

A Study On The Effect Of Constructivist Approach On The Achievement In Mathematics Of IX Standard Students.

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Abstract: *Constructivism is an emerging pedagogy among teaching community across the world and National curriculum Frame work (NCF 2005) confirmed the direction to it in Indian classroom situation. Constructivism emphasizes how the learner constructs knowledge from experience, which is unique to each individual. This study was a pre-test post-test quasi experimental design incorporating both qualitative and quantitative techniques. 5E's learning (Engage-Explore-Explain-Elaborate-Evaluate) strategy has been applied to experimental group and Traditional method of teaching followed by control group where total 60 students participated. The Mathematics Achievement Test (MAT) was used to estimate the students achievement in both the groups. The experimental data revealed the following results. Firstly Constructivist learning approach significantly improves student's achievement in mathematics as compared to using a traditional teaching. Secondly Constructivist learning approach was equally effective for boys and girls in improving their achievements in mathematics. Thirdly students taught in constructivist learning environment have significantly enhanced their understanding and application abilities as compared to other abilities like knowledge and skill.*

Key Words: *Constructivism, 5Es Model, Academic Achievement*

I. Introduction

Constructivism is a theory about knowing and learning that knowledge can not be directly transmitted but must be actively constructed by learners. It is based on the belief that knowledge is not a thing that can be simply given by the teacher inside the classroom to the students at their desks. Rather, knowledge is constructed by learners through an active mental process of development; learners are the builders and creators of meaning and knowledge. In other words constructivism is an epistemology, a learning or meaning making theory, which offers an explanation of the nature of knowledge and how human being learns. Constructivism begins with the notion that the human world is different from the natural, physical world and therefore must be studied differently. Constructivist learning is the combined element of the multiple realities constructed by people and implications of those constructions for their live and interactions with others (Patton, 2002). Constructivist view of learning emphasizes the significance of the individual learner's prior knowledge (Wu & Tsai, 2005). According to Cannella & Reift (1994), Richardson (1977), individuals create or construct their own new understanding or knowledge through the interactions on what they already know and believe and ideas, events and activities with which they come in contact. The constructivist revolution offers an active sense-maker and suggest new methods of instruction. It facilitates presentations of materials in a constructivist way and engages students in an active explorative learning. The new approach allows the learners to have more control over their own learning, to think analytically and critically and to work collaboratively. This constructivist approach is an effort at educational reform and particularly a revolutionary vision of instructional strategies. Research on instructional strategies, particularly in the areas of cognitive processing teacher effects and teaching of cognitive strategies, suggests specific instructional principles that can be of great use to create constructive learning environment in the classroom (Rosenshine 1996). According to Foreman and Pufall (2001), Newman, Griffin and Cole (2002), Piaget (1993), Resnick (1987), Vygotsky (1999), Constructivism is a theory of cognitive growth and learning that has gained many adherents in recent years.

II. Need Of The Study

Mathematics has been a confusing, , frightening and frustrating subjects 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. The obvious question is whether students' failure to learn mathematics can be attributed to the factors such as defective syllabus, defective methodology adopted by teachers or perhaps the combination of all these (Carnine, 1997). Hence most of reasons behind students failure in learning mathematics are mainly due to defective curriculum and teaching methodology and strategy as it is corroborated by the findings of (Carnine 1991; Jones, Wilson and

Bhaswani, 1997). The National Curriculum Frame work 2005 recommends a paradigm shift from students rote learning to learning by understanding. It suggests that curriculum should help students to develop their own thinking and ideas through experience, action and reflection. School should facilitate the process of knowledge construction and help them to become independent thinkers capable of solving their everyday problems. Becoming a constructivist may prove a difficult transformation since most of the teachers follow traditional teaching methodology in transacting curriculum of mathematics. In a recent study, constructivist instruction is found to be more effective teaching learning process than the direct instruction in classroom (Knoesbergen and Van Luit, 2012). Self-regulated learning strategy in constructivist pedagogy improves achievement in mathematics and level of confidence for middle school students (Cekolin, 2001).

Researchers have proved that constructivist based teaching approach is more promising towards mathematics learning for students (Ginburg-Block and Funtuzzo, 1998; Grave Meijer 1993) and it has also positive effect on both students' performance and motivation. In view of the aforesaid research evidences, question arises as to whether the constructivist approach has any impact on student's achievement in mathematics and hence, here lies the rationale of this present study.

