

The Effectiveness of Adey and Shayer's Strategy in Developing Formal Thinking for Fourth-Grade Preparatory Students with Physics

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Abstract

The aim of the current research is to identify the effectiveness of teaching Adey and Shayer's strategic strategy in developing formal thinking for fourth-grade preparatory students with physics, by verifying the following hypothesis:

“There was no statistically significant difference at the level (0.05) between the average scores of the experimental group students who studied Adey and Shayer strategy and the mean scores of the students of the control group that studied the usual way in the development of formal thinking”.

The study determined the fourth grade preparatory students in the day preparatory and secondary schools affiliated to the Directorate of Diwaniyah Education for the academic year (2018-2019) - the first semester, the number of members of the sample reached (69) students, and (34) students of the control group, which were studied in the usual way and (35)) students of the experimental group that studied the Adey and Shayer strategy. The two research groups (experimental and control) were valued in a number of variables, and these variables are (time months in months, intelligence, previous information). For the purpose of verifying the research goal, the researcher prepared (21) study plans according to the Adey and Shayer strategy, and the researcher prepared a test for formal thinking consisting of (30) items with a multiple choice. The validity of the test was checked, its reliability and the discriminatory strength of its items was calculated. The experiment was applied in the first academic year (2018-2019) and after the end of the experiment, the data was processed using the *T-test*, and the results showed the superiority of the experimental group students who studied the Adey and Shayer strategy to the students of the control group that studied the usual way in developing formal thinking.

Research Problem

The advancement of knowledge is characterized by rapid and continuous change scientifically and technology. The student's use of thinking processes as a method in his life that makes him an educated individual can coexist with this progress, and today we are in urgent need of teaching and learning strategies that provide the student with a wide and varied educational horizon that helps the student to develop their mental skills.

As a result of the use of traditional and ancient teaching methods that do not develop students' thinking, a decrease in their level of thinking has occurred. And the low level of thinking in physics for preparatory students in general, and fourth graders for preparatory in particular. Where the researcher believes that the use of this strategy (Adey and Shayer) may leave the major impact in developing higher-order thinking skills, mental capabilities, and the teacher's ability to communicate the subject matter, including the mechanism of modern trends in teaching. Through the researcher's knowledge of advanced teaching strategies and models, many of them have proven effective in speeding up thinking, including the Adey and Shayer strategy, and from these studies such as (The Sultan's Study 2016) and the David's Study 2018, the research problem can be formulated with the following question:

“What is the effectiveness of Adey and Shayer’s strategy in developing formal thinking for fourth-grade preparatory students in physics?”

Research Significance

Education is the main axis in the scientific development witnessed by this era as it aims to develop the capabilities of the person and strengthen them by focusing on the necessary skills such as the skill of communication, interaction, cooperation and problem solving and also aims to develop the personality of the learner in all its aspects to adapt to a developed and rapidly changing society (Al-Titi, 2013 : 53) At present, he found a great interest in scientific education, as the paths of advanced and developing societies in the treatment and management of scientific education multiplied that the rapid developments and changes constitute a challenge for education in general and scientific education in particular. Therefore, the human being must know the scientific alphabet in order to keep pace with the scientific changes and developments over the days (Zaytoun, 1996: 133). Learning through different strategies provides students with

productive, continuous and effective communication opportunities because the good environment for interaction and communication is what makes the student employ every sense and emotions to the maximum degree Possible during the learning process and until the process of communicating the desired goals is achieved (Qandil, 2005,5) and studying thinking and caring for it leads to the existence of a contemporary movement in educational literature called the movement of teaching thinking skills and includes more than one vision in this field and all of them start from the assumption of the possibility of learning to wrap CARE and the possibility of learning it, and then raising the level of thinking of a person when the right environment is created for the development (Abu Jada and Muhammad, 2007: 25). The Adey and Shayer strategy is a teaching model for physics teaching used in various educational stages. The importance of research can be summarized in the following points:

1. According to the researcher's knowledge, the first experimental research is interested in teaching the physics curriculum with the Adey and Shayer strategy, and there are no empirical studies on this approach.
2. The importance of research lies in the fact that he is interested in studying middle school, and this stage has great importance in building the student's personality.

Research Objectives

The current research aims to identify:

“The effectiveness of teaching with Adey and Shayer's strategy in developing formal thinking for fourth-grade preparatory students with physics”.

Research Hypothesis

For the purpose of achieving the aim of the research, the following zero hypothesis has been formulated:

“There was no statistically significant difference at the level (0.05) between the average scores of the experimental group students that were studied according to the Adey and Shayer strategy and the average scores of the control group students who studied in the usual way in the formal test for fourth-grade preparatory students”.

