing their ideas, discovering personal values and attitudes, and providing and receiving feedback (Al-Saadi, 2020: 84).

Fourth: Analytical Thinking

Its concept:1

Analytical thinking is a type of thinking whose first indications appeared in the writings of Descartes with his model that formed the essence of modern scientific thought. He demonstrated the possibility of fully understanding a thing through the characteristics of its parts. Analysis is the isolation of a thing from everything else in order to understand it. It is not possible to continue analyzing the parts except by reducing them to smaller parts. (Rasoul, 2019: 11). If one wants to understand a mental phenomenon, its concepts must be analyzed, and this phenomenon cannot be touched except through its results and what a person shows in different situations. He has faced... Cognitive psychologists find it difficult to understand the thinking patterns and styles of individuals, which required a long study that took researchers a long time and a lot of effort (Rozin, 2017: 102).

Analytical thinking is a mental skill that requires the ability to break down situations, things, and relationships into their components. Analysis comes at the fourth level of complexity in the cognitive levels identified by Bloom. The skill of analysis requires the student to break down information into

its small parts, create hypotheses or postulates, find differences between facts and opinions, or explore... Causal relationships. (Al-Sabab, 2018: 38).

The second axis: Previous Studies: Previous Studies

The first section: Studies that dealt with the (E.D.J.A) model as an independent variable:

Table (1): Studies that dealt with the (E.D.J.A) model as an independent variable

NO	Nama Peneliti & Tahun	Tempat Penelitian	Subjek Akademik	Ukuran Sampel & Gender	Tingkat Akademik	Metode Statistik	Jenis Tes	Tujuan Penelitian	Hasil Utama
1	Al-Helu dan Jagan, 2022	Dohuk, Iraq	Sejarah	50 siswa laki-laki & perempuan	Sekolah Menengah	Keuder-Richardson equation, Spearman-Brown equation, Microsoft Excel	Tes Prestasi	Mengidentifikasi efek model (E.D.J.A) pada prestasi siswa dalam pelajaran sejarah di tahun kedua sekolah menengah	Siswa kelompok eksperimen unggul dibandingkan kelompok kontrol
2	Abdullah, 2023	Karbala, Iraq	Senam Artistik	179 mahasiswa	Mahasiswa sarjana	SPSS statistical portfolio	Tes Keterampilan	Mengidentifikasi efektivitas kurikulum pendidikan menggunakan model (E.D.J.A) dalam meningkatkan hasil belajar beberapa keterampilan senam lantai artistik	Siswa kelompok eksperimen lebih baik daripada siswa kelompok kontrol

No.	Researcher and Year	Place of Study	Aim of the Study	Academic Stage	Sample Size and Gender	Study Material	Research Tool	Statistical Methods	Results
1	Al-Badrasawi, 2019	Gaza/Palestine	Identifying the effect of using PhET techniques for interactive simulations in developing achievement and some analytical thinking skills in science among seventh grade students in Gaza	Middle Stage	98 students (male and female)	Achievement test and analytical thinking skills test	T-test for two independent samples, chi-square, Pearson correlation coefficient, Spearman coefficient, difficulty coefficient equation, paragraph discrimination power equation	Students of the experimental group outperformed the students of the control group.	
2	Salman, 2021	Baghdad/Iraq	Identifying the impact of the Entostel model on the achievement of	Middle Stage	71 female students	Achievement test and analytical thinking test	Statistical portfolio program SPSS	Not specified	Female students of the experimental group excelled over the female

			female students in chemistry.						students of the control group.
3	Sayyad, 2021	Babylon/Iraq	Identifying the effect of the Barman model on the achievement of second-year female students in the science and analytical thinking subjects.	Middle Stage	63 female students	Achievement test and analytical thinking skills test	T-test for two independent samples, chi-square, Pearson correlation coefficient, Spearman coefficient	Not specified	Female students of the experimental group excelled over the female students of the control group.
4	Sayyad, 2022	Babylon/Iraq	Identifying the effect of the Barman model on the achievement of second-year female students in the science and analytical thinking subjects.	Middle Stage	63 female students	Achievement test and analytical thinking skills test	Difficulty coefficient equation, paragraph discrimination power equation, T-test for two independent samples, chi-square, Pearson correlation coefficient, Spearman coefficient	Not specified	Female students of the experimental group excelled over the female students of the control group.

