

## Effectiveness of employing 5E Instructional Model in the Teaching of Mathematics for Seventh Grade Students

Dr. Anna Neena George  
Associate Professor

### Abstract:

*The objective of the current study is to explore the effectiveness of employing 5E instructional model in the teaching of Mathematics for Seventh Grade students at a school. In order to accomplish this objective, the researcher followed semi-experimental method while teaching. Hence, the researcher divided the class into two different groups on a random basis. One group consisted of 30 students and identified as the Experimental group. Similarly, the other group comprised of 30 students and was identified as the Control group. It was decided by the researcher to conduct a pre-test and a post-test so as to identify the difference in between the experimental and the control groups. The researcher adopted the constructivist approach to teach the experimental group using the 5E instructional model. After the experiment, significant differences between the experiment and the control groups were recorded by means of T-test. It was observed that both the groups scored equal marks in the pre-test before the experiment, but the test scores of the experimental group was higher than the control group, after the experiment was done. Hence, it can be concluded that the difference in the test scores of the experimental group, after adopting the 5E instructional model had a positive impact in teaching. And that the students have really enjoyed this innovative practice of teaching in the classroom. Therefore, this also clearly indicates that the retention of learning as far as the experimental group is concerned is highly appreciable. The researcher has concluded the study with a few recommendations and findings.*

**Keywords:** 5E instructional model, Mathematics, constructivist approach.

### 1. INTRODUCTION:

One of the most popular learning theories in the present education system is the constructivist theory. This theory revolves around the fact that the teacher should play the role of the facilitator in the classroom, directing the process of learning by interaction with the study materials. He or she should also put full use of their knowledge and experience and make the process of learning more active and dynamic (Zaitoun, 2007). The unique feature of the constructivist theory is that it emphasizes on learning the concepts in the long-term memory rather than obtaining information from the learned way (Shiland, 1999). According to Afaneh and Abu Mallouh (2006), constructivism was defined as “an interface of three elements, namely: previous experiences, educational attitude presented to the learner and environmental climate where the learning happens. The constructivist theory is based on the concept of active learning rather than teaching. The prime focus of the constructivist theory is triggering the creative quotient of the students and allowing them to be more independent while learning. It also stirs their mind to explore and kindle their curiosity to learn more. Furthermore, it also stresses on the fact that learning should take place by active interaction and not by rote memory (Abu Safar, 2014). Through various instructional concepts, constructivist theory is considered to be a huge success in the education field as it has always resulted in proper acquisition of knowledge. Other theories that emerged from constructivist theory have proved to be successful techniques for teaching and learning process. All such theories concentrate on the active role played by students while acquiring knowledge. In addition to this, they highlight on the act that students are responsible for acquisition of their own knowledge. This paper underscores the importance of integrating 5E instructional model in teaching mathematics. Hence, it is important to learn about the 5E instructional model. It was proposed by Rodger W Bybee during the year 1997. The 5E model comprises of 5 different stages namely: engagement, exploration, explanation, elaboration, and evaluation. Each phase in the 5E instructional model has a

particular function and these processes are a value addition to the better understanding of knowledge accumulation of the students (Dahmash, Naaman, and Lafras, 2014; Bybee, 2006). Baser (2008) proposed to compare the 5E teaching model, based on the constructivist approach with the traditional teaching methods. The results of the study indicated that 5E instructional model had more impact than the traditional model of teaching.

## **2. LITERATURE REVIEW:**

A number of research studies are conducted on constructivist theories abroad whereas only limited literature is available in India. The 5E instructional model is implemented mostly in the learning of science but for teaching Mathematics the research is very limited. Ozdal, Unlu, Catak and Sari (2006), proposed an innovative design project in mathematics for the Malaysian Ministry. This research project was named as RtB educational solutions through which a learning material for teaching mathematics was prepared as a part of 5E instructional model.

Hiccan (2008) conducted a study on Mathematics and 5E learning model. In that study, she explored the impact of 5e learning model on the achievements of 7<sup>th</sup> grade students in linear equation. The results showed that the 5E instructional group performed better than in the pre and post-tests achievements. Baser (2008) proposed a study which was aimed at comparing the deployment of teaching activities of 5E instructional model centered on constructivist approach. The results proved that the students who were taught Mathematics using 5E instructional model learnt the concepts better than the students who learnt through the traditional model.

Campbell (2000) conducted a study that examined the understanding of the fifth grade students in learning concepts like force and motion with the application of 5E instructional design. The results of the study revealed that integrating 5E instructional model has resulted in the increased knowledge of force and motion among the students.