Research Limits

The current research is limited to:

- Fourth grade preparatory students in the morning preparatory and secondary schools, affiliated to the Diwaniyah Education Directorate.
- The first semester of the academic year (2018-2019).
- Physics textbook for the fourth year of preparatory, first edition of the year 2017.

Terms Definition:

First: Effectiveness

Tawfiq (1997,93) defined 'effectiveness' as "determining the expected impact of education or training for students to achieve the goals set and measured by identifying the increase or decrease in their average averages".

Procedurally: It is the effect that is expected to be measured by teaching students of the fourth preparatory stages with physics through their teaching on the Adey and Shayer's strategy.

Second: Adey and Shayer's Strategy

Moussa defined *Adey and Shayer's Strategy*: as a strategy that helps the student reach the stage of formal thinking early, and includes four steps: preparation and discussion - cognitive conflict (contradictions) - and metacognition (thinking in thinking) - and bridging (linking what the student is learning with the environment) (Muhammad, 2008, 59).

Procedural definition of the researcher for *Adey and Shayer's Modal*: This model helps students to reach thinking early through their studies of physics according to the four stages, namely: class discussions, cognitive conflict, thinking in thinking and the stage of bridging.

Third: Formal Thinking

Piaget defined it as the ability to solve problems using mental processes. (Wordsworth 96,1990). Also, Al-Rayan defined it as the ability to use abstracts and generalizations to enable forecasting, planning, and reaching conclusions (Rayan ,2006:88).

Procedural definition of the researcher for *Formal Thinking*: It is the degree that the student gets for the test that the teacher put in physics for the fourth preparatory stages.

Theoretical Background

The Adey and Shayer's strategy helps students to communicate continuously and effectively in learning, because a good environment for interaction and communication provides the student with all his senses and emotions during the learning process, and for the process of communicating the desired goals to be achieved, the communication environment must be appropriate and the teacher takes into account the words that are appropriate with Student growth levels (Qandil, 2006, 5). He pointed out in this strategy to its goal is to develop thinking in thinking, as it works to encourage students to think about their thinking, and realize their own way of thinking through the events and situations they interact with, and they have the opportunity to purposeful cooperation with each other, and they have a special coding among them within the subject of the study axis. Teaching according to this new model, "Adey and Shyer's Model", enhances students' thinking (Robertson 2001, 67).

The Foundations of Using Adey and Shayer's Strategy

1. Sensory counter:

In this step, the teacher presents the problem to the students, where discussions occur in three stages before experimentation, during experimentation and after experimentation. The teacher tries to divide the students into working groups to conduct the discussion so the teacher is more than just a teller of information. The teacher is an opportunity for students to talk about the relationships and connections they have reached or used or the procedures they have taken as the teacher links the experiences students gained in the class and daily experiences.

2. Cognitive conflict:

Students are exposed to observations that are surprising to them because they do not agree with their expectations and are not consistent with their motives or previous experiences that they were exposed to at the beginning of the activity. Cognitive development among

students in their thinking skills through cognitive hierarchy and the transition from lower to higher ability.

3. Building and forming concepts:

The student must build knowledge on his own, and he must be provided with the necessary and appropriate means, tools and opportunities to do so, not only understanding and digesting the concepts he built and formed, inference, and building rules and patterns for this reasoning in order to find solutions to problems.

4. Metacognition "Thinking and Thinking":

This step begins with achieving the principle of the learner's awareness of his or her thinking processes and his awareness of what he says and what he does, and why he used this method of thinking and why he thought through it.

- *How did you do that?*
- *Why did you do that?*

5. Bridging:

These steps aim to link the experiences that students have obtained from the actions they make with their experiences in their working life and with multiple study topics. Building intellectual bridges between activities and working life is necessary to bring educational experiences out of the theoretical framework to the practical framework and life applications (Darwish, 2007, 77).

The Importance of Teaching Using Adey and Shayer's Strategy

- ❖ The importance of teaching with this strategy is determined in the following points:
- ❖ High levels of students' mental development through the innovative activities they offer.
- ❖ It leads students to high levels in academic achievement.
- ❖ Increasing students 'motivation and practice of learning science operates as a strategy that gives breadth of thinking to students' experiences that helps students to link variables and the thinking of thinking.

- ❖ It deals well with science lessons and is one of the guiding aspects of working and realizing ideas (Imran, 22, 2016).

Teaching Philosophy Following Adey and Shayer's Strategy

In this strategy, a person falls under the influence of events or concepts that are incompatible with his knowledge and what he has about his world (Imran, 2016, 426). During the preparation of the guide according to this strategy, the researcher has considered how to solve the opposing situations "problem" of the learner through educational activities and worksheets, where these activities are a challenge to their ideas so that they will have acceptance and conviction with the new information, as well as the researcher has looked at encouraging and developing scientific thinking and science processes for students. The use of this model has an effective impact in teaching thinking, and in improving the level of thinking students with learning difficulties in the science subject through using the included thinking (Shayer, 2002).

