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The Impact of Using the "Express-Plan-Evaluate" Strategy in Teaching Science on the Academic Achievement and Development of Inferential Thinking Skills of Eighth Grade Students

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ABSTRACT

This study aimed at identifying the effect of using the "Express - Plan - Evaluate" Strategy in teaching science on the academic achievement and the development of the inferential thinking skills among eighth-grade students. The study was conducted on a sample of (52) students divided into two groups: a control group and an experimental group. A multiple-choice achievement test and an inferential thinking skills test were administered to the two groups as pre-post testing. The results of the study showed that there was a statistically significant difference in the achievement test between the experimental and control group, and in favor of the experimental group, who studied according to the "Express - Plan - Evaluate" Strategy. There were also statistically significant differences in the inferential thinking skills test between the experimental and control group and in favor of the experimental group. The study recommends using the "Express - Plan - Evaluate" Strategy to effectively teach other subjects of science and to hold training sessions for teachers of science on the use of "Express - Plan - Evaluate" Strategy in order to help them replace the traditional methods of teaching that are dependent on recall and memorization.

Keywords: "Express - Plan - Evaluate" Strategy, Academic Achievement, Inferential Thinking, Teaching science, eighth-grade students.

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1. Introduction

Special attention is being paid for developing and improving the science curricula in the Kingdom of Saudi Arabia in the various educational stages. These curricula now address students' minds and encourage them to think. This was reflected in the teachers' performance, during which they employed a set of effective teaching strategies, and applied to learn resources to enhance education to

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meet students' individual needs and develop their different skills such as problem-solving and skills of inferential, creative, critical, and contemplative thinking.

The identification and fulfillment of the student's educational needs are among the general educational goals that science curricula seek to achieve. Setting appropriate methods for education to become meaningful and applicable in all aspects of life is of crucial importance, which was highlighted by constructivism, and the teaching strategies that emerged from it, including the strategy "express-plan - evaluate".

The "express-plan-evaluate" strategy is based on the principles of constructivism, which mainly focus on identifying students' needs in order to facilitate the learning process of concepts, relationships and skills. Obaid (2011) believes that "express-plan-evaluate" strategy helps students to learn what they need in terms of relationships and skills and is one of the cooperative learning strategies. It also allows students to choose the educational activities appropriate to those needs, placing them in similar groups according to their needs and interests (Afana and Aljeesh, 2008).

The "express-plan-evaluate" strategy is based on some major points. First, students become motivated to learn the things they think they need or to fill a gap in their cognitive structure. Second, the learning process is meaningful if students participate in planning activities. Third, this strategy allows students to feed new experiences into their cognitive reservoir through the construction activities they participate in choosing, designing, and experimenting with them. Lastly, students discover the scientific content they studied by using the steps and procedures of scientific investigation (Rihan, 2015; Saeed, 2004).

The "express-plan-evaluate" strategy is drawn from the constructivism theory. However, it is more related specifically to the experiential-learning approach, which is related to the role of experience and its actual practice in much of what students learn. It also provides a vision for the topic of learning. The best way to learn is to link the student directly to the experience, which is beneficial to the students' needs. In this theory, students are free to define the goals from their learning and to put in place appropriate experiences and activities in order to achieve them.

The second approach related to this strategy is the Conversation and knowledge approach, where there is a relationship between language and logic, as they both can develop analysis and thinking of all kinds and to reach conclusions based on knowledge. It is an important method for the teacher to use to know students' ability in using different thinking skills. It also gives them many opportunities to listen to their thoughts, especially when they think aloud, and how they control the use of special processes for different thinking processes (Al Shamlati, Al Mahfouz, 2019).

The "express-plans-evaluate" strategy provides an opportunity for students to express their different educational needs. It also allows the teacher to build educational experiences in the light of these needs, and provides many opportunities for both the teacher and the student to build a bridge of relationships between existing knowledge, or what has been studied before and new knowledge, in order to support and strengthen the knowledge structure. It instills in the students' the responsibility for their progress and learning (Rihan, 2015: 18)

1.1 Stages of the "express-plan-evaluate" strategy

The "express-plan-evaluate" Strategy is based on three stages (Saeed, 2004) as follows:

The expression stage: The educational needs of the students are identified in this stage. To achieve this, their previous experiences must be known based on Ausubel's theory of meaningful learning, the wrong understanding they have and its treatment, the knowledge they need while studying the concepts of the lesson, the appropriate way in which they enjoy, and how much they appreciate the material they are learning and how much they need it.

The student's needs can be identified by giving a specific task and observing its implementation to know the extent of the student's ability to employ scientific concepts in implementing new tasks or good life situations. Asking questions is another technique, where the teacher must prepare questions that are directly related to the concept to be learned. Students must answer individually in order to reveal their views about the concept to be learned. The teacher must explain the importance of the knowledge to be learned to build educational experiences and activities based on students' needs, as well as respecting all ideas produced by students and diversifying how they can define their own educational needs.

