

5E Approach of Constructivist on Achievement in Mathematics at Upper Primary Level

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ABSTRACT

Constructivist approach is based on the belief that learning occurs when learners are actively involved in a process of knowledge construction as opposed to passive receiving of information. According to constructivist teaching, learners are the makers of their knowledge. The theory of constructivism is an approach to learning suggesting that children must construct their own understandings of the world in which they live. The present study aims to find the effectiveness of 5E approach of constructivist on achievement in mathematics of upper primary students. The present study was a quasi-experimental study, wherein a control and experimental group were employed. The 5E learning model include Engage, Explore, Explain, Elaborate and Evaluate, Which has been applied to experimental group and conventional teaching was used in the control group, a sample of 70 (35 students in experimental and control group respectively) students were selected by using the purposive sampling technique. The results of the study revealed that teaching through the 5E approach of constructivism is effective in enhancing achievement in mathematics of upper primary level as compared to traditional method.

Keywords: Constructivist approach, Achievement in Mathematics, 5E approach

Classroom teaching becomes more effective, when it is well informed by an understanding of how students learn and how learning will be more successful and interesting, if students are given the opportunity to explain and clarify their ideas in the class. Learning without meaningful understanding is valueless in our life. That's why teachers should use productive teaching method in order to make learning meaningful (Olosunde & Akinpelu, 2013). Conventional teaching is common in school education system which focus on lecturing and using chalk & board. Traditional classroom teaching is bookish in nature and is centred around the walls of the classroom. Traditional teaching and learning is the process of transmission of knowledge from teacher to student. It is essentially a one way process and involves coverage of content and rote memorization without proper understanding and creative thinking. Traditional method hardly pays any attention to the mental level and interest of

the student. The present scenario has changed the trends after the recommendations by NCF 2005 by adopting the method of constructivist approach through focusing more on innovative activities. In constructivist approach, teacher uses real life examples in order to make the students understand the concepts clearly and students get the opportunity to engage themselves in innovative activities. Constructivism transforms student from a passive learner to active learner where they construct their knowledge in an effective manner (Kusumaryono & Suyitno, 2016).

In India, National Curriculum Framework (NCF 2005) developed by the National Council of Educational Research and Training for school education has put importance on constructivist approach of teaching and learning. The NCF 2005 recommends connecting of classroom learning with their real life situation.

Mathematics is a subject which has been taught in a traditional way where teacher plays a main role by teaching mainly through lecture method and students play the role of passive learner or receiver. Different scholars such as John Dewey, Jean Piaget, Vygotsky and Jerome Bruner brought the fact into consideration that step by step studying in class make students unable to apply the knowledge of mathematics outside the classroom. Therefore it was felt that there is need that student should construct their own knowledge and education system should cultivate higher order skills (Nagalakshmi, 2011). Thus constructivist called out to reform education process in schools in order to improve classroom teaching and learning. Constructivists construct new knowledge on the basis of prior or existing knowledge and believe that knowledge is actively created by the child as they make their own efforts of understanding (Mustafa, 2010).

Need and significance of the study

Research stated that the essence of mathematics is to be able to think creatively, not simply arriving at the right answer (Mann, 2006). Majority of the students see math as burden as they are forced to become rote learners, they are not able to relate the concepts with real world which they had learnt in school and as a result of which they fail to become creative and depend on others. But if students are able to construct their knowledge then they'll be critical thinkers, independent thinkers, problem solver and not rote learners (Padmanabhan, 2007). Thus the present study focus on how effective constructivist approach is in teaching mathematics to upper primary students.

Review of related literature

Ayaz & Sekerci (2015) conducted a meta-analysis study to define the effects of constructivist approach on students' academic achievement. A sample of 53 studies were reviewed and the study shows that the constructivist learning approach, in comparison to traditional teaching methods, had positive effects on the student's academic achievement. It was found that 50 out of 53 studies shows the positive results and the remaining 3 have negative effect. Barman and Bhattacharyya (2015) conducted a study to know the effectiveness of Constructivist Teaching Method on students' academic achievement in