Ozsevec, Cepni and Bayri (2007) proposed a novel study which attempted to find out the efficiency of the 5E instructional model on 5th grade students. A learning model was developed by the researcher employing the 5E approach. The learning model focused on the objectives of learning force and motion. The results of the study revealed that there was no significant difference between the experimental and control group before the implementation of the 5E instructional model. After implementation it was found that the students in the experimental group learnt better than the control group.

Ozsevec (2006) conducted a study and examined the impact of 5E instructional model on 5th grade students. It was observed that the mean difference was significantly in favour of the 5E instructional model group. Similarly, in another study conducted by Lee (2003) in plant nutrition, he developed a learning model based on 5E instructional delivery using real plants, pictures and figures. There was small group interaction among the students in the classrooms. Consequently, the students were given an opportunity to know about the plants in everyday life.

Whilder and Shuttleworth (2004) explored the efficiency of 5E learning model and explored the efficiency of 5E model in Cell Inquiry. The participants of the study are students from high school. In the beginning the participants were motivated to think and learn. During this phase of investigation, the participants were given situations related to everyday life and allowed to explain their own words. It was observed that the participants performed well during the evaluation and they had developed an in depth understanding of the concepts. This revealed the success of integrating 5E instructional model in the process of teaching and learning. Saygin, Atilboz and Salman's (2006) conducted a study with 47 participants in a class using Bybee's 5E instructional model. Before teaching the concept of cell, participants were identified as the experiment and the control groups. The control group was taught using the traditional method and the experimental group was taught using the 5E model. It was observed from the post-test that the students from the experimental group performed well compared to the control group.

### **Objectives of teaching Mathematics:**

Mathematics occupies the fundamental process of our daily life. Addition, subtraction, multiplication, division, buying and selling are considered to be of great value in real life application of mathematics. Knowledge and skill in this process can be given to students in an efficient and a methodical manner by teaching mathematics. In many fields like banking, accountancy and taxation the role of mathematics is crucial. These fields function based on principles of mathematics. Hence, it forms the basis for global business and economy. Mathematics will continue to play a prominent role in an individual's life. Therefore, in this complex life where science and technology are driving the entire mankind, the practical value of mathematics is increasing day by day.

The following are considered to be the broader objectives of teaching mathematics:

1. To facilitate students with clear number concepts.
2. To provide an understanding of concepts and operations in number and quantity needed in every daily life.
3. To allow the individual to have good command over the number, applied to all measures such as length, breadth, volume, area, time, temperature, speed etc.
4. To empower the individual in becoming knowledgeable in the four fundamental operations of mathematics namely, addition, subtraction, multiplication and division.
5. To deliver mathematical skills related to vocational purposes.
6. To support the individual in acquiring mathematical skills to meet the requirements of work in the other fields of knowledge.
7. To help the students to make suitable calculations.
8. To make the learner understand the concept of ratio and scale drawing, study and interpret graphs, diagrams and tables.
9. To encourage the learner to apply mathematics to a wide range of problems in all walks of life. Hence, it is understood that the prime value of mathematics stems from the fact that it employs the logical reasoning rather than rote memory. Locke opines that mathematics is the way to learn the habit of reasoning. Mathematics can only be learnt with utmost concentration and focus. New ideas and methods are being introduced in all the fields every day. It is not only important to facts but only should also know how to apply it in real life. Therefore, it is understood that Mathematics has the potential to apply knowledge to any situation and possess the power to think efficiently.

### **5E model structure:**

The present study emphasizes on the need for 5E instructional model in teaching Mathematics as a part of experiential learning. As mentioned in the introductory section, it is one of the popular constructivist theories. The 5E learning model is employed for enhancing the learning interest of the students by raising their curiosity and makes them actively involved in research. Furthermore, it is a learning model that integrates skills and activities and provides opportunities for the students to learn concepts in depth. Biological Science Curriculum Study (BSCS) has proposed a formula for defining constructivism. This process is defined as five E's. They are: Engage, Explore, Explain, Elaborate and Evaluate (Bybee, 2001).