The planning stage: The teacher and students participate in planning the education process and defining procedures and steps through choosing educational goals, planning necessary experiences, activities, teaching materials, and executive procedures while considering the following:

- The compliance of the chosen goals to the educational needs identified by the student.
- The experiences and educational activities are diversified, interesting, and thrilling.
- Choosing both individual and group activities.
- Development of experiences and activities, higher thinking skills such as critical, reflective, and inferential thinking.
- Taking into account individual differences between students when choosing educational experiences and activities.
- Focusing on life experiences and activities.
- Following appropriate teaching strategies when providing experiences and educational activities such as (problem solving, induction, cooperative learning, and roundhouse).
- Creating a social learning environment during the educational process; in other words, a learning community.

The evaluation stage: Questions here are presented for students to help them in measuring what they have learned and achieved. The teacher should use many different evaluation tools, such as tests, observation and interview, to ensure the achievement of the desired goals. Evaluation should be built based on these needs and be in advance, constructive, concluding and connected to the environment and real-life issues. The teacher raises a set of questions to himself such as, what did the student acquire? What new knowledge did the student acquire? How did the student deal with new experiences? What is the extent of the change in student behavior? How did the student employ experiences in his/her working life?

In the event that the desired goal of learning is not achieved, the teacher must search for the reason behind this by analyzing educational situations and experimenting with other strategies in order to achieve the goal.

Accordingly, learning to think among constructivists entails learning new mental cognitive practices that students can perform a new response that was not present in their cognitive outcomes, such as thinking and different skills (Al-Atoum et al 2015). If the thinking student is given a set of experiences and information with meaning, this ensures that a greater volume of information remains in the memory than if he was given a small amount of information. The amount of forgetfulness would be less, and the volume of his inventory would remain after the learning situation was removed (Qatami, 2013).

1.2 Inferential thinking

Inferential thinking expresses the mental process used by adults and aims at solving the problem mentally through symbols and previous experiences. What distinguishes inferential thinking from other types of thinking is the transition from the known to the unknown. It requires the intervention of higher processes such as remembrance, imagination, judgment, understanding, abstraction, design, inference, planning, differentiating, reasoning, and criticism.

Lared argues that inferential thinking is a mental process to form logical inferences and conclusions and constitutes the center of the cognitive process as a major component of intelligence. It relies on the use of meanings, references and knowledge to build a set of possibilities that lead to the truth. It is also a symbolic solution to problems; it deals with symbols from tangible objects and it is an advanced form of abstract thinking. This type of thinking is used when facing a problem through known hints to achieve unknown results by moving from specifics to generalities, or from generalities to specifics (cited in Al-Qahtani, 2016).

Inferential thinking consists of a variety of skills. Firstly, inductive inference, where each cognitive mental activity is characterized by the conclusion of the general rule in its partiality. It also refers to the cognitive mental performance that is characterized by the conclusion of the general rule of its elements and individual situations, and by which the individual moves from private to general issues (Jarwan, 2010). Secondly, standard inference which is based on the transition from introductions to results, considering the validity of the introductions is the validity of the results. It also refers to the cognitive mental performance, which is characterized by the conclusion of the general rule of its

elements and individual situations, by which the individual moves from private issues to the general issue. Thirdly, deductive inference, which is the process when new information is extracted from the introductions that have been observed or discussed. It is defined as the process by which a certain conclusion is reached from available introductions and data, and each step of the logical conclusion leads to the conclusion of an absolute mathematical evidence of its validity (Abu Jado and Nouvel, 2013). It is the cognitive performance of an individual's ability to conclude from certain facts observed or imposed (Zahrani, 2014). Fourthly, probability inference that is expected to occur and is based on probability theory, which is based on chance and proportionality. Fifthly, deductive reasoning, which is defined as cognitive-minded performance characterized by the extraction of parts of the general rule: concluding from several introductions. It is a cognitive mental performance characterized by the extraction of parts of the general rule (Jarwan, 2010).

1.3 Problem of the study

The science curriculum has undergone several reviews and development to make it in line with modern requirements. Both teachers and students have new roles to play in the development of teaching and learning. Based on the recent trends that the student should be positive and fully interactive with the educational position, the call came to promote students' role, enabling them to acquire the necessary educational skills and to eliminate all factors that limit students' role in receiving and memorizing. Teachers must teaching strategies based on constructive theory if they wish to develop their performance and students' understanding and academic achievement.