the subject of Physical Science at secondary level. Samples of 50 students from VIIIth class Bengali medium school were selected by using the random sampling technique. The findings of study was that constructivist approach had a significant effect on academic achievement in the subject of physical science at secondary school students. Rawat, Soomro, Quaisrani, & Mughal, (2010) also conducted a study to know the effectiveness of teaching physics through learning cycle model and found significant difference. Abdi (2014) calculated the effect of inquiry-based learning method on students' achievement in sciences where in 40 students were taken as a sample of fifth grade from two different classes. Significant difference was found between the science achievement of both the experimental and control group. Achievement of those students who were taught through inquiry-based learning method found better than students who were taught through traditional method. Akanwa & Ovute (2014) studied the effect of constructivist teaching model on student's achievement and interest in physics. 160 senior secondary school students were taken as sample, which are categorized into experimental and control groups. Quasi-experimental design was used for the study. The experimental group was taught using constructivist approach whereas the control group was taught the same concepts (waves and sound) using conventional (chalk board) approach. The findings of study was that constructivist approach had a significant effect on both the achievement and interest in physics of senior secondary school students. Duyilemi & Bolajoko (2014) inspected the effects of constructivists learning strategies on students' achievement and retention in biology. 160 students were taken as a sample of the study from senior secondary schools of Ondo. The research design Pre-test post-test control group quasi-experimental design was used in the study. An achievement test was used to calculate the scores of both groups. It was found that there was a significant difference between their pre-test and post test score. Therefore it was concluded that constructivist approach is better than traditional approach in teaching of sciences.

Chowdhury (2016) studied the effect of constructivist approach on achievement in mathematic of ninth grade students. The samples were taken from H.S.

Govt. High School of IXth std. students which are located in Tinsukia district of Assam. Findings of this study shows that those students who were taught by constructivist approach scored higher than those who were taught through traditional approach which means experimental group gained higher mean score than the control group. It means 5E learning approach is better than the conventional method in teaching mathematics. It was also found that 5E learning approach was equally effective to both boys and girls in improving their achievement in mathematics. Kusumaryono & Suyitno, (2016) studied the influence of constructivist learning using scientific approach on mathematical power and conceptual understanding. A sample of 48 students were taken from Grade IV of Semarang Sultan Agung elementary school. Study was directed to determine the difference between the conceptual understanding and mathematical power and also to determine the interaction between learning approaches and initial competence on the mathematical power and conceptual understanding also to describe the mathematical power of students. Statistical analysis of the data show that experimental group overtook control group in terms of conceptual understanding and mathematical power. Tok, Bahtiyar & Suleyman (2015) conducted experimental study to know the effects of "teaching math creatively" on sixth grade students on mathematics achievement, their attitudes towards mathematics and mathematics anxiety. The study used Pre-test post-test control group quasi-experimental design. A sample of 42 students of sixth grade were taken from public elementary school. The two groups: experimental group was taught through constructivist approach by teaching maths creatively while the control group was taught through traditional method. Significant difference was found between scores of experimental and control group in context of math achievement. Valdez (2015) directed an experimental study to investigate the effect of constructivist method on achievement and retention in analytic geometry. A sample of 160 students was taken from Tarlac University. The Experimental group taught through constructivist approach obtained greater scores than control group taught through conventional approach. It was concluded that constructivist approach is better/superior than conventional approach to improve students' achievement and

retention in mathematics. Mrayyan (2014) in a study on impact of constructivism learning in mathematics teaching on achievement and mathematical thinking among first year college students in vocational education shows that students who were taught by constructivist approach scored higher than those who were taught through traditional approach which means experimental group gained higher mean scores than the control group. Therefore studies suggested to use constructivist approach to enhance the mathematical power of students and their conceptual understanding.

Operational definitions

Constructivism: Constructivism can be defined as "the idea that development of understanding requires the learner to actively engage in meaning-making" (Brader – Araje and Jones 2002). Constructivism is a theory which is based on observation and scientific study about how students learn. In the present study constructivism means the 5E instructional model which is used to transact in experimental group. The 5E include Engage, Explain, Explore, Elaborate and Evaluate.

Engage: Students are given the opportunity to express what they already know about the topic in order to make connections between the past and present learning experiences.

Explore: During this phase students are provide an experiences to identify and develop concepts, processes, and skills due to which students actively explore their environment or manipulate materials.

Explain: In this phase students explain the concepts they have been exploring and give opportunities to express their conceptual understanding or to develop new skills or behaviours.

Elaborate: This phase helps the students to extend their conceptual understanding and practice skills. Through which they gain new experiences that helps the learners to understand the concepts in depth, obtain more information about areas of interest and refine their skills.

Evaluate: During this phase students are enable to reflect upon what they have learnt. This phase encourages them to assess their understanding and abilities and lets teachers evaluate students' understanding of key concepts and skill development.

Achievement in mathematics: In the present study 'Achievement' refers to marks obtained by VIIIth std. students in achievement test in mathematics.