During the first stage that is the engagement stage, the task is introduced to the students. In this stage, students relate their past learning experiences with the present. They are encouraged and motivated to ask questions, define a problem and perform an event. Next, during the exploration stage, students are given opportunity to connect with the materials and concept. By doing this, they get an opportunity to develop their own experiences with the concepts. Working in groups, they build a common experience which benefits them in communication and interaction. The teacher acts as the facilitator who provides learning materials for students and guides them through the instructional model. It is a thorough exploratory process by which students learn to question and inquire. In the next stage that is the explanatory stage, students realize some abstract experiences. Communication takes place through some logical input of language. This communication is done by peers, teachers or most of the times by the students themselves. By working in groups, students help each other in the understanding of the concepts. During the elaboration phase, teachers challenge and extend the conceptual understanding and skills. With the help of the new experiences, the students culture an in depth

understanding of the skills. Later, students relate their understanding by participating in activities. The final phase is the evaluation phase. During this phase, the students get feedback on the acquired knowledge and abilities. It is a kind of a diagnostic process where the teachers evaluate the students and verify whether they have understood the concepts clearly or not. Since evaluation is the final phase, it does not mean that evaluation should be done only at the end; in fact, teachers can verify the knowledge of the students at any point of time during the course of 5E. Some tools are required for teachers to form uniform assessment of students like, the lesson plan, checklists, course objectives and assessments. Thus, incorporating the 5E instructional model involves five different phases.

### 3. METHODOLOGY:

#### Research Design:

The focus of the study is to investigate the effectiveness of employing 5E instructional model in teaching mathematics for the seventh grade students. Hence, this study involves the conduct of a pretest and a post-test it can be considered as an experimental study. This study was conducted with a random sample of seventh grade students.

#### Tools for the Study:

The guidelines and the activities for teaching the unit employing 5E instructional model was tested upon the students after getting the consensus of the experts. The guidelines, pre-test and the post-test were designed based on the suggestions given by a group of experts in the field of mathematics such that the validity of the tools was verified. The experts' percentage of agreement on the validity of the tests was 80%. With minor corrections suggested by the experts the guides were modified and tested upon the students.

#### Participants:

The participants of this study are seventh grade students who were 60 in number. The students were divided into the experimental and the control groups on a random basis such that each group had 30 students.

#### Analysis and Interpretation:

As mentioned in the methodology, the study is an effort to explore the efficiency of integrating 5E instructional model in the teaching and achievement of mathematics. Hence, in order to confirm the homogeneity of both the experimental as well as the control groups, mean, standard deviation, and t-test were done. This was performed prior to the integration of the 5E instructional model. The significant differences between the experimental and control groups are given in Table.1 and Table.2.

Pre-test	Group	N	Mean	Standard Deviation
	Control	30	7.2752	1.66679
	Experimental	30	7.2336	2.58219

Table.1. Mean and standard deviation before the integration of 5E Instructional model.

Pre-test	T	Df	Sig.	Mean difference
	.0741	58	0.9412	.042

Table.2. t-test to validate the data, before the integration of 5E Instructional model.

From table 1 and 2, it is observed from the results that there was no difference observed in the mean scores of both groups. The mean score of the experimental group is 7.2336 and the mean score of the control group is 7.2752. T-test was used to compare the scores which revealed that the t-value 0.74 is significant at  $\alpha$  0.05 level of significance. Hence, it is apparent that there is no difference between the

control and the experimental groups in the pre-test. Furthermore, it can be concluded that both the groups were equivalent and heterogeneous.

In order to investigate the effectiveness of employing 5E instructional model in teaching mathematics for the students of seventh grade, mean and standard deviation were calculated for the control and the experimental groups. Therefore, after integration of the 5E model this was done once again to observe the effectiveness of implementation. The following tables 3 and 4 reveal the results of the post –test.

Post-test	Group	N	Mean	Standard Deviation
	Control	30	8.2065	2.76945
	Experimental	30	11.6330	2.35592

Table.3 Mean and standard deviation after the integration of 5E Instructional model.

Post-test	T	Df	Sig.	Mean difference
	5.1617	58	0.0001	-3.4265

Table.4. t-test to validate the data after the integration of 5E Instructional model.

From the above tables 3 and 4 it is understood that there is significant variance between the scores of both the groups. And, the score of the mean of experimental group is 11.6330 which is different than the mean score of control group which is 8.2065. The significant differences were verified using the ttest for independent samples. From the results, it is observed that the t-value is -5.125 which is at  $\alpha=0.05$  level of significance. Therefore, it can be determined that there are variations between both the groups. And these differences are in favor of the experimental group in post-test. Furthermore, it indicates that the experimentation of integrating 5E pedagogical model in the teaching of mathematics for seventh grade students is highly effective.