By reflecting on the reality of science teaching, it has been shown that the activities presented in the book stimulate thinking. However, the question is, how do these activities progress? In order to achieve this goal, the "express-plans-evaluate" strategy can be used as it is one of the modern strategies that represent the constructive theory. It stimulates thinking and makes sense out of education because it advocates for the student in terms of who he is and urges diversity in tasks and outputs taking into account the abilities of students and the individual differences between them. In addition, there is a scarcity of previous studies and research in this strategy, particularly in the teaching of science, in Saudi Arabic, which is a good justification for conducting this study.

Based on the above, the problem of studying is addressed by the following questions:

1. What is the impact of using the "express-plans-evaluate" strategy in teaching science on the academic achievement of students of second intermediate grade?
2. What is the impact of using the "express-plans-evaluate" strategy in teaching science on the development of inferential thinking skills of students of second intermediate grade?

1.4 Hypotheses of the study

The study attempted to test the validity of the following two hypotheses:

- There are statistically significant differences at the level of (α=0.05) between the mean scores of students of the experimental group and the control group in the post-test of the academic achievement test in favor of the experimental group.
- There are statistically significant differences at the level of (α=0.05) between the mean scores of students of the experimental group and the control group in the post-test of the inferential thinking skills test in favor of the experimental group.

1.5 Study objectives

The current study aims to identify:

- The impact of using the "express-plans-evaluate" strategy in teaching science on the academic achievement of students of second intermediate grade.
- The impact of using the "express-plans-evaluate" strategy in teaching science on the development of inferential thinking skills of students of second intermediate grade

1.6 Significance of the study

This study presents a modern strategy based on the constructivist theory that addresses different types of learning, taking into account individual differences between students, encouraging them to express their needs, and participating in the planning of activities so that meaningful learning

occurs. The study also provides teaching models for science teachers using "express-plans-evaluate" strategy. The results of the study will inform science teachers in Saudi Arabia in general how to prepare for daily lessons. The results also will feed into the process of decision making regarding the training of teachers and curriculum design.

1.7 Limitations of the study

This study is limited by the selection of the Environmental Resources and Protection Unit in the science course for the second intermediate grade 2020 edition. The study is also limited to the choice of school to apply the study, which was chosen in the random simple method from the schools of the city of Abha during the second semester of the school year 2019-2020.

1.8 Previous studies

Different studies investigated the use of EPS strategy in developing various skills. For example, in developing research skills of students, Saeed (2004) conducted a study aimed at identifying the impact of using the "express-plans-evaluate" strategy on the development of scientific research skills among first-year secondary students in physics. The study found statistically significant differences in the pre-post tests of the experimental group concerning their possession of scientific survey skills in favor of the post-test. There were also statistically significant differences between the two groups in the achievement test and the post science skills test and in favor of the experimental group.

Other studies investigated the relationship between the EPE strategy and inferential thinking. Benson (2005) conducted a study aimed at identifying the impact of the "express-plans-evaluate" strategy in the achievement and development of inferential thinking skills in mathematics in high school students. The study found that there were statistically significant differences between the two groups in the achievement test and the inferential thinking test in favor of the experimental group.

Abu Adherah (2010) investigated the impact of employing a strategy "express-plans-evaluate" in teaching mathematics on the development of inferential thinking skills. The study found statistically significant differences between the mean scores of female students in the experimental and control groups and in favor of the experimental group.

Al- Mukhim and Abu Maghnam (2014) identified the impact of employing some of the strategies of differential teaching (SKAMBAR, Circular House, express-plans-evaluate) in geography education in achievement and development of divergent thinking skills of first-grade secondary students. The study found statistically significant differences in the post-test of the cognitive achievement test and the divergence thinking test for students of the experimental group who studied using some differential teaching strategies.

Ahmed and Habad (2014) conducted a study aimed at identifying the impact of a training program based on interactive teaching strategies and the strategy "express-plans-evaluate" in the achievement and development of inferential thinking in mathematics for primary students. The results indicated that the students of the experimental group outperformed the female students of the control group in the post-test of the inferential thinking test.

Al-Ahmari (2015) conducted a study to identify the effectiveness of a model using Addai Scher in acquiring scientific concepts and developing the skills of inferential thinking in science among middle-class first-graders in Khamis Mushit, Saudi Arabia. The results of the study found positive impact of using the model based on Addai Scher in acquiring scientific concepts and developing inferential thinking skills of the experimental group.

Al-Qahtani (2016) conducted a study aimed at identifying the impact of using the structural analysis model in teaching science on the development of scientific concepts and inferential thinking skills in middle-school students. The results of the study found positive impact of the structural analysis model on the development of scientific concepts among the sample of the study.

In the linguistic domain, Al-Shuwaili (2016) identified the impact of the strategy "express-plans-evaluate" on the achievement and transmission of the impact of learning and retention among middle-grade students in Arabic grammar. The results of the study indicated statistically significant differences between the mean scores of female students in the experimental and control groups and in favor of the experimental group.