III. Objectives:

- To study the effectiveness of Constructivist Approach on the student's achievement in Mathematics in IX standard.
- To study the effectiveness of Constructivist Approach on the students' achievement in Mathematics with respect to their gender.
- To examine the different dimension(s) of achievement in mathematics of Secondary School Children.

Hypotheses

The hypotheses formulated in the light of above stated objectives are:

- The Constructivist Approach has a positive effect on the achievement of IX standard students in mathematics.
- There is a significant difference between Boys and Girls Achievement in Mathematics due to Constructivist Approach in teaching mathematics.
- There is no significant difference on different dimension of achievement in mathematics of secondary school children.
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Design of the Study

The experiment was set up according to the non-equivalent pre-test and post-test design. The intact class of IX standard as a whole was considered as experimental and control groups for the study. Before starting the experiment the researcher conducted MAT pre-test to ensure whether the two groups had achieved the same levels of creativity performance.

Sample

While selecting the sample for the present study, the researcher had adopted the Purposive sampling method. A Govt H.S. School which is affiliated to S.E.B.A in Tinsukia (Assam) was purposively selected for the sake of convenience in conducting the experiment for the study. One section of class ix was taken as the experimental group and other one section as the control group, selected randomly.

Procedural Details of the Study

The study was carried out in no less than three phases as follows.

Phase -I: Development And Tryout Of Tool And Lesson Plan

At this stage lesson plans for instruction, tools like achievement test in mathematics were developed.

Development Of Instructional Materials:

The researcher developed different instructional materials which helped for imparting instruction and facilitation for learning. Two types of instructional tools used in this present study. The constructivist approach (CA) followed for experimental group and Traditional Method of Teaching (TMT) followed for controlled group by the investigator.

The instructional strategies of Traditional teaching was limited to the controlled group where a teacher centralized an environment which prevails and course instruction emphasized on content recitation without allowing time for students to reflect upon the materials presented, relate it to previous knowledge, or apply it to real life situations.

“Experimental teaching” based on the constructivist learning model as described by Yager (1991), the “5E” implies Engage, Explore, Explain, Elaborate, Evaluate model developed by Bybee(1993) and applied by Lord (1998, 1999, 2001). Both the groups’ experimental group and control group were taught by the investigator himself so as to avoid teacher variable.

Phase-2: Implementation Phase

The students of experimental and controlled group were selected based on the marks obtained by the students in 1st unit test conducted by the school. Achievement test was administered by the Investigator on both groups as pre-test. The experimental group was taught through constructivist approach .For experimental group Instructions consisted of a series of short (5-10 minutes) lectures in which they were introduced to new material (Engage), followed by the formulation of a problem or exercise (Explore). Depending on the nature of the task involved or the degree of difficulty, students were given to solve these problems with the members of their co-operative group. This provided an opportunity for interaction with other classmates as they tried to make sense of the new information relevant to past experiences or previous knowledge. Their consensus answers i.e. misconceptions arises on a sheet that was turned in (Explain Phase). The amount of discussion was depending on the accuracy of the responses of prior understanding of the students and amount of time remaining. Then the experiment proceeded to the Elaborate Phase in which addressed misconceptions evidence arises by each group. Then listen carefully the students expanded concepts which they had learnt and thereby linked it to the world around them. At the end Evaluation, the fifth ‘E’ is an ongoing diagnostic process determined whether the learners had attained understanding of discussed concept and the controlled group that was taught by conventional method. The total duration of implementation of study was 25 days covering total 50 periods (25 for each section).

Phase-3: ADMINISTRATION OF TOOLS

After implementation phase, the Achievement test administrated on both Experimental and Controlled groups.

Statistical Techniques Used

The Investigator used the statistical techniques like percentage, mean, standard deviation (SD), t-test etc. for analyzing and interpretation of the data collected for the study.

Measuring Tool:

In order to measure student’ Achievement in Mathematics Achievement Test (MAT) was developed by researchers and it was validated by some mathematics experts and educational evaluator. This test consisted 35 items, including both subjective and objective items from the chapter ‘TRIANGLES’ from class-IX, Mathematics Text book. The instruments were trial tested to establish reliability. One of the schools that meet the criteria but not used for the main study was used for the trial testing study. Test-Re Test formula was used to calculate the reliability coefficient of the MAT and the co-efficient of internal consistency for MAT was 0.19 which was highly reliable.