1. Crystallizing the research problem and defining its dimensions.

2. Provide the researcher with many important references and sources for his study.

3. Learn about statistical methods and benefit from them in selecting the appropriate ones for the study.

4. Getting to know research procedures such as: (the experimental method, imposing hypotheses, choosing the sample size, and constructing tests, recommendations, and proposals).

Preparing analytical thinking test items.5

6. How to start the experiment, the steps that must be taken, and the supplies you need

7. Performing statistical equivalence between the two research groups in some variables.

Chapter Three (Research Methodology and Procedures)

2. Methodology

The researcher followed the experimental method to achieve the two objectives of the research, because it is considered one of the most accurate and efficient scientific research methods. According to this method, the researcher arrives at what will be under controlled conditions. Through this method, specific factors in the situation are controlled and a factor or factors are released to show the extent of their influence on a variable. What, and arriving at results that are carefully calculated (Zayed, 2018: 21).

Second: Experimental Design

Since this research includes an independent variable (E.D.J.A model, the usual method), and a dependent variable

It is (analytical thinking), so the researcher used an experimental design with partial control for two equal groups,

one experimental and the other control, and Table (3) shows this:

Table (3): Experimental research design

Group	**Equivalence Independent**	**Variable Dependent**	**Variable**	**Test**
Experimental Officer	1. Chronological age calculated in months**.** 2. Raven's intelligence 3. Analytical thinking test	Form (E.D.J.A(The usual method	Analytical thinking	Analytical thinking test

Third: The research community and its sample

The research population is represented by students in the first intermediate grade in secondary and intermediate day schools for boys in the Najaf Governorate/Kufa District for the academic year (2023 AD - 2024 AD), in which the number of sections in the first intermediate grade is not less than two or more. After the researcher identified the schools included in the research, the researcher chose the method Al-Qasdiyah (Aleppo Middle School for Boys).
When the researcher visited (Aleppo Middle School for Boys), the school administration showed great cooperation with the researcher. The middle school included two divisions for the first intermediate grade: (A, B) with (37, 36) students in each division respectively, and the researcher chose Division (A). Randomly, to represent the experimental group that will study physics according to the (E.D.J.A) model, and Section (B) to represent the control group that will study the same subject in the usual manner. The total number of students in both groups reached (73) students, before a failed student was excluded from the experimental group. And two failed students from the control group, so the number of students in the two groups after exclusion became (70) students, with (36) students in the experimental group, and (34) students in the control group, and Table (4) shows this:

Table (4): Number of students in the two research groups before and after exclusion

NO.	Group	Division	Number of students before exclusion	Number of excluded Student	Number of students after exclusion
1	Experimental model (E.D.J.A) Controller(	A	37	1	36
2	(normal method	B	36	2	34
Total			73	3	70

Fourth: Equivalence of the Two Research Groups

The chronological age of students calculated in months

 The dependent variable: The variable that predicts through our knowledge of the value of the independent variable. The dependent variable is measured in both groups by the achievement test that is administered to them after the end of the experiment and the analytical thinking test that is

administered to them before and after the end of the experiment.

 Experimental group: The group whose students are subjected to the independent variable (E.D.J.A) model in teaching physics.

 Control group: The group whose students are subjected to the usual method of teaching physics.

 The researcher wrote the names of the divisions (A, B, C, D) on small papers and put them in a bag. He pulled out the first sheet, which was Division (B), to represent the experimental group, and withdrew the second sheet, which was Division (C), to represent the control group.

The researcher conducted statistical equivalence in the chronological age calculated in months for the students of the two research groups. To determine the significance of the difference between the average chronological ages of the students of the two groups, the researcher used the t-test for two independent samples, and the results were as in Table (5) and Chart (1). Table (5): Results of the t-test for two independent samples of students in the two research groups regarding chronological age calculated in months.

Group	Number	Arithmetic Mean	Standard Deviation	Variance	Degree	T-Value	Significance Level 0.05
Experimental	36	150,611	3,781	14,295	68	Tabular 2,000	Not a sign
Officer	34	151, 176	4,181	17,480		Calculation 0.594	

Chart (1): Ages of students in the two research groups in the age variable (calculated in months)

Raven's intelligence test:2

To determine the significance of the difference between the average scores of students in the two groups, the researcher used the t-test for two independent samples, and the results were as in Table (6) and Chart (2).