Awad (2016) conducted a study aimed at identifying the impact of "express-plans-evaluate" strategy and Numbered Heads Together strategy on the achievement and retention among middle-class second-graders in mathematics. The study found a statistically significant difference between the mean scores of female students, and in favor of the experimental group that studied mathematics using a strategy "express-plans-evaluate".

Other studies explored the impact of using the EPE strategy in teaching mathematics.

Farajallah (2017), for example conducted a study aimed at identifying the impact of using "express-plans-evaluate" strategy in developing certain mathematical skills and maintaining the learning retention among low-achieving sixth graders. The study found statistically significant differences in favor of the experimental group in the development of certain mathematical skills, as well as the retention of learning of low-achieving students.

Al-Janabi (2019) also conducted a study aimed at identifying the impact of using "express-plans-evaluate" strategy in teaching mathematics and developing conceptual assimilation among fifth-grade students. The results of the study showed the effectiveness of the strategy in the achievement and conceptual understanding of the students of the experimental group.

Hassan (2019) investigated the impact of using "express-plans-evaluate" strategy in the achievement of geography among students of the fifth grade. The results of the study showed positive impact of this strategy in developing the students' skills of the experimental group.

The current study is consistent with previous studies in the use of "express-plans-evaluate" strategy in its impact on academic achievement (Benson, 2005; Ahmed Wahbad, 2014; Al-Maqdand, 2014; Al-Shuwaili, 2016; Al-Janabi, 2019; Awad (2019). This study also agrees with (Benson, 2005 in using a strategy (via -plans- people) and showing its impact on the development of the skills of a type of thinking. Most of these studies showed the positive impact of using "express-plans-evaluate" strategy in teaching different academic subjects. The current study is the first, according to the researcher's best knowledge, to use "express-plans-evaluate" strategy in teaching inferential thinking skills science in Saudi Arabia.

2. Methodology

The study followed the semi-experimental method, where the sample of the study was divided into two groups: a control group, who studied the unit of the circulatory and immune system in the conventional way, and an experimental group, who studied the same unit using "express-plans-evaluate" strategy.

The study included two variables; an independent variable, which is represented in the teaching method and has two levels, "express-plans-evaluate" strategy and the conventional strategy. The dependent variable was students' responses to the academic achievement test and the inferential thinking skills test.

2.1 Sampling

The community of the study consists of all students in the second intermediate grade enrolled in science class in Asir school during the school year 2019-2020. The sample of the study was 52 students, who were randomly selected and divided into two experimental and control equal groups.

2.2 Study tools

To achieve the objectives of the study, the researcher used two tools:

2.2.1 Academic achievement test

This test was designed to measure students' achievement in science before and after the study at levels of remembering, understanding, application, and higher mental levels. It was built in accordance with the following procedures:

-Analyzing the content of the Environmental Resources and Protection Unit and formulating behavioral goals distributed at Bloom's Taxonomy.

-Setting up a specification table for the test so that the relative weights of content dimensions and behavioral goal levels are taken into account.

-Writing the test items in multiple-choice format; their number was (20) items.

-The content, behavioral objectives and test items were presented to a group of experienced and competent judges, who were asked to review the content analysis, test items, alternatives provided for each paragraph, and language accuracy.

-In light of the opinions of the judges, the test was finalized and applied to an exploratory sample outside the study sample to ensure its consistency and to calculate the coefficients of discrimination and difficulty.

Validity:

The validity of the test was verified by presenting it to a group of eight experienced and competent judges (specialized in science teaching methods and science teachers). They reviewed whether the test is appropriate in terms of the integrity of alternatives and the integrity of language formulation. In light of the judges' observations and suggestions, some modifications were made to the test.

Discrimination and difficulty coefficients:

Discrimination coefficients were calculated through the following equation:

Eq. (1): Discrimination coefficient = number of correct answers for the upper group - number of correct answers for the lower group/

Number of students in one group

The discrimination coefficients for the test items ranged from (0.37-0.88), which is an educationally acceptable ratio (Odeh, 1985).

Difficulty transactions were calculated through the following equation:

Eq. (2): Difficulty coefficients = number of errors in the questions

Number of participants

The difficulty coefficients for the test items ranged from (0.31-0.87), which is an educationally acceptable ratio (Odeh, 1985).

Reliability

To ensure the reliability of the study tool, the test-retest method was used, where the test was applied two weeks before to a pilot sample of 27 students from the Al-Tayseer School in Abha. The test was reapplied two weeks later, and the reliability coefficients were (0.91), which is suitable for the purposes of the study. The test was finalized in its final form as shown in Appendix 1.

