

Effectiveness of Constructivist Approach on Academic Achievement in Science at Secondary Level

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Abstract:

The present study investigated the effectiveness of constructivist approach on academic achievement in science at secondary level. For this pre-test post-test experimental and control group design is used, with 58 samples grouped as experimental group (29) and control group (29) on the basis of matching by intelligence test. The investigators conducted this experiment over three weeks by using both traditional and constructivist 7E-model. The self-developed achievement test covering class IX text book of West Bengal Board of Secondary Education, India was used as tool. The study found that the students exposed to the constructivist 7E-model significantly achieved better than traditional method. In addition, the students exposed to the 7E-model significantly higher than those exposed to the traditional teaching method in respect to their gain scores at every intelligence levels. The constructivist approach strategy is capable of improving student's mastery of content at the higher order levels of cognition. It is therefore recommended that constructivist 7E-model strategy should be used in science teaching for the development of student's higher achievement in science at secondary level.

Key Words: Constructivist 7E-model, Science, Secondary level.

Introduction:

Education is a social process, it changes society. It changes adult's role of society, shifting responsibilities of education from parents to teacher and from family to school. Societies change its effective use of education in designing, developing, producing, implementing and evaluating curriculum. It helps teaching learning process in a classroom situation. It increases learning outcome, increases students achievements, reducing student's dropouts and also reducing student's burden, stress, anxieties and frustration. So now a day's development of new teaching strategies is essential for all-round developments of students. Here researcher wants to compare the difference between the traditional lecture methods with constructivist approach. Constructivist teaching is based on constructivist learning theory. Constructivist learning has emerged as a prominent approach to teaching during this past decade. The work of Dewey, Montessori, Piaget, Brunner and Vygotsky among

others provides historical precedents for constructivist learning theory. Constructivism represents a paradigm shift from education based on behaviorism to education to education base on cognitive theory .Behaviorist epistemology focuses on intelligence, domains of objectives levels of knowledge and reinforcement. Formalization of the theory of constructivism is generally attributed to Jean Piaget, who articulated mechanism by which knowledge if internalized by the learners .He suggested that through process of ‘accommodation’ and ‘assimilation’ individuals construct new knowledge from their experiences.

The Biological Science Curriculum Study (BSCS), team along with its principal investigator Roger Bybee developed an instructional model for constructivism, called the 7Es. This model recommendation for science teaching. In this model the process is explained by employing 7 E’s. They are Elicit, Engage, Explore, Explain, Elaborate, Evaluate and Expand.

Rationale of the Study:

Throughout the world science is one of the compulsory subjects in schools. Majority of students in schools ignored to learn science due to lack of interest and motivation that leads to low academic achievement in science. Majority of teachers generally follow the traditional methods of instruction in schools. The conventional teaching method of teachers as sole information giver to passive students appears outdated. At secondary level scientific concepts to be taught should be to make of everyday experiences.

Apart from simple experiments and hands on experiences, an important pedagogic practice at this stage is to engage the students (in groups) in meaningful investigations-particularly of the problems, they perceive to be significant and important. Indian Education Commission (1964-66) criticized that if science is poorly taught and badly learnt than it will be burden for learner’ mind. Therefore, appropriate method of curriculum transactions must be to inculcate scientific temper. Science inculcates the value of creativity and logical thinking. Due to limitations of the traditional teaching, now a day’s some skills such as updating, practicing, criticizing and analyzing the knowledge gain importance. Constructivist theory plays an import role in the field of education.

Secondary education is the base for future education and it prepares students for higher education. In secondary level, science knowledge construction is very essential which welcomes constructivist approach (Icon-model/7E-model) of teaching. Lee and Fraser (2000) have reported that students from the science independently perceived their class room environment in a more favorable than students of other stream. Miheso (2002) revealed that girls achievement score is better than boys by using icon model than traditional teaching method. It is also found by other researchers (Jong, 2005; Peter, et. al. 2010; Nayak, 2010; Cakici and Yvuz, 2010; Enok and Joel, 2011; Saran, 2011) that the used of constructivist approach social science subjects and at the same time, (Miheso,2002; Becker and Maunsaiyat, 2004;Obiekwe,2008; Abu,2008; Hussein, 2009; Hijazi, 2009; Bimbola and Deniel, 2010; Ovute, 2014; Qarareh, 2016) studied on science