Table (6) t-test results for two independent samples for students of the two research groups in the Raven's intelligence test variable

Group	Number	Arithmetic Mean	Standard Deviation	Variance	Degree	T-Value	Significance Level 0.05
Experimental	36	36,722	10,732	115,175	68	Tabular 2,000	Not a sign
Officer	34	35,382	10,322	106,543		Calculation 0.532	

Chart (2): Results of students of the two research groups on the Raven's intelligence test variable

Analytical thinking test: 3

The researcher used the t-test for two independent samples to determine the significance of the difference between the average grades of students in the two groups. The results were as shown in Table (7) and Chart (3).

Table (7) t-test results for two independent samples for students of the two research groups in the analytical thinking test variable

Group	Number	Arithmetic Mean	Standard Deviation	Variance	Degree	T-Value	Significance Level 0.05
Experimental	36	14,361	7,333	53,772	68	Tabular 2,000	Not a sign
Officer	34	13,294	6,913	47,789		Calculation 0,626	

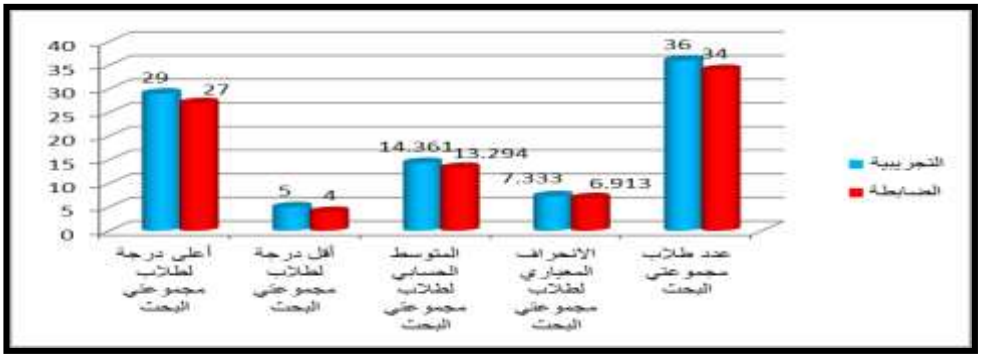

Chart (3) results of students of the two research groups on the analytical thinking test variable

Fifth: Controlling Extraneous Variables

The researcher tried as much as possible to control the non-experimental variables that he believes affect the integrity of the experiment. The following are the most important extraneous variables that may affect the experiment: (selection of sample members, accompanying incidents, experimental extinction, processes related to maturity, measurement tool, confidentiality of the experiment, subject teacher, Distribution of classes, teaching aids, school building, subject matter (0

Sixth: Research Requirements:

Research Requirements

Defining the scientific material: The researcher determined the scientific material that would be taught to the students of the two research groups during the duration of the experiment. The scientific material included chapters (fourth and five), namely (heat, and the effect of heat on materials) from the physics

book for the first intermediate grade, revised 6th edition, for the year (2023 AD)

1: Seventh: Search Tools

Building a test for analytical thinking:

The research required building a test to measure the extent to which first-year intermediate students possess analytical thinking in physics. Therefore, the researcher prepared an objective test of the type called (multiple choice), in which the analytical thinking skills that are to be measured are determined. The researcher followed the following steps:

a. Determine the purpose of the test: The test aims to measure the ability of first-year intermediate students (research sample) in analytical thinking

B. Building the test items: After the researcher was acquainted with the literature on thinking in general and analytical thinking skills in various other fields and stages and reviewed some sources and previous studies, he prepared the test items according to the three analytical thinking skills and (36) items of the objective test type were formulated (choice from Multiple), as the paragraph included three alternatives. The student must choose one alternative that matches the content of the question. The researcher took into account scientific and linguistic accuracy, and that it be similar to the scientific content and appropriate for the level of first-year intermediate students. Table (8) shows this.