The two scientists (Piaget and Vygotsky) have developed common features of Adey and Shayer's strategy represented as the followings:

1. Students' thinking challenge.
2. The concertation on social construction of knowledge and understanding.
3. Encouragement and promotion of opportunities for epistemological thinking (Adey and Shayer, 2010).

Shayer (1999) classified each base according to its connection with the philosophical basis, some of which are attributed to *Piaget*, and some of which are attributed to *Vygotsky* according to the following table.

Base	Piaget	Vygotsky
<i>Concrete sensory preparation</i>	X	X
<i>Cognitive Conflict</i>	X	
<i>Metacognition</i>		X
<i>Bridging</i>	X	X
<i>Concepts building</i>	X	X

Literature Review

1. Adam (2006) 's Study

The study aimed to identify the effectiveness of the Adey and Shayer model in accelerating cognitive development, developing scientific inference and academic achievement in the subject of science for fourth preparatory students (Adam, 2006).

2. Mohammed (2008)'s Study

This study aimed to identify the effectiveness of the Adey and Shayer model in accelerating mental development

This study aimed to identify the effectiveness of the Adey and Shayer model in accelerating mental development

For first-graders in biology through their studies of biology, scientific thinking and building an organism. The sample of the study consisted of 27 students representing the experimental group and 26 students representing the control group. The researcher adopted the study tools of the achievement test and the Piaget stages of mental development test. The results showed the effectiveness of the Adey and Shayer model and in favor of the experimental group on the control group in the research variables (Mohamed, 2008).

Research Method

First: Research Design:

The researcher chose the "semi experimental design" and the pre and post test for two groups, one of them is an experimental group that studies the Adey and Shayer's model and the other is a control that is taught according to the usual method.

Second: Sample and Population of the Research

The research community consisted of all fourth-grade preparatory students in the daytime preparatory and high school (at Diwaniyah Governorate Center), which is affiliated with the General Directorate of Education in Diwaniya Governorate, for the academic year 2019-2020. One student (35) for the experimental group and (34) for the control group.

Third: Comparison of Research Group

The researcher has equalized the two research groups in a number of variables:

1. Chronological age: the students' ages for the two research groups (experimental and control) were calculated in months after obtaining them from school records, and the mean and standard deviation for both groups (experimental and control) were calculated, and the T value was calculated.
2. Intelligence: The two groups (experimental and control) were valued in terms of the intelligence variable by applying (Raven test for standard successive matrices) consisting of five groups (A, B, C, D, E), and the mean and standard deviation of both groups were calculated (experimental and control), And calculate the T value.
3. Prior knowledge: For the purpose of identifying what students have of the two research groups (experimental and controlling) from previous information in physics subjects, the researcher adopted test 1 consisting of 25 items with a multiple choice, and the arithmetic mean and standard deviation for both groups (experimental and control) were calculated, and an account T value.

Table (1)

Equivalence of the two research groups (The experimental and control groups) in a number of variables

Group	Experimental (34) Students		Controlling (35) students		T Value		Significance level at 0.05
	Mean	Standard Deviation	Mean	Standard Deviation	Calculated Value	Tabular value	
<i>Age in Month</i>	192.68	2.66	192.70	2.48	1.130	2	Insignificant
<i>Intelligence</i>	33.38	1.36	33.49	2.48	.77		Insignificant
<i>Prior Knowledge</i>	13,03	2.71	12.69	2.41	1.90		Insignificant

<i>Formal Thinking</i>	18.07	2.66	18.37	3.20	1.53		
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Equivalence of the experimental and the control groups in a number of variables

Table (1) shows that the calculated "T" value for all variables was less than the tabular "T" value, and this indicates that the two research groups are equivalent in these variables.

Fourth: Preparing Research Requirements

To complete the procedure of the research, a number of requirements need to be implemented, including:

1. **Specifying the educational subject:** The educational subject that the researcher teaches was determined for the two research groups (experimental and controlling groups) during the experiment period (the second semester) of the academic year (2018-2019). The educational material included the chapters of the physics book for the fourth preparatory grade, which includes four chapters.
2. **Formulating behavioral goals:** The researcher formulated (127) behavioral goals in the light of the material book of physics scheduled for the fourth year of middle school, and the researcher relied on the formulation of goals on the classification of "Bloom" in the cognitive field, relying on the first three levels which are (level of recall, level of understanding "Absorption", the level of application), and the researcher presented behavioral purposes to experts with expertise and specialization in the field of teaching methods, and (80%) of the experts' opinions were taken.
3. **Preparing teaching plans:** In light of the content of the four chapters of the physics book for the fourth preparatory grade, (22) study plans were prepared according to Adey and Shayer's strategic, and the researcher prepared (22) plans according to the usual method of the control group, and a group of experts specializing in teaching methods and physics was presented.

