

The Impact of Using (5e's) Instructional Model on Achievement of Mathematics and Retention of Learning among Fifth Grade Students

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Abstract: This study aimed to investigate the impact of using (5E's) Instructional Model on achievement of mathematics and retention of learning among fifth grade students. To achieve the objectives of the study and answering its questions, the researcher used the semi-experimental method. Experiment group were equal to (30) student, and control group were equal to (29) students. Pre and post tests were used to see the difference in two groups. Experiment group was teached with constructivist approach by using the (5E's) instructional model. T-test was used to check the significant difference between experiment and control group after experiment. It is explored that both the groups were equal regarding their achievement scores in pre-test before the experiment, but after experiment both were different in their achievement test scores in favor of experiment group. It is concluded that this significant performance of experiment group may be due to teaching them with the (5E's) instructional model. The study also concluded that there were no statistically significant differences in the experimental group attributed to the post and postponed test (three weeks after) which shows retention of learning among experimental students. Finally, in the light of the findings, the study has been proposed a number of recommendations.

Keywords: 5E's, instructional model, mathematics achievement, retention.

I. Introduction

The constructivist theory is one of the contemporary learning theories that emerged from knowledge theories, in which underlying its philosophical basis that the teacher role should be trainer, leader and facilitator of learning processes and create an educational environment for the student to build his knowledge by himself through direct interaction with the learning material and the use of all his accumulated concepts and previous experiences to be the center of the educational process (Zayton, 2007). The constructivist approach and the studies carried out in parallel to it, focused on how to secure the permanence of the knowledge rather than obtaining it and how derive new information from the acquired knowledge (Shiland, 1999). Constructivism was defined by Afaneh and Abu Mallouh(2006, p. 339) as "a process of interaction between three elements in the educational attitude: past experiences, educational attitude presented to the learner, and environmental climate in which the learning process takes place, to build and develop new knowledge structures, characterized by inclusiveness comparing to the previous knowledge, and using these new cognitive structures in addressing new environmental attitudes." The constructivist theory constructed on learning rather than teaching, dealing with learners as creative student and encouraging them to independence, initiative, research, investigation, and discussion, as it emphasizes the curiosity to learning, creative thinking in order to build a new knowledge, and change the teacher's role to be interactive teacher, organizing the learning environment, while the role of the learner is characterized by activity and positive innovation and try to discover knowledge, self-understanding through discussion with others and keep away from memorization (Abu Safar, 2014). Constructivist theory model has been proven in its different stages success in the conceptual change through various instructional models, resulting in a proper understanding of cognitive structure, all these emerged models from constructivist theory were successful strategies and models for teaching, and they all focus on the active and effective student's role and emphasizing that he is the producer of his knowledge. The (5E's) instructional model is one of these constructivist models, and was developed by Rodger W Bybee in 1997 which consists of five stages: engagement, exploration, explanation, elaboration, and evaluation, and each phase has a specific function and contributes to the teacher's coherent instruction and to the learners' formulation of a better understanding of scientific and technological knowledge (Dahmash, Naaman, and Lafras, 2014; Bybee, 2006).

The (5E's) instructional model phases:

The (5E's) instructional model consists of five main phases (Kotaite and Kherissat, 2009; Zaitoun, 2007; Bybee, 2006) which are:

- 1- Engagement phase: At this stage, teacher should stimulate students to draw their attention, involving in the learning process and make connections between past and present learning experiences through varied interesting and meaningful activities; where raised questions concerning the pre-defined problem at

