Effect of Constructivist Approach on Achievement in Mathematics of Eighth Grade Students

Pooja Walia,
Assistant Professor, Central University of Haryana, India

Abstract

The present study was conducted to study the effect of constructivist approach and traditional approach on achievement in mathematics. Sample comprised of 80 eighth grade students of D.A.V. public school affiliated to C.B.S.E. of Kurukshetra city. Further it was divided in two intact groups namely experimental and control group of 40 students each. Pretest-posttest control group quasi-experimental research design was used. Mathematics Achievement Test developed by investigator was used as measuring tool. Experimental group was taught through constructivist approach and control group was taught through traditional approach through lesson plans on both approaches prepared by investigator. Findings revealed that constructivist approach is more effective than traditional approach of teaching in relation to achievement in mathematics.

KEYWORDS: Constructivist approach, Traditional Approach, Achievement in Mathematics

Mathematics is generally considered one of the most important subjects at school level all over the world. National Curriculum Framework of School Education (2005) vision of excellent mathematical education is based on the twin premises that all students can learn mathematics and all students need to learn mathematics. All the major commissions and committees reports on education since independence of India emphasised the importance of mathematical knowledge and its utilitarian value. In spite of all of these reports and recommendations many students struggle with mathematics and become disaffected as they constantly bump into obstacles to engagement (Vijyana, 2014). Mathematics has been a confusing, frightening and frustrating subject for learners of all ages till date. A single negative experience in mathematics in childhood is enough to create a pessimistic attitude towards mathematics in adulthood (Chowdhury, 2016). Dissatisfaction with mathematics education has numerous reasons. Many research studies have been conducted to find the reasons of dissatisfaction with mathematics. Some of the reasons are poor mathematical base, negative attitude towards mathematics, irregular study habits, parental non-involvement (Vijyana, 2014). Mathematical base and attitude towards mathematics is directly affected by teaching methods. If teacher uses faulty methods of teaching then student's interest in the subject will be affected adversely. Generally traditional education system is failing to achieve the goals and particularly subject mathematics is suffering from serious problems. By and large teachers follow traditional teaching approach that does not relate classroom learning to life outside the school. Few studies have been conducted to compare the effectiveness of traditional method with innovative method (Nayak, 2011; Tripathy, 2010; Ponnusammy & Sudarsan 2001 and Swarnalekha, 1997). They found lower mathematics achievement scores obtained by students taught through traditional approach in comparison to different innovative methods. Other shortcomings of the traditional approach to mathematics education include its inability to:-stimulate interest, promote understanding, integrate abstractions with applications and integrate mathematics with human culture. These reasons lead to low achievement in this subject; subsequently

most of the students leave this subject at the secondary level (Position paper, National Focus Group on Teaching of Mathematics, NCFSE, 2005). Teacher should use such approach in the classroom which creates interest, increase motivation and active participation of the learners in class room. In this context NCFSE, (2005) proposed that constructivist approach is a teaching approach which may increase the achievement of students in mathematics.

Constructivism certainly does have the potential to revolutionize teaching for all grades and subjects (Pon & Jacobsen, 2001). Students achieved a positive attitude for mathematics when they were instructed using constructivist methods of teaching (Clarke, 1997 and Simon & Schifter, 1997). Review of the literature revealed most of the reported studies in this field have been conducted in western countries. Compared to this, only a very small proportion of the studies have been conducted in India. More scientific investigation is required to study the effectiveness of constructivist approach. All the reasons stated above encouraged the investigator to conduct the present study

CONSTRUCTIVISM

Constructivism has received considerable attention in educational enterprises. Etymologically the word constructivism originated from a Latin word "construer" which means to arrange or give structure. Knowledge is acquired through involvement with content instead of imitation or repetition (Kroll & LaBoskey, 1996). Learning occurs by an active construction of meaning, rather than by passive recipient (Piaget, 1977). Learners actively take knowledge, connect it to previously assimilated knowledge and make it theirs by constructing their own interpretation (Cheek, 1992). Constructivism provides an alternative epistemology base to the objective tradition. It emerged due to dissatisfaction with behaviourism. Behaviourists emphasised that learning is a mechanical association of specific response with specific stimulus followed by reinforcement to correct answers that the teachers want. Constructivists opposed this notion and explained the process of knowledge construction. According to constructivists, knowledge is constructed by the learner when they are actively engaged in social experiences and activities either independently or collectively. Whereas a behaviourist would continue to look at the content to be learned and the influence of the environment upon that learning, a constructivist would be more interested in knowing how the learner is attempting to construct meaning (Weeger, 2012). Constructivism has many approaches viz. Inquiry based learning, Web based learning, cooperative learning, 5E instructional model etc. Investigator used the steps of 5E instructional model that is based on the principle of constructivism.

ACHIEVEMENT IN MATHEMATICS

Achievement is a measure of knowledge, understanding of skills in a specified subject or group of subjects (Craighead & Nemeroff, 2001). In literal sense mathematics achievement is concerned with the quantity of learning attained in mathematics after a period of instructions. In the present study achievement in mathematics means scores obtained by the students in Mathematics Achievement Test (MAT) developed by the investigator.