#### 4. CONCLUSION:

The effect of 5E teaching model as a constructivist pedagogy is proved through various analysis. In comparison with the traditional method, the 5E instructional model has created a positive impact in the minds of the students. It should also be noted that this model helps in long-term understanding and retention of concepts by students. The major findings of the study also prove that the experimental group learned concepts better than the control group. However, there are a few recommendations, they are the present study is integration of a new instructional model. Hence, teachers shall be given adequate training for employing 5E models in the curriculum. With adequate training, guidance and motivation teachers will be able to deliver the content effectively in the classroom. Similarly, necessary book and course materials can also be prepared and given to teachers for the effective use of 5E model. Moreover, in future, while designing the curriculum, the course can encompass such active learning models to trigger the intellectual and emotional quotients of the students. Hence, this paper is an attempt to quantify the effectiveness of an innovative learning model namely the 5E instructional design and delivery. Through appropriate tools and samples the study has definitely created a reverberation in the teaching of mathematics. Subjects like mathematics require such innovative practices in the classroom to stir the interest of the students.

#### REFERENCES:

1. Zaitoun, AyeshMahmoud(2007).Constructivisttheoryand strategies forteaching science. Oman: Sunrise Housefor publication and distribution.
2. Shiland TW (1999). Constructivism: The Implications for Laboratory Work. J. Chem. Educ., 76(1): 107-109.
3. Afaneh, Izzo& Abu Mallouh, Mohammed (2006). The effect of using some constructivist theory strategies in the development of systemic thinking in geometry at ninth-grade students in Gaza. Proceedings of the First Scientific Conference of the Faculty of Education, the Palestinian experience. Vol.1, No. 24.
4. Abu-safar, FatimaAbdul Latif(2014). The impact ofthe employment of two strategies; Quintetlearning cycle(5E's) and self-table (kwl)in mathematical problem solving ateighthgradestudentsin Gaza Governorates. College of Education: Al-Azhar Universityin Gaza, unpublished Master Thesis.
5. Bybee, Rodger W.; Taylor; Gardner; Scotter; Powell; Westbrook; Landes (2006). The BSCS 5E Instructional Model: Origins and Effectiveness, Colorado Springs. A Report Prepared for the Office of Science Education National Institutes of Health, Colorado Springs: Biological Sciences Curriculum Study "BSCS".
6. Dahmash, Abdul Wali& Noman, Abdel Kawi &Lafras, thekra (2014). The effect of using Bybee model to adjust the alternative scientific conceptions for students at eighth grade. Arab Journal of scientific and technical education. Vol.54, No. 2.
7. Özdal, J., Ünlü, K., Çatak, M. & Sarı, S. (2006). A mathematics lesson designed using 5E learning cycle model. VI. Uluslararası Eğitim Teknolojileri Konferansı, 19-20-20 Nisan 2006, Doğu Akdeniz Üniversitesi, MagosaK.K.T.C. 8. Hiçcan, B. (2008). 5E öğrenme döngüsü modeline dayalı öğretim etkinliklerinin ilköğretim 7. sınıf öğrencilerinin matematik dersi birinci dereceden bir bilinmeyenli denklemler konusundaki akademik başarılarına etkisi, Yayınlanmamış yüksek lisans tezi, Gazi Üniversitesi, Ankara, Türkiye. 9. Başer, E. T. (2008). 5E modeline uygun öğretim etkinliklerinin 7. sınıf öğrencilerinin matematik dersindeki akademik başarılarına etkisi, Yayınlanmamış yüksek lisans tezi, Gazi Üniversitesi, Ankara, Türkiye.
10. Campbell, M. A. (2000). The effects of the 5E learning cycle on students' understanding of force and motion concepts. MS Thesis. University of Central Florida
11. Özsevgeç, T., Çepni, S. & Bayri, N. (2007). Kalıcı kavramsal değişimde 5E modelinin etkililiği. EDU 7, 2(2), 1-12.
12. Özsevgeç, T. (2006). Kuvvet ve hareket ünitesine yönelik 5E modeline göre geliştirilen öğrenci rehber materyalinin etkililiğinin değerlendirilmesi, Türk Fen Eğitimi Dergisi, 3(2), 36-48.
13. Wilder, M., & Shuttleworth, P. (2004). Cell inquiry: A 5E learning cycle lesson. Science Activities, 41(1), 25-31.
14. Saygın, O., Atılboz, N. G., & Salman, S. (2006). Yapılandırmacı öğretim yaklaşımının biyoloji dersi konularını öğrenme başarıları üzerine etkisi: canlılığın temel birimi-Hücre. Gazi Üniversitesi Eğitim Fakültesi Dergisi. 26(1), 51-64.