2.2.2 Inferential thinking test

This test was designed to measure the inferential thinking skills of second intermediate graders. It was built in accordance with the following procedures:

- Access to the literature, research and previous studies, which have tackled measuring the inferential thinking skills (Al-Qahtani, 2016; Al-Ahmari, 2015).
- Determining the goal of the test, which is to measure the level of inferential thinking skills in the science curriculum of second intermediate graders.
- The test was limited to inferential thinking skills: inductive inference, deductive inference and inductive reasoning skills.
- The drafting of the test items: the initial form of the inferential skills test consisted of (3) introductions containing (9) results. These introductions are general and the results are simple facts. If the result is completely derived from the introduction, the student puts the "right" mark under the option (correct result). The inductive inference skill consisted of (3) introductions containing (9) results, and these general introductions are simple facts followed by results in the form of generalizations. If the result is completely derived from the introduction, the student puts the "right" mark under the option (correct result). Inductive reasoning skills consisted of (9) paragraphs where each paragraph has of a set of scientific terms belonging to a particular field, including one that did not belong to the remaining three terms and the student had to define the term, thereby reaching a relationship that combined those scientific terms.
- The test included (27) paragraphs measuring the skills of inferential thinking: inductive inference, deductive inference and inductive reasoning skills, which is suitable for science in the second intermediate grade.

Validity:

The validity of the test was verified by presenting it to a group of 10 experienced and competent judges (curricula and methods of teaching science, science teachers, and educational psychology). They reviewed the appropriateness of the test in terms of linguistic accuracy and the extent each paragraph measures each skill. Some paragraphs have been amended in the light of the observations of the judges. The test was formulated in its final form as shown in appendix (1).

Reliability:

The reliability of the test was measured by the test-re-test method, where it was applied to a group of students outside the sample of the study (26 students) and after two weeks the test was reapplied. The reliability coefficient was (0.891), which was acceptable for research purposes.

2.3 Educational material

The educational material was the Environmental Resources and Protection Unit, which was prepared to fit the nature of the strategy to be a guide for the science teacher to use it during preparation and application. The following is a presentation of the steps for preparing the educational material:

- Analysis of the content and the Environmental Resources and Protection Unit and the setting of behavioral objectives for each of the unit's lessons;
- Preparing a daily preparation plan for each lesson according to "express-plan-evaluate" strategy.
- Presenting the preparation plans to a group of eight experienced and competent judges to express their observations and opinions, which was amended by deleting and adding in accordance with their observations.
- The scientific material was ready for implementation within the classroom to be applied to the experimental group, after which it was presented to the teacher participating in the experiment and trained for implementation.

2.4 Study procedures

The researcher followed the following steps to carry out the study:

- Reviewing the literature and previous studies relevant to the recent trends in teaching science, especially the use of strategies based on the constructivist theory, including "express-plan-evaluate" strategy, that are appropriate to the age characteristics of middle-class students.
- Reformulating the Environmental Resources and Protection Unit in accordance with the strategy of "express-plan-evaluate" strategy and presenting it to a group of judges to take their opinions and observations, and make adjustments accordingly.
- Preparing the two study tools (academic achievement test and inferential thinking test) in science for the second intermediate grade.
- Selecting the sample of the study randomly and dividing it into two groups, an experimental group to study using the "express-plan-evaluate" and a control group to study using the conventional method.
- Determining the time of the experiment, which took three weeks to carry out.

Applying the pre-tests (academic achievement and inferential thinking tests) to the two groups to find out at the level of second intermediate graders in inferential thinking and achievement in science.

- Teaching the redesigned Environmental Resources and Protection Unit using the "express-plan-evaluate" to the experimental group, while the control group studied the unit using the conventional method.
- Applying the post-tests (academic achievement and inferential thinking tests) to determine the level of second-intermediate graders the tested skills.
- Correcting the two tests, recording their results and conducting appropriate statistical analyses using (SPSS) to reach and discuss the results of the study.
- Providing appropriate recommendations.

2.5 Statistical analysis

To answer the study's questions, the following statistical analyses were carried out; mean scores and standard deviations of student responses to the academic achievement test and the inferential thinking test. The T-Test was used to answer study questions about the detection of statistical differences between the mean scores of the experimental group and the control group in the pre-posttests.

3. Results and discussion

First: Results on the differences between the experimental and control groups prior to the application of the study.

To measure the levels of the experimental and control groups, the academic achievement test and the inferential thinking skills tests were administered to the two study groups prior to the study. Mean scores and standard deviations of student responses are shown in Table 1.

Table 1.

T-test results for the responses of the two study groups to the pre-test.