- this stage, have the students reveal their ideas and beliefs, compare students' ideas, let them work individually or in cooperative groups, then the students should become mentally engaged in the concept, process, or skill to be learned.
- 2- Exploration phase: At this stage, the student will interact with new experiences that arouse many questions that may be difficult to answer, and then by doing activities and trying to find an answer to these questions will lead him to discover relationships that were not known to him before, and the teacher's role will be guidance, encouragement, and training to enhance continuing such activities until the clear image of scientific concept becomes apparent.
 - 3- Explanation phase: At this stage, the student will benefit from the results of the previous two phases where he can correct his misconception, and the teacher's role is to collect information from students to help them in organizing and summarizing and processing it mentally until the concepts, operations, and skills become understandable and clear; then the student, at this stage, reaches the new ideas offered by the teacher and has the ability to re-formulate these ideas in a scientific manner, and the teacher starts to draw and connect the student's interpretations with these experiences to make sure that the student is able to interpret the exploratory experiments using scientific terms correctly.
 - 4- Elaboration phase: At this stage, teachers challenge and extend students' conceptual understanding and skills. Through new experiences, the students develop deeper and broader understanding, more information, and adequate skills. Students apply their understanding of the concept by conducting additional activities.
 - 5- Evaluation phase: At this stage, students receive feedback on the adequacy of their explanations and abilities, informal evaluation can occur from the beginning of the instructional sequence. It is an on-going diagnostic process that allows the teacher to determine if the learner has attained understanding of concepts and knowledge. Evaluation and assessment can occur at all points along the continuum of the instructional process. Some of the tools that assist in this diagnostic process are: rubrics (quantified and prioritized outcome expectations) determined hand-in-hand with the lesson design, teacher observation structured by checklists, student interviews, portfolios designed with specific purposes, project and problem-based learning products, and embedded assessments.

There are many advantages of (5E's) instructional model like that; it takes into account individual differences, introduce progress in knowledge and science as a way of research where the student follows the learning from micro to macro, motivate student to use his mental processes, and show attention to focus on the development of multi-thinking skills, based on thrill and excitement to attract attention, also depends on the explanation and interpretation, discussion and collaborative learning, and also depends on the detailed expansionist thinking, makes learning meaningful and helps edit understanding error, and finally provides the student with many different ways of evaluation (Zaitoun, 2003; Ahmed, 2006).

Finally, one of the most important goals of education in general is learning retention, which means the continued possession of experiences and skills that students can be restored after a period of time and practice them in new situations, this is an indication of the quality of the used teaching strategy and the diversity of learning styles, in which enhances and raises student interest and gives him a chance to share with his all senses and aims to satisfy his needs and motivations, and this will lead to retention of concepts and retrieve it when needed (Alsaad, 2013). Mathematics subjects considered to be one of the most courses need to keep learning because its knowledge and concepts built on each other as an accumulative science, and that's what current study trying to achieve by applying (5E's) instructional model to see its impact on the achievement and its impact on learning retention.

II. Previous Studies

Abo Ssfr study (2014), which aimed to know the effect of the employment of two strategies; quintet learning cycle (5E's), and self-table (kwl) in the development of mathematical problem solving skill at the eighth grade students in Gaza Governorates, Palestine. The study used semi-experimental approach and applied the study on a sample of 94 female students who were divided into three groups; two experimental groups consisting of (32) students each, and each group studied with one of the employed strategies, and a control group consisting of (30) students who studied with traditional method, the result found that the effectiveness of the study using the two strategies applied in the experiment at the achievement test, and also the study revealed that there were no statistically significant differences between the two strategies applied.

Abu Attas study (2013), which aimed to know the effect of employing learning cycle model in the development of creative thinking skills in mathematics at ninth grade students in Gaza, Palestine. The study implemented a pilot study on a sample of 28 students studied using the learning cycle strategy, and another control group composed of 26 students taught using the traditional method, and the results of the study showed a significant difference between the two groups in favor of the experimental group.

Hamdanistudy(2013), which aimed to study the effect of using the Bybee model in the achievement of fifth grade students in mathematics and the development of formal thinking in Mosul city, Iraq. where the study sample consisted of two groups; experimental which studied according to the Bybee model, and control which studied with traditional method. Results indicated the effectiveness of using Bybee model in the achievement test and the development of the formal thinking than those who studied with traditional method.

Taleb Study(2008) aimed to investigate the effective use of quintet learning cycle in the acquisition of scientific concepts and the development of innovative thinking to the ninth grade student in the city of Taiz, Yemen. The results proved the existence of significant difference in acquiring the concepts and the development of innovative thinking in favor of experimental group.