subjects and also Daloğlu (2009) studied on language subject have reported that students taught through constructivist approach scores higher than those taught with traditional method. The existing literature in science education is inconclusive about gender achievement in science. Because of this inclusiveness there is a need to examine the role of constructivist 7E model on the performance of male and female students in science. (Lin, 1998; Panda, 2005; Agrawal and Chawla, 2005; Satyaprakasha and Patnaik, 2005) have reported that co-operative learning has a significant effect on student's achievement in science and sociability among learners reported that. Kim (2005) have founded that constructivist teaching is more efficient than traditional, and constructivist teaching is not effective in relation to self-concept and learning strategy but some effect upon motivation anxiety towards learning and self monitoring. (Dhindsa and Emran, 2006; Hijazi, 2009; Qarareh, 2016) have reported that there was no gender difference in the mean achievement score for the constructivist group than traditional method. Pritinanda (2007) had founded that icon model has no significant effect on achievement of English, but a statistically significant effect on communicative competency like reading, writing and speaking, Folasade and Akinyemi (2009) had concluded that constructivist learning technique is more efficient, and also reported that there was no significant difference between the performance of male and female students taught with constructivist approach.. Saran (2011) reported that Low achiever students learnt through constructivist approach had achieved significantly higher score as compare to their counterpart learnt by traditional method for social science (Geography) subject. NCF-2005 has emphasized to follow constructivist approach in classroom in so that student can construct their own knowledge and understand the concept at grass-root level. Ultimately their achievement will be enhancing. However many research finding are in favors of it. Therefore researcher wants to find out how for constructivist approach has significant effect on student achievement in comparison to traditional method. Therefore it is worthwhile to study the effect of constructivist approach on the achievement of physical science students.

After analyzing all the above studies indicate that the application of constructivist approach during teaching science has been widely used. Majority of researchers have found that the constructivist approach of teaching is better than traditional method of teaching in Biology and in some Social Science subjects it is most significant but it has no significance on English subject. It has been found that the low achievers students are highly benefitted by constructivist approach. From the above analysis, no such study have found on the effect of 7E-Model in achievement of students in physical science subject with relation to intelligence and gender. Most important point is that all the studied have been conducted on the English medium C.B.S.E. curriculum. That's why researcher wants to study the effect of constructivism (7E-Model) on academic achievement of secondary school students in West Bengal Board of Secondary Education (Bengali Medium) on basis of intelligence.

Statement of the Problem:

NCF-2005 has emphasized to follow constructivist approach in classroom in so that student can construct their own knowledge and understand the concept at grass-root level. In secondary level, science knowledge construction is very essential which can be meaningfully achieved through the use of constructivist approach (Icon-model) of teaching. Thus, the present study is stated as, “*Effectiveness of Constructivist approach on academic achievement in science at secondary level*”.

Operational Definition of the Key Terms:**Constructivist Approach:**

- Constructivist approach refers to construct knowledge by connecting new ideas/experience to existing ideas /experience.
- Here, the researcher has taken 7E-Model of constructivism for intervention.

Achievement

- Achievement reference to performance of the students.
- Here the achievement refers to the scores obtained by secondary school students in science before and after using constructivist approach.

Secondary School Students:

- The students are studying in class-V to class-X are considered as secondary school students.
- In this study researcher has selected class – IX students only.

Objectives of the study:

1. To study the effect of constructivist approach over traditional method on students’ achievement in physical science.
2. To compare the effect of constructivist approach over traditional method on students’ achievement in physical science with respect to their intelligence.

Hypotheses of the Study:

1. Students taught through constructivist approach gain significantly high achievement in Physical science than traditional method.
2. There is no significant difference in achievement test score among High, Average, and Low IQ students through constructivist approach over traditional method of teaching in physical science.