Table (8): Analytical thinking skills and number of test items

NO.	Paragraph	Skills	NO.	Paragraph	Skills
1	(1, 2, 3)	Identify traits or qualities	7	(19, 20, 21)	Category
2	(4, 5 ,6)	Determine properties	8	(22, 23, 24)	Building the standard
3	(7, 8, 9)	Make an observation	9	(25, 26, 27)	Arranging and setting priorities
4	(10, 11, 12)	Differentiate between similar and different	10	(28, 29, 30)	See relationships Guessing,
5	(13, 14, 15)	Compare and Contrast	11	(31, 32, 33)	predicting/predicting
6	(16, 17, 18)	Grouping (tab)	12	(34, 35, 36)	Determine cause and effect

T. Formulating the test instructions: The instructions for answering the test items were clearly formulated for students in order to avoid errors that affect the student's grade, and the time specified for answering the test items and some precautions to be taken into consideration before answering were stated in the answer sheet attached to the test.

Th. Establishing correction instructions: The researcher designed a model answer sheet for the test items to be relied upon in correcting the test. The test is corrected by giving a score of (one) for the correct answer and (zero) for the incorrect or left out answer, or if the answer is based on more than one alternative. Thus, the score ranged The total answer to these items ranges from (0-36) points.

C. Validity of the test: To verify the validity of the test, the researcher used the apparent validity of the test, as the researcher presented the test in its initial form to a group of arbitrators, to ensure the veracity of the items, their integrity, and their suitability to what they were designed to measure. Each item of the test obtained a percentage of (80%) or more as a standard. For the validity of the test items and

their suitability to measure the characteristic for which they were developed, the percentage and the value of a square were used at the level of significance (0.05), as most of the test items obtained the approval of the arbiters on their validity and suitability for the purpose for which they were developed, as the percentage ranged from (100% - 86%). As for the value of the square, it ranged (21 - 10.71), and therefore the test items were left (36) items, and Table (9) shows this:

Table (9): Chi-square value and percentage for extracting the validity of the analytical thinking test

NO.	Test item number Analytical thinking	Number of arbitrators	Percentage	Chi-square value	Statistical significance
1	(3,5,9,10,14, 15, 21,22,26, 27,30,31,32,35,35)	Agreeers 21 who disagree 0	100%	Tabular 3,84 Calculation 21	Function
2	(2,8,11,16,20, 23,25,28,29,33,34).	21 1	95%	3.84 17.19	Function
3	(4,6,12,17,19, 24)	21 2	90%	3.84 13,86	Function
4	(1,7,13,17)	21 3	86%	3,84 10,17	Function

-Difficulty of the test items: Using the equation (difficulty factor) for the objective items, it was found that the difficulty factors for the items ranged between (0.35 - 0.69), and thus all the items have an appropriate level of difficulty, as (Najm and Tariq, 2018) believe that the test items are It is acceptable if its difficulty factor ranges between (0.20 - 0.80), and it is deleted if it is greater or smaller than these two degrees (Najm and Tariq, 2018: 18). -Discriminatory power of the test items: The discriminatory power of each item was calculated using the (discriminatory power) equation. Its value was found to range between (0.30 - 0.59), and thus all test items were considered to have an acceptable discrimination coefficient.

-The effectiveness of the wrong alternatives: The effectiveness of each wrong alternative and for each of the (36) test items was calculated using the equation for the effectiveness of the wrong alternatives. It was found that the values were all negative, meaning that they attracted more answers from the students of the lower group compared to the answers of the upper group, and this is evidence of The effectiveness of the alternatives, so it was decided to keep the paragraph alternatives.

: Construct validity

-The relationship of the item score to the overall test score: To determine the extent of the correlation between the score of each item and the total score of the test, the researcher subjected the scores of the students in the second exploratory sample, numbering (100), to item analysis, which is the same sample on which the discriminatory power of the test items was calculated and according to the correlation coefficient for the score of each item. The total score of the test using the Pearson correlation coefficient. The correlation coefficients ranged between (0.30 - 0.69), and thus all the items were statistically significant. Thus, all test items, amounting to (36) items, were retained, and Table (10) shows this:

Table (10) Correlation coefficients between the item score and the total score for the analytical thinking test

NO.	Link	NO.	Link	NO.	Link	NO.	Link
1	0.48	10	0.61	19	0.68	28	0.37
2	0.54	11	0.57	20	0.69	29	0.35
3	0.56	12	0.48	21	0.49	30	0.36
4	0.52	13	0.37	22	0.44	31	0.58

5	0.40	14	0.47	23	0.35	32	0.46
6	0.44	15	0.42	24	0.60	33	0.46
7	0.60	16	0.51	25	0.48	34	0.45
8	0.45	17	0.62	26	0.59	35	0.52
9	0.70	18	0.30	27	0.60	36	0.59