Variable	group	Number	mean score	Standard deviation	T-value	Significance
Pre-test	control	26	10.37	2.19	0.965	**0.339** Not statistically at α=0.05
	experimental	**26**	**10.57**	**2.11**		

It is clear from Table (1) that the mean scores of the experimental group in the pre-test was (10.57) and the standard deviation was (2.11), by a very small margin from the mean scores of the control group (10.37) and a standard deviation of (2.19). After conducting the T-test, the calculated (T) value was (0.965), which was not statistically significant at the α=0.05, which indicates that there are no statistically significant differences between the two groups and that the two groups started learning in the study approximately at the same level.

Table 2.

T-test results for the responses of the two study groups in the pre-test on inferential thinking skills.

Skill	Method	No.	mean score	Standard deviation	T value	Statistical significance
Deduction	control	26	2.80	0.69	0.18	Not statistically at α=0.05
	experimental	26	2.86	0.78		
induction	control	26	2.26	0.91	0.154	
	experimental	26	2.30	0.88		
inferencing	control	26	3.46	0.98	1.16	
	experimental	26	3.88	1.55		
Total score	control	26	8.53	1.65	0.95	
	experimental	26	9.03	2.10		

It is clear from Table (2) that the mean scores of the control group in the inferential thinking test was (8.53) and the standard deviation was(1.65), which has a very small difference from the mean scores of the experimental group of (9.03) and a standard deviation of (2.10). Results of the T-test showed that the calculated (t) value was (0.95) and was not statistically significant at the level of (α=0.05), which indicates that there are no statistically significant differences between the two groups, which means that the two learning groups have begun to learn from approximately the same level.

Second: What is the impact of using the "express-plans-evaluate" strategy in teaching science on the academic achievement of students of second intermediate grade?

To answer this question, mean scores and standard deviations of student responses were extracted from the post-test as shown in Table 3.

Table 3.
T-test results for the responses of the two study groups to the post-test

The method	number	mean score	Standard deviation	T value	Freedom degree	Level of significance	ETA square
control (the conventional method)	26	11.88	1.70	11.75	50	0.05	**0.73**
Experimental "express-plan-evaluate"	**26**	**17.19**	**11.88**				

Table (3) shows that the calculated T value was (11.75), indicating statistically significant differences at the level of (α=0.05) between the mean scores of the control and experimental groups. These differences were in favor of the experimental group, which were taught using "express-plan-evaluate," where the mean scores of the control group were (11.88) and with a standard deviation of (1.70). The mean score of the experimental group was (17.19) and with a standard deviation of (11.88), which means that the group studied with "express-plan-evaluate" strategy outperformed the group who studied in the conventional method.

The reason for the better achievement for the experimental group may be that teaching using "express-plan-evaluate" strategy is suitable for the nature of the science subject, as it is a newly developed subject and reflects on scientific issues related to the reality of the student. The "express-plan-evaluate" also gave students a general idea of the contemporary scientific issues, giving them the desire to think and expand knowledge, to conclude and link the information contained in it. The hierarchical and logical organization of "express-plan-evaluate" strategy facilitated for students the process of extracting ideas and information and remembering them. This strategy gradually presents to students general ideas first and then less general, and so on to the point of reaching the smallest part of the knowledge that falls within the framework of general ideas. The strategy then creates excitement for students to think and conduct measurements and other processes, which increases their concentration and awareness of the scientific material and their interest in it. The "express-plan-evaluate" strategy also refined their cognitive structure. This has been demonstrated by students' interaction and responses during the experiment, making it easier to acquire and retain scientific materials and experiences and to allow them to experience similar new educational situations. They have also grown in self-dependence in answering and correcting themselves if they are wrong and in enriching themselves if they need more knowledge.

Third: The results related to the second question: What is the impact of using the "express-plans-evaluate" strategy in teaching science on the development of inferential thinking skills of students of second intermediate grade?

To answer this question, mean scores and standard deviations of student responses were extracted from the inferential thinking skills post-test as shown in Table 4.

Table 4.
T-test results of the responses of the two study groups to the inferential thinking post-test.

skill	group	No.	mean score	Standard deviation	T value	Freedom degree	Level of significance	ETA square
Deduction	control	26	3.0321	0.664	11.87	50	Not Statistically significant at the indication level(0.05)	0.73
	experimental	26	6.2612	1.1213				
induction	control	26	2.5732	0.854	12.44			0.76
	experimental	26	6.1544	1.181				
inferencing	control	26	4.4512	1.133	9.08			0.62
	experimental	26	7.6502	1.3843				
total score	control	26	10.0565	1.8022	15.88			0.84

experimental	26	20.0658	2.26448

Table (4) shows that the mean scores of the responses of students of the experimental group exceeded the mean scores of the control group on the inferential thinking test with its overall degree and the three skills (deduction, induction, and inferencing). To reveal the significance of the individual differences between the mean scores of the two groups, T-test was conducted to determine whether there was an effect of the independent variable. .