Alexjastudy(2006) aimed to investigate the impact of using two constructivist learning model; one is learning cycle, and the other is Wheatley model on mathematical concepts achievement at the ninth grade students in Amman, Jordan. the sample of the study consisted of 247 students at six sections from two different schools, where they divided into three groups; two experimental and each group studied with one of the employed strategies, and a control group studied with traditional method. Students were divided into three categories: students with high achievement, students with average achievement, and students with low achievement, based on their scores in mathematics course. The study results showed the effectiveness of the use of learning cycle strategy and Wheatley strategy in the achievement development, as well as the existence of statistically significant difference in favor of the interaction between the experimental teaching strategies.

Catalina Study(2005), which aimed to find out the effectiveness of the quintet learning cycle to the biology development concepts and the students' attitude to it, at the seventh grade students at Texas, USA. The sample consists of two groups; experimental which composed from (40) students, studied using the quintet learning cycle, and the control group consists of (40) students and studied with traditional method. The result revealed statistically significant difference between the two groups in favor of experimental group.

III. The Problem of the Study

Based on the importance of mathematics to be involved in a lot of modern sciences, but it is still that mathematics considered to be a difficult subject for many students to learn, and that might be due to many teachers still using the traditional methods in teaching mathematics in which that leads to poor achievement and a dislike to learning mathematics unless there was no continuously renovation and modernization in teaching strategies to raise motivation, curiosity, discovery and development of thinking skills. Hence, the problem of this study appeared to explore the impact of using (5E's) instructional model on achievement in mathematics and how students retain what they learned. We determine the problem of the study by the following questions:

1. What is the impact of using the (5E's) instructional model on achievement of mathematics among fifth grade students?
2. What is the impact of using the (5E's) instructional model on learning retention of mathematics among fifth grade students?

Objectives of the Study

The study aims to:

1. Identify the impact of using the (5E's) instructional model on achievement of mathematics among fifth grade students.
2. Identify the impact of using the (5E's) instructional model on learning retention of mathematics among fifth grade students?

IV. The Importance of the Study

Constructivist theory is one of the most important cognitive learning theory in the field of education and has influenced the research movement to demonstrate and apply new various models and strategies to innovate learning and teaching methods. The implementation of mathematics and science project in the Kingdom of Saudi Arabia accompanying with emphasis on using many strategies to enhance active learning, which leads to the continuous improvement of the educational process and actual experience of different strategies in the field that promote student retention of learning. In addition, following a constructivist strategy as a non-traditional learning and teaching model would give students the opportunity to build mathematical concepts correctly based on their alternative concepts and previous experience. Among the most prominent of these models is the (5E's) instructional model which consists of five successive phases, and considered to be one of the models that help students build concepts and knowledge by linking it with previous experiences (Hamdani, 2013). So the importance of this research synchronizes with mathematics project reform and enriches the educational field with true applications of new active models, and that might give a clear vision to the policy maker, textbook authors, and planners of mathematics curriculum regarding the effectiveness of such model.

V. The Study Methodology

This is a semi-experimental study, and was designed to explore the impact of using (5E's) instructional model in the teaching of mathematics at fifth grade students at elementary school through controlled pretest and post-test to see the impact of the current model, and postponed test to examine the learning retention. The study was delimited to a random sample of fifth grade students at Khamiss Mushayt province, Saudi Arabia.

Tools of the Study:

- Teacher's guidelines for teaching the unit using (5E's) instructional model, and another guideline to the student to practice exploratory activities.

- Achievement tests; pre, post, and postponed test.

The guidelines and tests were presented to a group of experts in the field of teaching mathematics in order to determine the validity of the tools; the percentage of agreement among experts on the validity of the tests was (81%), and the guides were edited and modified according to the experts' opinions.

VI. Results and Discussion

The first question: What is the impact of using the (5E's) instructional model on achievement of mathematics among fifth grade students?