Before start of the experiment, the researcher spent few days to discuss overall experimental process. An mathematics achievement test (MAT) pre-test was administered to ensure that prior to the experiment, whether the two groups had achieved the same levels of achievement in math. Also all the learning activities for both the experimental group and the control group was ready before the experiment. The decision about sample, observer, and school permission was finalized before the experiment.

During the treatment process, the experimental group participated in constructivist learning environment and the control group participated in the normal tradition instructional strategy. The treatment was given until the completion of chapter and the totals an implementation 50 periods of (25 days) to both experimental and control group. At the end of the experiment, the mathematics achievement test (MAT) was administered to both the experimental group and control group in order to compare their achievements in mathematics.

Analysis And Interpretation Of The Data:

In order to determine the effect of constructive approach, the data were analyzed taking in consideration the overall achievements scores of students as different dimensions (knowledge, understanding, application and skill) of MAT. The gender difference in mathematics achievement was also analyzed by taking the post score of achievement test

Table-1: Pre-Test Mean, Sd And T-Value Of Score On Mat For Two Group.

GROUPS	MEAN	SD	DF	T-VALUE	Significance level
Control GROUP (N=30)	44.3	3.35	58	1.85	Significant level
Experimental GROUP (N=30)	46.1	4.18			

It is evident from the Table-1 that the means of MAT score in mathematics of the experimental group and control group were 46.1 and 44.3 respectively. It is further indicated that the obtained t-value (1.85) at 0.05 level of significance. Hence there is no significant difference between experimental group and control group on their achievement in mathematics. Therefore both the group was found to be almost equal as far as their previous achievement in mathematics is concerned.

Table-2: Table Exhibiting Mean, Sd And T-Value Of Scores On Mat Of Experimental Group

MATHS ACHIEVEMENT TEST(SAT)	Test	MEAN	SD	T-VALUE	Significance level
	Pre-test (N=30)	46.1	3.35	12.07	Significant at 0.01 level
	Post-test (N=30)	59.5	5.12		

It is evident from table 2 that mean value in post -test was 59.5 while the mean value of the same group in the pre-test score was 46. It can be said that there is gain in the academic achievement of the students in the experimental group. The calculated t-value 12.07 was found to be significant at .01 levels with 58 degree of freedom as in table above.

Table-3: Post-Test Mean, Sd And T-Value Of Scores On Mat For Two Groups

	TEST	MEAN	SD	T-VALUE	Significance level
MATHS ACHIEVEMENT TESTS (MAT)	Pre-test (N=30)	44.3	2.68	6.42	Significant at 0.01 level
	Post-test (N=30)	51.5	5.42		

Table-3 indicates that the mean value in post-test scores of the controlled group was 51.5 while mean value of the same group in the pre-test score was 44.3. The calculated t-value 6.42 indicates a significant gain in the achievement of the students in this group at 0.01 levels with 57 degree of freedom as shown in the table above.

Table-4: Post-Test Mean, Sd And T-Value Of Scores On Mat For Two Groups

Group	Mean	SD	DF	T-value	Significance level
Control Group	51.5	4.01	58	6.78	Significant at 0.01 level
Experimental Group		5.03			

The comparison between distribution of scores obtained by Experimental Group and Control Group in post-test indicate heterogeneity in both groups. The calculated t-value 6.78 is significant at .01 levels with 58 degree of freedom and this value indicates that the performance of experimental group was significantly better than that of control group in the post test as shown in table 4.

Table-5: T-Test Results For Comparision Of Boys And Girls:

SEX	N	MEAN	SD	T-VALUE	Significance level
MALE	32	30.3	2.7	1.89	Significant at 0.05 level
FEMALE	28	29.2	1.8		

A non-significance difference was observed in the mean achievement scores of Boys and Girls, t-value of 1.89 was found to be non significant at 0.05 level. From the mean value it is clear that Boys had almost same academics achievement scores (M= 30.3) and Girls(M= 29.2). Hence there no significant difference between Boys and Girls achievement in mathematics as an effect of constructivist approach.