Delimitation:

- This study was conducted in Bengali medium Dakshineswar Adyapeath Annada Vidyamandir, (Bengali medium) of Kamarhati Municipality, Kolkata, which is affiliated to West Bengal Board of Secondary Education.
- The present study was conducted on 80 class IX students only.
- This study was delimited within be delimited within physical science subject only.
- The study was limited to two lessons (From physical Science) of class 9th science and other units not covered, it is also purposeful study

Design of the Study

The present design of study was quasi-experimental, (Pre-test Post-test control group design).

Population

Class 9th students of Dakshineswar Adyapeath Annada Vidyamandir, were population of this research.

Sample

The purposive sampling was used for selecting Secondary School. 58 students were selected from two sections for the purpose of the study. Researcher selected section 'A' as experimental group and section 'B' as control group.

Tools and Techniques

For the present study, the researcher had used two types of tools:

- Instructional Tool
- Measuring Tool

Instructional Tool

It was in the form of unit wise lesson plans based on 7E model of teaching. Other teaching aids like pictures, chart papers, models etc., were used.

Measuring Tool:

For grouping the students researcher will use Ravens Progressive Matrices. Measuring tools is in the form of teacher made achievement test questions based on constructivist principles.

It is the teacher made achievement test based on Constructivist principle (7E-model).

Data Analysis

The data were analyzed by using appropriate statistical techniques like Mean, SD, SEM, t-test, ANOVA.

Major Findings :

On the basis of the results and their interpretation, the following major findings were found

i) There was no significant difference between experimental group and control group in pre-test. [$M_1=7.1$, $M_2=6.1$, 't'-value is 1.042, significance value is 0.306 i.e. no significance difference between two group at 0.05 levels] . In the present study is found that there exists no significant difference between the mean scores of students in experimental group and control group before intervention. From the above statistical analysis, it is clear that mean of pre-test score of experimental group were slightly higher than the mean score of control group but no significant difference found in students' achievement in between both groups before interventions.

ii) There exists significant difference between the mean scores of students in experimental group and control group in post-test. (From the comparison of achievement score of control and experimental group in post test the mean difference between two groups in post test is 4.24 and its 't' value is 5.627 which is significant at 0.01 levels. So from mean difference (4.2) and significance value (0.000) it can be concluded that there is difference between experimental and control groups post-test achievement scores, these difference arises due to different treatment i.e. by constructivist 7E approach and traditional approach.

iii) Constructivist approach (7E-model) had significant effect on the achievement of class 9th students in physical science than traditional method. (Experimental group gain score mean greater than control group gain score mean is 3.24, 't'- value is 4.387,significance value is 0.000 i.e. there is significance difference between gain scores of experimental and control groups at 0.01 levels). From both mean difference and significant difference it can be concluded that there is significant difference between the gain score obtained by experimental and control group. Hence it can be concluded that there is difference between experimental and control groups post-test achievement scores, these difference arises due to different treatment i.e. by constructivist 7E approach and traditional approach. From the mean values of experimental (10.38) and control group(7.14) researcher found that gain by experimental group is higher than the gain by control group. Hence it can be concluded that experimental group gain greater achievement (constructivist 7E-approach) than control group (Traditional-approach). That is the stated hypothesis is accepted. Finally it can be concluded that constructivist approach has significantly improved the achievement of students in science at secondary level.

iv) Constructivist approach had significant effect on low and average intelligent students by constructivist 7E-approach with respect to high intelligent students. Mean difference gain score between experimental and control groups by low intelligent students (4.86) higher than the gain by average intelligence students (3.42), which is also higher than gain by high intelligent students (1.9),. For high intelligence level mean difference in gain score is not significant(0.281) at 0.05 level, for average intelligence level gain score mean difference is significant (0.003) at 0.01 level and for low intelligence gain score mean difference is significant (0.005) at 0.01 levels. As previous basic knowledge of high intelligence students are comparatively higher with respect to average and low intelligence that is why high intelligence students scored high with respect to average and low intelligence students in pre-test before interventions. But after intervention achievement score is more or less similar for all intelligence levels. So the mean difference of gain score (1.9) is lower with respect to average (3.42) and low (4.86).

There is no significant difference in achievement test score among High, Average, and Low IQ students through constructivist approach over traditional method of teaching in physical science. Variance (ANOVA) of Experimental Post test in relation to intelligence level.