It is noted from Table (4) that T-value was (15.88), indicating statistically significant differences at the level of (α=0.05) between the mean scores of the control and experimental groups. These differences were in favor of the experimental group, which was taught using "express-plan-evaluate" strategy, where the mean score of the control group was (10.0565), with a standard deviation of (1.8022), which was lower than the experimental group's means score (20.0658). This indicates that the group taught through "express-plan-evaluate" achieved better than the group taught in the conventional method. This result is consistent with the results of other studies, such as (Benson, 2005; Al-Maqham and Abu Magnum, 2014).

This result could be due to the great compatibility between "express-plan-evaluate" and between inferential thinking and science in raising important issues that enable students to practice various mental skills during the application of the study. The nature of the science syllabus gives students a prominent role in education by conducting higher mental processes, provoking different discussions, expressing opinions, organizing ideas, and giving them the opportunity to meditate and contemplate, which helps to develop the skills of inferential thinking. Using this strategy has enabled students to delve deeper into different issues, built through plans, respected their minds and potential, and encouraged them to put forward their ideas and opinions, listened to and discussed with their colleagues, and eventually enriching them with multiple inferential thinking skills.

4. Conclusion and recommendations

The aim of this study was to reveal the impact of using the "express-plan-evaluate" strategy in teaching science on the academic achievement and development of inferential thinking skills among second intermediate grade students. The results of the study revealed a positive impact of using such strategy as it develops students' ability to think and infer information. The strategy also helps students to develop their inferential thinking skills (deduction, induction, and inferencing). It allows them to use these different skills in an interactive way while still benefiting from the core concepts of the lessons.

The use of this strategy also allows teachers to depend of different techniques and various styles to teach scientific concepts to students. Teachers were also able to facilitate good achievement and develop inferential thinking skills for students by using the "express-plan-evaluate" strategy. The integration of the different cognitive skills paved the way for students to explore their own skills and identify their strengths and weaknesses, which eventually reflects on their academic achievement.

In light of the results of this study, the researcher recommends:

- Expanding the application of "express-plan-evaluate" strategy to include the rest of the science courses in other educational stages.
- Training teachers in the field of science at all stages on how to use "express-plan-evaluate" strategy in teaching because it has a positive impact on academic achievement and development of inferential thinking skills.
- Identifying the effectiveness of using "express-plan-evaluate" strategy in other learning outcomes such as critical and creative thinking.
- Applying "express-plan-evaluate" strategy to a larger sample or another sample of primary and secondary students, or a sample from other educational areas.

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Appendix (1)

Academic Achievement test

Test instructions

Dear student, Peace be upon you.

You have an achievement test consisting of (20) multiple-choice paragraphs. For each question, there is only one correct answer out of the four alternatives given under each question. Note that the purpose of this test is for scientific research only. Before you begin, you should read the following instructions:

Do not write anything on the brochure/booklet

Write your name and all your information.

Do not choose more than one answer for the same question.

Duration of this test is 45 minutes only.

1. Example of renewable resources:

A. Oil	B. Graphite
C. Iron	D. Wood.

2. One of the following is a fossil fuels in the environment:

A. Coal	B. Oil
C. Natural gas	D. All of the above

3. Hydroelectric power is formed by:

A. Investing the wind energy to power generators.	B. Investing water energy to power generators.
C. Investing nuclear energy to operate power generators.	D. Investing geothermal energy to power generators.

4. Which of the following types of energy does not pollute the environment:

A. Wind Energy	B. Hydroelectric
C. Nuclear energy	D. Geothermal energy

5. Calculators work using which energy:

A. Nuclear	B. Solar
C. Hydroelectric	D. Geothermal

6. The layer of gases that surrounds Earth is an expression of the concept of:

A. Pollutants.	B. Atmosphere
C. Ozone hole	D. Acid rain

7. Air pollution produced when:

A. Evaporation of paints	B. Cutting down forest trees
C. Dumping industrial waste into lakes	D. Washing fuel tanks

8. Which of the following energy sources is never ending (endless):

A. Oil	B. Nuclear
C. Solar	D. Groundwater

9. Tidal power is utilized in:

A. Operating a calculator	B. Producing electricity
C. Running ships	D. All of the above

10. In which layer is the Ozone?

A. Stratosphere	B. Troposphere
C. Mesosphere	D. The correct answer is not mentioned.

11. The Ozone is a form of:

A. Hydrogen	B. Carbon Dioxide
C. Oxygen	D. Nitrogen

12. ---------- is a harmful radioactive toxic gas obtained from some rocks:

A. Carbon Monoxide	B. Radon

C. Carbon Dioxide	D. Acid Rain

13. Increasing of algae are pollutants of:

A. Soil	B. Surface water
C. Air	D. Groundwater

14. Batteries residues are:

A. Hazardous waste	B. Solid waste
C. Soil pollutants.	D. All of the above

15. Contouring tillage works on:

A. Preserving water	B. Preventing soil erosion
C. Reducing the spread of waste	D. Preventing air pollution

16. Example of natural compost:

A. Paper / Leaf	B. Plastic
C. Fabric	D. Damaged tires

17. The main gas that heats the earth is…

A. Nitrogen	B. Hydrogen
C. Carbon dioxide	D. Oxygen

18. Acid rain leads to…

A. Extracting nutrients from the soil	B. Air pollution
C. Increasing earth temperature	D. Ozone depletion

19. Oxygen consists of:

A. One atom of oxygen	B. Two atoms of oxygen
C. One oxygen atom and one hydrogen atom	D. Two oxygen atom and one hydrogen atom

20. Hazardous waste includes:

A. Old refrigerators	B. Used toys
C. Insecticides	D. Old Computers

Inferential thinking test

Test instructions

Dear Student, Peace be upon you.

The test consists of three skills (deduction, induction, inferencing). Note that the purpose of the test is for scientific research only and has nothing to do with your grades. Before you begin, you should read the following instructions:

- Read and carry out the instructions for each sub-test.
- Answer all questions and do not leave a single question.
- Make sure you put your answer in the right place.
- Do not answer until you have been asked to.
- If you want to change your answer, make sure that you cancel your first answer completely.
- Duration of this test is 45 minutes only.

Part one: Deduction

Dear student, you have three questions in front of you, and each one consists of an introduction that contains two or more correct phrases, followed by three results that may be correct or incorrect:

A. If you find that the answer is completely derived from the introduction, place a checkmark below the correct option.

B. If you find that the answer was not derived from the introduction, place a checkmark below the incorrect option.

First question:

- Fossil fuel have formed in the Earth's crust thousands of years ago.
- Fossil fuel is non-renewable resource.

	Suggested answers	Correct answer	incorrect answer
	Oil is a fossil fuel		

	Oil is renewable resources		
	Oil is an environmental pollutant		

Second question:

- Solar energy is the most important source of energy:
- Solar energy is never ending.

	Suggested answers	Correct answer	incorrect answer
	Solar energy is an alternative to fossil fuels		
	Solar energy does not pollute the environment		
	It is used in heating and operating computers		

Third question:

- Recycling: is the reuse of the material by treating and remanufacturing.
- Not all used materials currently can be restored.

	Suggested answers	Correct answer	incorrect answer
	Recycling is considered to be one of the ways to protect the environment		
	Using paper as a natural fertilizer is a recycling method		
	Plastic is easily recycled		

Part Two: induction

Dear student, you have three questions in front of you, and each one consists of an introduction that includes three or more correct phrases, followed by three results that may be correct or incorrect:

- If you find that the answer is correct, place a checkmark below the correct option.
- If you find the answer is wrong, place a checkmark below the incorrect option.

First question:

- Cotton is a renewable resource.
- Wood is a renewable resource.

- The sun is a renewable resource.

	Suggested answers	Correct answer	incorrect answer
	Renewable resources are natural resources.		
	Renewable resources are constantly renewed with nature		
	Some renewable resources are sometimes decreasing		

Second question:

- Wind energy is a renewable energy.
- Hydroelectric energy is a renewable energy.
- Tidal energy is a renewable energy.

	Suggested answers	Correct answer	incorrect answer
	All types of renewable energy reduce environmental pollution		
	Renewable energy is an alternative to fossil fuels.		
	Producing electricity from renewable energy replaces fossil fuels.		

Third question:

- Acid rain is an environmental pollutant.
- Hazardous wastes are environmental pollutants.
- Carbon monoxide and Radon are toxic and polluting gases.

	Suggested answers	Correct answer	incorrect answer
	Recycling wastes is a form of environmental conservation.		
	Reusing some materials is a form of environmental conservation.		

	Air is the only thing affected by the previous pollutants.		

Third Part: inferencing

Dear student, in front of you this part of the test and it consists of (9) concepts, each one consists of four scientific terms, One of these terms differs from the rest of them, while the rest of the terms are connected, you are required to extract the different concept.

	Vocabularies	Different concept	Connection with the rest of the concepts
	Carbon monoxide, Radon, Methane, Oxygen.		
	Solar energy, Wind energy, Hydroelectric energy, Oil.		
	Plastic, Paint, Tires, Wood		
	Grass clippings, Paper, Vegetable peels, and Pesticides.		
	Iron, Uranium, Copper, Cotton.		
	Smog, Fossil fuel, Acid rain, Natural fertilizer.		
	Terraces, Contouring tillage, Strip farming, wildfires.		
	Consumption rationalization, Recycling, Consumption rationalization, Erosion.		
	Volcanoes, Wind, Wildfires, Ozone layer		