Table-6: Post-Tests Mean, Sd And T-Value For Different Dimensions Of Mat For Two Classes:

TEST	DIFFERENT DIMENSIONS OF MAT	CLASSES	MEAN	SD	DF	T-VALUE	Significant level
MATHEMATICS ACHIEVEMENT TEST(MAT)	KNOWLEDGE	EXP.	11	3	58	1.5	NS
		CONT.	10	2			
	UNDERSTANDING	EXP.	18	4	58	3.0	Sig
		CONT.	15	3.8			
	APPLICATION	EXP.	20	5	58	2.58	Sig
		CONT.	17	4			
	SKILL	EXP.	10.5	3.2	58	1.52	NS
		CONT.	9.5	3			

Table-6 reflects that there is a significant difference understanding and application dimension between the experimental group and control group as both these cases t-values (3.0 and 2.58) more than the table value at 0.05 level of significance. On the other hand t-value result shows there is no significance difference in knowledge and skill score between the experimental and control group at 0.01 level of significance as t-value found 1.5 and 1.52 respectively in this dimensions. It appear that the students learning in constructivist approach has substantially enhanced the understanding and application abilities of students in Mathematics as compare to other abilities like knowledge and skill.

Table-7: Students Post-Test Scores On Mat In Terms Of Grade:

ASSIGNED GRADE	MARKS IN PERCENTAGE	NO.OF STUDENT IN TWO CLASSES	% OF STUDENTS IN TWO CLASSES
A	Above 80% (>40)	E=7 C=2	E=23.23 C=6.66
B	Between 70%-80% (35-40)	E=10 C=4	E=33.33 C=13.33
C	60%-70% (30-35)	E=5 C=8	E=16.66 C=26.66
D	50%-60% (25-30)	E=6 C=9	E=20 C=30
E	Below 25%	E=2 C=7	E=6.66 C=23.33

Table 7 indicates the number and percentage of students securing different grades in Mathematics achievement test, In experimental group more number of students at the post test have secured A and B grades as compared to the control group. But it was found reversed in the case of grades like C, D and E.

Major Findings Of The Study:

The analysis and interpretation of the data revealed significant results which have been consolidated and presented in the form of major finding as follows:

- The Constructivist Approach has a positive effect on the achievement of students in Mathematics. It is evident from the analysis that the students taught by constructivist approach scored higher than those taught by conventional method in the control group.
- Constructivist Approach was found equally effective for both boys and girls in improving their achievement towards mathematics.
- Students taught in constructivist-learning environment have significantly enhanced their understanding and application abilities as compared to other abilities like knowledge and skill.

IV. Discussion:

From the studies it was found that Constructivism based teaching significantly improved academic achievement in comparison to traditional method of teaching of class IX students. This finding is supported by the findings of a number of studies. Jong Su Kim (2005) found that using constructivist teaching methods of 6th grades resulted in better student achievement than traditional methods. Indrani, Ketika, Seemal (2007) found that teachers who were using constructivism in teaching in class 8th, achievements of their students increased. Sasikala and Ramchandran (2006) used child driven learning environment for teaching computer programming and it was found to be more effective than traditional classroom teaching. The possible reasons behind such finding may be following:

- The environment was democratic and children were given freedom to discover the unknown .There were no parameters that could limit a student’s right to questions.
- Pupils were encouraged for group activities in which they had a scope to share their knowledge among peers and constructed and reconstructed their knowledge related to the concepts under the study.

- Students were made to establish relations between subjects and real life by interacting with the in-hand materials.
- Students were encouraged to develop the ability to integrate new information with the already learnt knowledge.
- Learners were exposed to a variety of activities created by the teacher in the classroom and classes were given importance to learner-centeredness.
- Students' self-assessment and teacher's regular maintenance of portfolios in the classroom.
- The teacher played a commendable role in prompting and facilitating deliberations.

These are also may be the reasons for which their understanding and application abilities enhanced as compared to other abilities like knowledge and skill .From the study it was also found that Boys had almost same Academic achievement score as Girls. The reasons behind such findings may be that constructivist approach was equally effective for both boys and girls in improving their achievement towards mathematics.

V. Conclusion

Studies have suggested that the orthodox system of teaching is not enough to inculcate the critical thinking and risk taking attitude amongst the present day students. Therefore, there is urgent need to reform our teaching practices in light of recommendations of NCF-2005. In this framework child is viewed as a "discoverer" who actively construct his knowledge and build his understanding by meaning making process. Hence, the framework advocates the use of constructivism at every stages of Mathematics teaching. However, the success of this pedagogy presupposes that the teachers should not only be well trained in a constructivist approach, but they also be dedicated enough to follow its requirements patiently. This strategy is time consuming and requires lots of patience on the part of teachers and administrators. In order to take up adequate teaching measures in light of the present needs of the education system, the teachers need to be well trained and well acquainted with the subject matters capable enough of the making out the a student's psychology working behind his/her ability to take up or make out what is being taught. The teachers should also be trained in the use of relevant technologies. All this required massive support from school authorities, principal, administration and the government.

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