Objectives

1. To compare the mean scores on the achievement test in Mathematics of class VII students to be taught mathematics with traditional method and constructivist method before the experimental treatment.
2. To measure mean score on the achievement test in mathematics of class VII students who were taught Mathematics with the use of constructivist approach and traditional approach.
3. To analyse the effectiveness of constructivist teaching method in relation to achievement in mathematics.

Hypothesis

1. There is no significant difference in the mean scores of pre-test on achievement scores in mathematics between experimental and control group before teaching using constructivist approach.
2. There is a significant difference in the mean scores on the achievement test in mathematics experimental and control group after the experimental treatment.
3. There is a significant difference between the mean scores of pre-test and post-test of achievement in mathematics of VIIth standard students as a result of constructivist approach.

Methodology

The present study was a quasi-experimental design where in a Pre-test post-test non-equivalent group design was used. The population of this study consist of students of VIIth class of Middle school, Fatehpur, Sitamarhi of Bihar having Hindi medium. The sample was drawn from two sections of VIIIth standard as experimental and control group which was selected randomly. The sample of the study was confined to 70 students (the experimental and control group consists of 35 students each) of VIIth standard. Purposive sampling technique was used in the present study. In the present study,

experimental group was taught by the investigator using constructivist approach, which took about the time of two weeks and the control group was taught by the regular teacher by using conventional method.

The study was carried out in two phases: Phase 1: Developmental phase: In this phase, appropriate learning experiences were developed by the investigator in following ways: content analysis, preparation of lesson plan, planning for assessment. One unit from VIIth standard i.e. 'Area of circle' was identified and content analysis was done. The lesson plan was prepared by making use of 5E's i.e. Engage, Explore, Explain, Elaborate and Evaluate. In engage teachers involve students to perform some activity to find out the area of circle. In exploration teachers provide different opportunities for students to explore themselves. In explanation teacher motive is to interact with students to discover ideas by asking questions to cause them to reflect. In elaboration teachers help students to use their new knowledge and continue to explore its implication in new and unfamiliar situations. In evaluation both teachers and students were assessed to determine how much learning and understanding has taken place in the 5E model of learning.

Phase II Experimental phase: the study was quasi-experimental in nature involving pre-test post-test where the effects of treatment was judged by pre-test and post-test scores. The experiment group was taught by the investigator by using constructivist approach and control group was taught by regular teacher by using regular method of teaching. This phase includes three main stages:

- (i) Administration of pre-test
- (i) Experimental treatment
- (iii) Administration of post-test.

The Instrument used to gather data in this study was Achievement test on mathematics. 't' test was used by the investigator in the present study for the analysis and interpretation of data.

Analysis and Interpretation

For the collection of the data, the investigator selected two sections of VIIth standard as experimental and control group where section A was taken as experimental and section B was taken as control group. The experimental and control group were

Table 1: Pre-test achievement score on Mathematics of Experimental and Control group

Group	N	Mean	S.D	S.E. _D	t-test	Table value (0.01)	Df	Significant/not significant
Experiment	35	5.04	3.16	0.07	0.16	2.65	68	Not significant
Control	35	4.91	3.39					

Table 2: Mean scores of post-test of Control group and Experimental group

Group	N	Mean	S.D	S.E. _D	t-test	Table value (0.01)	Df	Significant/not significant
Experiment	35	18.05	2.94	0.91	5.90	2.65	68	Significant
Control	35	12.68	4.62					

Table 3: t-test between Mean scores of pre-test and post-test of Experimental group

Experimental	N	Mean	S.D	S.E.D	t-test	Table value (0.01)	Df	Significant/not significant
Pre-test	35	5.04	3.16	0.72	18.06	2.65	68	Significant
Post-test	35	18.05	2.94					

given a pre-test Maths achievement which was followed by the treatment. Both experimental and control group was administered post-test after the intervention.

Ho.1: There is no significant difference in the mean scores of pre-test on achievement scores in mathematics between experimental and control group before teaching using constructivist approach. From Table 1, it is found that the t-value (0.16) is less than the table value of 2.65 at 0.01 level of significance. Therefore, the null hypothesis stating that there is no significant difference in the mean scores of pre-test on achievement scores in mathematics between experimental and control group before teaching the VIIth standard students using constructivist approach is accepted.

Ho.2: There is a significant difference in the mean scores on the achievement test in mathematics experimental and control group after the experimental treatment.

From table 2 it was found that the t-value (5.90) is greater than the table value of 2.65 at 0.01 level of significance. Therefore, the null hypothesis stating that there is no significant difference in the mean scores on the achievement test in mathematics of students of class VIIth between experimental and control group after the experimental treatment is rejected and the alternate hypothesis stating that there is significant difference in the mean scores on

the achievement test in mathematics of students of class VIIth between experimental and control group after the experimental treatment is accepted.