Fifth: Preparing the Research Tool

Formal test: The researcher relied on building the formal test on six skills identified by the study (Gharawi, 2011). These skills are:

1. **Hypothetical reasoning:** It is a person's ability to put forward a set of assumptions and try to test their validity.
2. **Deductive reasoning:** It is the formulation of a general rule of special results.
3. **Proportional reasoning:** It is the ability to establish a relationship between two relationships to reach a solution to the problem.
4. **Structural inference:** It is the establishment of a number of arrangements and connections for a number of variables.
5. **Defining and controlling the variables:** the ability to know the effect of one of the variables on the problem and the ability to control it.
6. **Logical reasoning:** the ability to infer relationships between concepts.

(Gharawi, 2016, 670)

Preparing the test: After determining the dimensions of the formal test, the researcher formulated (5) items for each dimension, and thus the total number of items (30) items became in the form of multiple choice, i.e. giving (1, zero) for each item of the test, so the highest degree gets The student has a score of (30) and the lowest score he gets (zero).

Test Validity: The validity of the formal test was verified by presenting the test in its initial form to a group of experts, specialists in teaching methods, physics, supervisors, specialists, and physics teachers, and expert opinion was used regarding the validity, safety, and authentication of the test items in scientific, technical and linguistic terms.

Exploratory application of the test: The researcher applied the test to a sample of (120) students from the fourth year of middle school, and the researcher corrected the answers of the sample students and the grades were arranged in descending order and then divided into two groups, higher and lower, after taking (27%) of the higher grades and (27) %) Of the lower grades, after which the following statistical analyzes were performed:

The Discriminative force of items: The researcher calculated the discriminatory strength of each of the test item and found that their value ranges between (0.39-0.82), thus the test item are good and a factor of their distinction.

Test Consistency: The consistency factor was calculated by the method of re-testing: (Method Test –retest) After applying the test to the second-stage exploratory sample, the test was repeated on the same sample individuals and after (14) days have passed, and the correlation coefficient was calculated using the *Pearson correlation coefficient* between the degrees of Students in the first application and the second application, as the amount of the coefficient of test consistency was (0.86) and this amount is considered acceptable.

This chapter includes a presentation of the research results and their interpretation, then explaining the conclusions, recommendations and proposals that have been reached.

First. Results preview: For the purpose of verifying the null hypothesis, which states that (there is no statistically significant difference at the level (0.05) between the average scores of students of the experimental group that were studied according to the Adey and Shayer's model and the average scores of students of the control group that were studied in the usual way in a test Physical reasoning in physics), the researcher calculated the mean and the standard deviation of the scores of students of the experimental group and the control group, as in table (2).

Table (2)

T-Test Results for Test Scores Formal Thinking of the Two Groups (Experimental and Control)

Group	Students Number	Difference Average	Standard Deviation	T-Value		Statistical Significance
<i>Experimental</i>	34	25.55	1.19	6.5	2	Significant
<i>Controlling</i>	35	22.45	2.45			

Table (2) shows that the average score for students of the experimental group in the achievement test (25.55) and the standard deviation (1.19), while the average score for the students of the experimental group (22.45) and the standard deviation (2.45) and by using the T-test for two independent samples (T-test), It was found that the calculated T value is equal to (6.5) and it is greater than the tabular value which equals (2) at the significance level (0.05) and the degree of freedom (63). This means that there is a statistically significant difference between the experimental and control groups in the achievement test and in favor of the experimental

group that was studied according to the teaching Adey and Shayer's model compared to the control group and that were studied according to the usual method.

Second. Interpretation of the results: The results reached by the researcher show that the use of the Eddy and Shire model in teaching physics is effective in formal thinking among students of the fourth year of middle school with the subject of Physics. The researcher believes that the reason for the effectiveness of this model compared to the usual way is that learning according to the Eddy and Shire model is an active cognitive process that allows the learner the opportunity to pass through a variety of exploratory educational experiences, and that a model that facilitates the student to form new cognitive structures and thus a cognitive development occurs in the student.

Third. Conclusions: Through the current search results. The effectiveness of the Adey and Shayer's model in formal thinking was compared to the usual method

Fourth. Recommendations: In light of the research results, the researcher recommends conducting in-service training courses for physics teachers on the use of the Eddy and Shire model in the physics teaching process, through cooperation between the *Diwaniyah Education Directorate* and the *Training and Development Center at the University of Qadisiyah*.

Fifth. Suggestions: In completion of this research, the researcher suggests:

1. Studying the effectiveness of the Eddy and Shire model in teaching Physics at other academic levels.
2. Conducting other studies to reveal the efficacy of the Eddy and Shire model in other variables.

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