OBJECTIVES

1) To study the effect of constructivist approach on achievement of eighth grade students in mathematics.
2) To study the effect of traditional approach on achievement of eighth grade students in mathematics.

3) To compare the effectiveness of constructivist approach and traditional approach in terms of achievement of eighth grade students in mathematics.

HYPOTHESES

1) The constructivist approach is likely to be effective to improve achievement of eighth grade students in mathematics.
2) The traditional approach is likely to be effective to improve achievement of eighth grade students in mathematics.
3) The achievement of eighth grade students in mathematics taught through constructivist approach is likely to be found better than those taught through traditional approach.

DESIGN OF THE STUDY

Pretest-posttest control group quasi-experimental research design was used. The design consisted of two equivalent intact groups. The equivalence of the groups was established on the basis of first semester scores in mathematics of both groups. For establishing equivalence t-test was employed. No significant difference was found between mean achievement score of both groups. These two different groups were designated as experimental group and control group.

Sample of the Study

Purposive method of sampling was used in order to select the sample. Eighth grade students studying in English medium private schools affiliated to Central Board of School Education located in Kurukshetra city were taken as population of the study. Out of them D.A.V. public school was chosen to conduct the experiment. The school is co-educational and located in urban area. There were six sections of eighth grade in school. Age of the eight grade students lied between 13-14 years. Two sections consisted of 92 students were chosen randomly. In the beginning 46 students in each section were considered for experiment. But twelve students were excluded due to irregularity and non-seriousness in the classroom activities. In this way achievement in mathematics scores of 80 students were used for data analysis.

Tools Used

1. Instructional Tool
2. Measuring Tool

Instructional Tool

Investigator developed instructional material (Lesson Plans) herself by using constructivist approach and traditional approach on selected units of mathematics of eighth grade viz. Rational Numbers, Algebraic Expressions and Identities, Exponent and powers, Understanding Quadrilaterals, Visualising solid shapes and Mensuration. Lesson plans for experimental group was developed by following the steps of 5 E instructional model. Lesson plans for control group was developed by following the steps of RCEM approach.

Measuring Tool

For the present study investigator developed and standardized Mathematics Achievement Test (MAT). Test consisted of 34 questions carry 80 marks. The product moment coefficient of correlation between scores of these two halves was calculated i.e. 0.84. Spearman–Brown prophecy formula was applied to find coefficient of correlation of whole test i.e. 0.92. Content validity was determined by ten Elementary school teachers from four schools of Kurukshetra city were taken as experts. It was observed that the items of the Mathematics Achievement Test were distributed over all the units of the instructional material and objectives.

PROCEDURE OF DATA COLLECTION

The experiment was conducted under three phases. In the first phase two equivalent groups were formed on the basis of first semester scores in mathematics. The students were provided orientation and instruction about pretesting tool. MAT was administered as Pre-test. Data was collected and scoring was done. After the administration of the test second phase was executed. Experiment was conducted for a period of two months. Six units of their syllabus were covered. Each group were taught by respective teaching approach i.e. experimental group was taught through constructivist approach and control group was taught through traditional approach. After being taught selected topics, parallel form of MAT was administered as post-tests in third phase. Data was collected and scoring was done.

ANALYSIS & INTERPRETATION

The data were analysed by considering mean pretest, posttest and gain scores of experimental and control group on MAT. Mean gain scores shows actual difference between the mean posttest and mean pretest achievement score in mathematics. Analysis and interpretation of the data are presented in following paragraphs.

Table I

Significance of Difference between Pretest and Posttest Achievement Scores in Mathematics of Experimental Group

Sr. No.	Levels of Achievement and Total Achievement in Mathematics	Phase	Mean	S.D.	t
1.	Remembering	Pre	0.88	0.86	14.38*
		Post	3.68	0.85	
2.	Understanding	Pre	3.03	1.83	13.41*
		Post	8.55	1.85	
3.	Applying	Pre	2.90	3.19	4.76*
		Post	6.65	3.82	
4.	Analysing	Pre	3.05	1.58	6.54*
		Post	6.65	3.10	
5.	Evaluating	Pre	3.05	3.13	5.69*
		Post	7.82	4.28	
6.	Creating	Pre	0.68	1.32	4.12*
		Post	4.08	5.05	
7.	Total Achievement in Mathematics	Pre	13.59	7.57	9.53*
		Post	37.43	13.88	

$N_1 = N_2 = 40$, df=38 (*=Significant at 0.01 level)

It is seen from the table I that all the mean posttest achievement in mathematics scores are more than the mean pretest scores along with its all the levels. It means constructivist approach has a significant effect on achievement in mathematics of the eighth grade students Therefore all the concerned null hypotheses are refuted and research hypothesis is accepted.