1.1 ANOVA of Experimental Post Test in Relation to Intelligence

Table-1.1 Analysis of Variance of Experimental Post Test in Relation to Intelligence Level

	Sum Squares	df	Mean Squares	F-value	Significance
Between groups	38.384	2	19.192	1.856	0.176
Within groups	268.857	26	10.341		
Total	307.241	28			

From the above ANOVA table-1.1 F-value 1.856 and significance value is 0.176 which proves that there is no significant difference in score among High, Average, and Low intelligence students.

Educational Implications

The study and its findings will be applicable for:

The most outstanding characteristics of any research is that it must contribute something new to the development of the area concerned. The present study was conducted on regional medium students to find the effectiveness of 7E model of teaching in science. The result is useful for teachers, curriculum planner, students, teacher educators, text book writers, researchers, corporate and government organization. 7E model can be use by teacher as effective teaching methodology for difficult and complex concepts, this model of learning may also help the learners to construct their knowledge in a meaningful way as it give enough scope for active participation and interaction in classroom with peers and teachers. Through 7E interaction, low

intelligent students can get better opportunity to acquire knowledge and comprehend what they are learning. In addition, this model will create a joyful learning environment between teacher and students. The implications can also be categorized as given below:

➤ **For learners**

In general constructivist approach and in particular, 7E's model of teaching helps the learners to construct their knowledge positively. It gives enough scope for active participation and social interaction in classroom with peers and teachers. Through interaction, students of all intelligent level can get better opportunity to acquire new knowledge, especially for low intelligent students. They can develop the ability of analysis, divergent thinking, interpretation, ability, critical thinking and scientific attitude towards science education.

➤ **Teachers**

Teacher will benefit greatly by understanding the constructivist approach of teaching which the findings of the present study is. As such, teachers need to encourage peer interaction, group discussion, experimentation, field visiting etc. 7E's model of learning can provide such situation between teacher and student. This model promotes joyful learning among students in classroom situation by facilitating learning process is a two-way mode of learning between learners and teacher. The ideals of teaching learning process of teacher as a facilitator while students develop their potentialities after getting instructions from teacher is what the study indicated.

➤ **School Administration**

School atmosphere plays crucial role in managing the teaching learning process. The administration of school has important role to develop a congenial atmosphere among teachers as well as students. 7E's model may create such situation where a learner can interpret the concepts in many ways and teachers always try to provide them appropriate learning situation. Constructivist approach of learning brings better academic achievement of the students. For successful implementation of this strategy, the school administration should understand how learning need to supported and provide all required learning resources to the learners.

➤ **Policy makers:**

The present study and its finding has showed how the constructivist approach learning in science at secondary level enhance students' achievement and this need to taken into consideration while framing the policies of school education to bring qualitative change. At the same time, curriculum planner may incorporate this strategy in curriculum planning and development and preparation of framework/ guidelines for achievements of intended learning outcomes.

Suggestions for Further Research

1. Present study was conducted only on secondary school students. Further study can be conducted with other group of sample and also study can be conducted on school located at rural area process using constructivist 7E-model.
2. The study was conducted on students' achievement in science at secondary level. Therefore, study can be conducted on the specific branch of science like on Chemistry, Physics and Biology at secondary level and also non science subjects required to be studied.
3. A study can be undertaken to know the effect of Constructivist approach on students' self-concept and their learning process.
4. In this study only 7E's Model has been implemented. Other models of constructivist approach Interpretation Construction model (ICON-model) may be taken up for the purpose of study.
5. Problems and issues regarding assessment through constructivist approach is an emerging topic to investigate for the present situation.
6. The study also can be undertaken by taking larger sample and other context.

Conclusion

From the whole review, analysis and discussions, the following conclusion can be arrived at:

- 1) Constructivist approach is an effective learning tool, which has significant effect on the achievement in science concepts among all psychological groups of students.
- 2) Constructivist approach helps in achieving meaningful learning in science concepts among class 9th students.
- 3) There is no significant difference in achievement test score among High, Average, and Low IQ students through constructivist approach over traditional method of teaching in physical science.

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