Ho.3: There is a significant difference between the mean scores of pre-test and post-test of achievement in mathematics of VIIth standard students as a result of constructivist approach.

From table 3, it is found that the t-value 18.06 is greater than the table value of 2.65 at 0.01 level of significance. Therefore the null hypothesis stating that there is no significant difference between the mean scores of pre-test and post-test of achievement in mathematics of VIIth standard students as a result of constructivist approach was rejected. It means there is significant difference between the mean scores of pre-test and post-test of achievement in mathematics of VIIth standard students as a result of constructivist approach. The findings shows that the experimental group was benefited.

Findings of the study

1. In the present study, it was found that there is no significant difference in the mean scores of pre-test on achievement scores in mathematics between experimental and control group before teaching the VIIth standard students.
2. It was found that there is significant difference between the mean scores on the achievement

test in mathematics of students of class VIIth of experimental and control group after the treatment. Which support the findings of earlier studies Chowdhury (2016), Valdez (2015), Mrayyan (2014), Madu & Ezeamagu (2013), Tugba & Yil (2013), Tuna & Kacar, (2013). Pulat (2009) found that constructivist approach is better than traditional approach on the achievement of students in the teaching of mathematics.

3. The constructivist teaching method is found to be significant in the teaching of mathematics to the VIIth standard students than the traditional approach.

DISCUSSION

From the findings of the study, it was concluded that constructivist approach is better and more effective in the teaching of mathematics than the traditional approach. It is basically a theory which is based on observation and scientific study about how people learn and create new ideas. In the light of these themes, in this paper, discussions have been made on concept of constructivist learning, 5E approach of constructivism, difference between constructivist learning and traditional approach of learning, teacher's and learners role in constructivist learning approach, and implications of constructivist learning approach (Khalid, & Azeem, 2012).

Constructivist approach focus on knowledge construction rather than reproduction, it helps students in developing skills and attitudes. Human knowledge is constructed; learner builds new knowledge on the foundation of previous learning (Sarikaya, Guven, Goksu, & Aka, 2010). Two groups were taken: the experimental and the control group. The experiment group was taught by the investigator by using constructivist approach and control group was taught by regular teacher by using regular method of teaching. The study show that teaching through the 5E approach of constructivism is effective in enhancing achievement in mathematics of upper primary level as compared to traditional method. Different types of practical examples and real life example, innovative activities made the constructivist approach more effective and interesting.

REFERENCES

- Abdi, A. 2014. The Effect of Inquiry-Based Learning Method on Students' Academic Achievement in Science Course. *Universal Journal of Educational Research*, 2(1): 37-41.
- Akanwa, U.N. & Ovute, A.O. 2014. The effect of constructivist teaching model on SSS Physics students' achievement and interest. *Journal of Research and Method in Education*, 4(1): 35-38.
- Ayaz, M.F. & Sekerci, H. 2015. The Effects of the Constructivist Learning Approach on Student's Academic Achievement: A Meta-Analysis Study. *Turkish Online Journal of Educational Technology-TOJET*, 14(4): 143-156.
- Barman, P. & Bhattacharyya, D. 2015. Effectiveness of constructivist teaching method: an experimental study. *International Journal of Research in Social Sciences and Humanities*, 5(1): 69-76.
- Chowdhury, S.R. 2016. A Study on the effect of constructivist approach on the achievement in Mathematics of IX standard students. *Journal of Humanities and Social Science*, 21(2): 35-40.
- Duyilemi, A.N. & Bolajoko, A.A. 2014. Effects of constructivists' learning strategies on senior secondary school students' achievement and retention in biology. *Mediterranean Journal of Social Sciences*, 5(27): 81-88.
- Jha, A.K. 2009. *Constructivist Epistemology and Pedagogy – Insight into Teaching Learning and Knowing*, Atlantic Publishers, New Delhi.
- Jones, M.G. & Brader-Araje, L. 2002. The impact of constructivism on education: Language, discourse, and meaning. *American Communication Journal*, 5(3): 1-10.
- Khalid, A. & Azeem, M. 2012. Constructivist vs traditional: effective instructional approach in teacher education. *International Journal of Humanities and Social Science*, 2(5): 170-177.
- Kusumaryono, I. & Suyitno, H. 2016. The Effect of Constructivist Learning Using Scientific Approach on Mathematical Power and Conceptual Understanding of Students Grade IV. In *Journal of Physics: Conference Series* (Vol. 693, No. 1, p. 012019). IOP Publishing.
- Madu, B.C. & Ezeamagu, M.U. 2013. Effect of constructivist based approach (5E's) on the pupils' achievement in primary mathematics in Enugu state, Nigeria. *International Journal of Educational Science and Research*, 3(4): 59-70.
- Mann, E.L. 2006. Creativity: The essence of mathematics. *Journal for the Education of the Gifted*, 30(2): 236-260.
- Mrayyan, S. 2014. The impact of constructivism learning in mathematics teaching on academic achievement and mathematical thinking among students in a college algebra course for first year students in vocational education. *Sci-Afric Journal of Scientific Issues, Research and Essays*, 2(10): 449-455.
- Mustafa, S. 2010. The impact of constructivist approach on students' academic achievement and retention of knowledge. *Academic Journal*, 9(1): 413.