Table II
Significance of Difference between Pretest and Posttest Achievement Scores in Mathematics of Control Group

Sr. No.	Levels of Achievement and Total Achievement in Mathematics	Phase	Mean	S.D.	t
1.	Remembering	Pre	0.58	0.50	8.81*
		Post	2.38	1.19	
2.	Understanding	Pre	3.23	1.94	3.11*
		Post	4.75	2.42	
3.	Applying	Pre	3.03	2.59	1.78
		Post	4.03	2.43	
4.	Analysing	Pre	1.98	1.72	1.14
		Post	2.48	2.17	
5.	Evaluating	Pre	2.35	2.98	1.51
		Post	3.45	3.52	
6.	Creating	Pre	1.13	1.27	1.12
		Post	1.58	2.19	
7.	Total Achievement in Mathematics	Pre	12.30	7.46	3.35*
		Post	18.67	9.42	

$N_1 = N_2 = 40$, df=38 (*=Significant at 0.01 level)

It is observed from the table II there is a significant difference between the pretest and postest Remembering, Understanding and Total achievement in mathematics scores, therefore, the concerned null hypotheses are rejected. It may be interpreted that traditional approach helps to improve lower levels of cognitive domain, Remembering, Understanding and Total achievement in mathematics of the eighth grade students. Hence concerned research hypotheses are accepted.

It is also observed from there is no significant difference between the pretest and postest Applying, Analysing, Evaluating and Creating scores, therefore all the concerned null hypotheses are accepted. It may be interpreted that traditional approach does not help to improve higher levels of achievement in mathematics viz. Applying, Analysing, Evaluating and Creating.

Table III
Significance of Difference between Mean Gain in Achievement Scores in Mathematics of Experimental and Control Groups

Sr. No.	Levels of Achievement and Total Achievement in Mathematics	Group	Mean Gain	S.D.	t
1.	Remembering	Experimental	2.80	1.14	3.79*
		Control	1.80	1.22	
2.	Understanding,	Experimental	5.52	2.12	8.44*
		Control	1.52	2.11	

3.	Applying	Experimental	3.75	3.41	4.09*
		Control	1.00	2.54	
4.	Analysing	Experimental	3.60	3.63	4.89*
		Control	0.50	1.71	
5.	Evaluating	Experimental	4.77	3.98	4.79*
		Control	1.10	2.78	
6.	Creating.	Experimental	3.40	4.79	3.51*
		Control	0.45	2.30	
7.	Total Achievement in Mathematics	Experimental	23.84	9.71	9.70*
		Control	6.37	5.93	

$N_1 = N_2 = 40$, df=38 (*=Significant at 0.01 level)

It is observed from table III that all the mean gain in achievement in mathematics scores of experimental group are more than those of control group. It may be concluded that constructivist approach is more effective than traditional approach in terms of achievement in mathematics of the eighth grade students. Hence research hypothesis is accepted.

RESULTS

1. Significant difference was found on achievement of eighth grade students in mathematics taught through constructivist approach.
2. Significant difference was found on achievement of eighth grade students in mathematics taught through traditional approach, however this approach of teaching in not found effective with respect to higher levels of cognitive domain of achievement viz. Applying, Analysing, Evaluating and Creating.
3. Significant difference was found on achievement of eighth grade students in mathematics taught through constructivist approach than those taught through traditional approach.

DISCUSSION

The findings of the present study reveal that traditional approach is unable to improve achievement in mathematics at higher level of cognitive domain. It also found that constructivist approach has significant effect on achievement in mathematics at all its levels. Findings of Chowdhury (2016), Aydisheh & Gharibi (2015) and Valdez (2015) substantiate the findings of present study. Chowdhury (2016) found that constructivist approach has significant effect on understanding, application and skill in mathematics. Aydisheh & Gharibi (2015) found that constructivist approach is better than traditional approach on knowledge, understanding, application, analysis, combination and evaluation as all levels of achievement. Findings of research conducted by Hala & Karema (2014), Madu & Ezeamagu (2013), Bhutto (2013), Nayak, (2011) and Upadhyaya, (2000) also in conformity with the findings of the present study.

The findings of present study can be understood in light of the nature and concept of constructivism. Constructivist approach provides chance of active participation of learners throughout the unit. Teacher plans his/her lessons in such a manner that learners associate their previous knowledge to the new one. Teacher makes the environment conducive and collaborative so the learners of different abilities learn from each other. Knowledge is constructed by the students themselves. Walker (1999) found that student centred strategy produced higher probability of

obtaining the correct answer to mathematics items those measures conceptual, rather than procedural understanding. It raises the level of thinking and takes it to higher order level of cognitive domain; therefore, investigator found results in favour of constructivist approach.

CONCLUSION

The use of constructivist approach in classroom can offer answers to many problems and challenges faced by Indian educational system. Constructivist approach enhances students' achievement which cultivates in them a sense of confidence and a desire to learn more mathematics. This may prove effective in controlling and even reducing the rate of abandoning mathematics at secondary level of education system. The goal of mathematisation of nation may be achieved by this approach, envisaged in NCFSE, 2005. The findings of the study have their implications for teachers, teacher-educators, curriculum planners, and administrators. Constructivist approach to the teaching of mathematics should be introduced in classrooms for the benefit of the students to achieve higher level objectives. The teacher educators should encourage pupil teachers to use this new approach for teaching mathematics. They should arrange workshops for pupil teachers to train them in applying constructivist approach in classrooms.

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