To ensure the homogeneity of the groups before start using the (5E's) instructional model, we extracted means, standard deviations, and t-test to demonstrate the significance of differences between control and experimental groups before start the model application, tables(1) and (2) clarifies that:

Table (1) Arithmetic means and standard deviations for the experimental and control groups before starting the program to study the groups equality

Achievement pre-test	Group	N	Mean	Std. Deviation
	Control	29	7.2759	1.66683
	Experimental	30	7.2333	2.58221

Table (2) t-test to demonstrate the significance of differences between control and experimental groups before starting the program to study the groups equality

Achievement pre-test	T	Df	Sig.	Mean Dif.
	.075	57	.941	.04253

From table (1) and (2), results showed no difference between the mean scores of experimental and control groups. The mean score of experimental group is 7.2333 whereas mean score of control group is 7.2759. The comparison of scores was done using t-test, which indicates that t-value 0.75 is insignificant at $\alpha = 0.05$ level of significance, then it is clear that there is no statistically significant difference between experimental and a control student on pre-test and it is concluded that the groups were equal and heterogeneous. To explore the effectiveness of using (5E's) instructional model in development of students' achievement for fifth grade on the unit of (denominators and complications), we calculated means and standard deviations between the control and experimental groups after the implementation of teaching program using the instructional model on experimental group, and tables(3) and (4) describe it:

Table (3) Arithmetic means and standard deviations for the experimental and control groups after using the instructional model on experimental group

Achievement post-test	Group	N	Mean	Std. Deviation
	Control	29	8.2069	2.76947
	Experimental	30	11.6333	2.35597

Table (4) t-test to demonstrate the significance of differences between control and experimental groups after the application of the program on experimental group

Achievement post-test	t	Df	Sig.	Mean Dif.
	-5.125	57	.000	-3.42644

From table (3) and (4) results showed difference between the mean scores of experimental and control groups, the mean score of experimental group is 11.6333 different than the mean score of control group is 8.2069, and the significance of the difference was tested using t-test for independent samples. T-statistics revealed that t-value -5.125 is significant at $\alpha = 0.05$ level of significance. It is concluded that there are significant differences between the control and experimental groups in favor of the experimental group in post-test, which indicates the presence of the effectiveness of the use of instructional model in development of students' achievement for fifth grade on the unit of denominators and complications.

Second question: What is the impact of using the (5E's) instructional model on learning retention of mathematics among fifth grade students?

To answer this question, arithmetic means and standard deviations were extracted between the results of the total score of the experimental group on the post-test and the total score of the results of the students on the postponed-test(three weeks later) after the implementation of the program and tables(5)and (6)shows that:

Table (5) Arithmetic means and standard deviations of the results of the total score of the experimental group post-test and the total score of the results of postpone-test

	N	Mean	Std. Deviation
Post test	30	11.6333	2.35597
Postponed test	30	11.0000	2.98271

Table (6) t-test to demonstrate the significance of differences between the means of the total score for the experimental group post-test and the total score of the results of postpone-test

	t	df	Sig.	Mean Dif.
Post and Postponed test	.913	58	.365	.63333

From table (5) and (6), results showed no difference between the mean scores of experimental group in post and postponed tests. The mean score of experimental group in post-test is 11.6333 whereas mean score of the same group three weeks later in postponed test is 11.0000. The comparison of scores was done using t-test, which indicates that t-value 0.913 is insignificant at $\alpha = 0.05$ level of significance, then it is clear that there is no statistically significant difference between experimental group in post-test and postponed test to conclude that the learning retention is apparent among fifth grade students, which means the effectiveness of the (5E's) instructional model in retention of learning.

VII. Conclusions and Recommendations

Impact of (5E's) instructional model as a constructivist teaching method has been proved through various researches to be comparatively better than that the traditional teaching method. The findings of the study proved that the students of experimental group not only learnt and achieve better but also their retention of learning was also apparent. The study would recommend the following:

- The present study suggests that modern and practical instructional techniques using constructivist approaches would enhance the need to improve students learning at the elementary schools
- Appropriate training for teachers to use (5E's) instructional model to teach mathematics would enhance the active learning.
- Preparation of a teacher's guide accompanying the mathematics textbooks containing the executive steps and activities of the instructional model would help them to adopt such model

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