- Nagalakshmi, R. 2011. Effectiveness of constructivist approach on students' achievement in science, science related attitudes, science process skills and perception of nature of science at secondary level. Published doctoral dissertations, Periyar University, Salem.
- National Council of Educational Research and Training 2005. *National curriculum Framework 2005*, New Delhi, NCERT.
- Olosunde, G.R. & Akinpelu, S.O. 2013. Impact of constructivist model-based training programmes on pre-service teachers' knowledge, creativity, classroom practice and junior secondary schools learning outcomes in mathematics. *Journal of Education and Practice*, **4**(23): 48-56.
- Oludipe, B. & Oludipe, I. 2010. Effect of constructivist-based teaching strategy on academic performance of students in integrated science at the junior secondary school level. *Educational Research and Reviews*, **5**(7): 347-353.
- Ozdilek, Z. & Ozkan M. 2009. The effect of applying elements of instructional design on teaching material for the subject of classification of matter. *The Turkish Online Journal of Educational Technology*, **8**(1): 84.
- Padmanabhan, J. & Rao, M.P. 2011. Constructivist approach and problem solving ability in science. *Journal of Community Guidance and Research*, **28**(1): 56-70.
- Padmanabhan, J. 2007. Effectiveness of Constructivist Approach on the Achievement and Problem Solving Ability in Science of VII Standard Students, M.Ed. Dissertation, Regional Institute of Education (RIE), NCERT, Mysore.
- Peter, O.I., Abiodun, P. & Jonathan, O.O. 2010. Effect of constructivism instructional approach on teaching practical skills to mechanical related trade students in western Nigeria technical colleges. *International Academic Journals*, **5**(3): 59-64.
- Pulat, S. (2009). Impact of 5E learning cycle on sixth grade students' mathematics achievement on and attitudes toward mathematics. Published doctoral dissertation, Middle East Technical University, Ankara, Turkey.
- Raval, J.V. 2012. Effectiveness of constructivist approach to the teaching of animal classification in science and technology of standard ninth. Published doctoral dissertation, Saurashtra University, Rajkot.
- Rawat, J.K., Soomro, A.Q., Quaisrani, M.N. & Mughal, S.H. 2010. Teaching Physics through Learning Cycle Model: An Experimental Study. *Journal of Educational Research*, **13**(2): 5-18.
- Richard, C.K., Samuel, W.W. & Johnston, M.C. (2015). Effects of constructivist teaching approach on students' achievement in secondary school chemistry in Baringo North Sub-county, Kenya. *International Journal of Advanced Research*, **3**(7): 1037-1049.
- Sarikaya, M., Guven, E., Goksu, V. & Aka, E. 2010. The impact of constructivist approach on students' academic achievement and retention of knowledge. *Elementary Education Online*, **9**(1): 413-423.
- Shaljan, A. 2012. Effects of inquiry based instruction on science achievement and interest in science: Evidence from Qatar. *Journal of Education Research*, **105**(2): 134-146.
- Tok, S., Bahtiyar, A. & Suleyman, K. 2015. The effect of teaching mathematics creatively on academic achievement, attitudes towards mathematics and mathematics anxiety. *International Journal of Innovation in Science and Mathematics Education*, **23**(4): 1-24.
- Tugba, T.T. & Yil, Y. 2013. Problem solving, creativity and constructivist based teaching practice of pre-service mathematics teachers. *Journal of Educational and Instructional Studies in the World*, **3**(1): 169-172.
- Tuna, A.K. & Kacar, A. 2013. The effect of 5e learning cycle model in teaching trigonometry on students' academic achievement and the permanence of their knowledge. *International Journal on New Trends in Education and their Implications*, **4**(1): 73-87.
- Valdez, J.M. 2015. Constructivist method: Effect on achievement and retention in analytic geometry. *International Journal of Engineering and Technology Research*, **3**(1): 300-304.