-The relationship of the item score to the overall skill score: To statistically establish the validity of the internal consistency of the test, the Pearson correlation coefficient and the level of statistical significance were found between the score of each item and the skill score, as the skill of identifying traits or attributes ranged between (0.30 - 0.56), and the skill of identifying characteristics ranged between (0.33 - 57), the skill of conducting observation is between (0.36 - 0.58), the skill of differentiating between similar and different is between (0.39 - 0.46), the skill of comparing and contrasting is between (0.31 - 0.55), and the skill of grouping (tabling) is between (0.34). - 0.65), while the classification skill ranged between (0.37 - 0.60), while the standard building skill ranged from (0.41 - 0.59), while the ranking and setting priorities ranged from (0.32 - 0.61), while the skill of seeing relationships ranged from Between (0.35 - 0.62), while the skill of guessing/predicting ranged between (0.38 - 0.63), while the skill of determining cause and effect ranged between (0.42 - 0.64), which are good correlation coefficients and thus all correlation coefficients between the item and the skill degree are significant. Statistically, this means that these skills actually measure or express analytical thinking towards physics, and thus characterize the test of analytical thinking towards physics with constructive validity, and Table (11) shows this:

Table (11) Correlation coefficients between the item score and the skill score for the analytical thinking test:

Identify traits or qualities		Determine properties		Make an observation		Differentiate between similar and different	
NO.	Link	NO.	Link	NO.	Link	NO.	Link
1	0.30	4	0.57	7	0.45	10	0.39
2	0.43	5	0.33	8	0.58	11	0.46
3	0.56	6	0.44	9	0.36	12	0.40

Compare and contrast		Grouping (tab)		Category		Building the standard	
NO	Link	NO	Link	NO	Link	NO	Link
13	0.47	16	0.34	19	0.49	22	0.50
14	0.31	17	0.65	20	0.60	23	0.41
15	0.55	18	0.48	21	0.37	24	0.59

Arranging and setting priorities		See relationships		Guessing, predicting/predicting		Determine cause and effect	
NO.	Link	NO	Link	NO	Link	NO	Link
25	0.61	28	0.53	31	0.63	34	0.42
26	0.54	29	0.35	32	0.38	35	0.51
27	0.32	30	0.62	33	0.52	36	0.64

The relationship of the skill score to the total score of the analytical thinking test: The score of each skill must be correlated with the total score of the analytical thinking test. Correlation coefficients were calculated between the score of each skill and the total score of the test using the Pearson correlation coefficient, and Table (12) shows this:

Table (12) Correlation coefficients between the skill score and the total test score

NO	Skills	Link	NO	Skills	Link	No	Skills	Link
1	Identify traits or qualities	0.80	5	Compare and contrast	0.85	9	Arranging and setting priorities	0.83
2	Determine properties	0.86	6	Grouping (tab)	0.82	10	See relationships	0.81
3	Make an observation	0.85	7	Category	0.82	11	Guessing, predicting/predicting	0.83
4	Differentiate between similar and different	0.84	8	Building the standard	0.87	12	Determine cause and effect	0.81

Test reliability: Test reliability means that the test gives the same results if it is re-applied to the same students in the same circumstances (**Salah, 2020: 43**). The internal consistency reliability of the test with objective items was calculated using two methods as follows:

-Split-half method: The researcher extracted the Pearson correlation coefficient between the scores of the two halves of the test, and it reached (0.873), and when corrected using the (Sieberman-Brown) equation, it reached (0.932), which is a good and reliable reliability coefficient seen by (Al-Nabhan, 2004: 240). The reliability coefficient reached (0.70) or more, which indicates that the reliability coefficient is high **(Tariq, 2019: 33**).

) -Kuder-Richardson 20) method: The researcher extracted the reliability coefficient and found that it was equal to (0.849). This is considered an acceptable reliability coefficient, according to what was indicated by researchers and those working in the field of psychological and educational measurement. Thus, all test items were preserved and the test became ready to be applied in its final form to a sample. Search.

Eighth: Experiment Application Procedures

1. The final analytical thinking test was administered to the students of both research groups on (Sunday) corresponding to (4/28/2024 AD), and there were no cases of excused or unexcused absence.

Ninth: Statistical Methods: The researcher used statistical methods using the statistical program (SPSS) in processing the data of the current research.

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