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EFFECTIVENESS OF CONSTRUCTIVIST APPROACH ON STUDENT'S ACHIEVEMENT IN SELECTED TOPICS OF SCIENCE AT SECONDARY LEVEL

Shivalika Sarkar[1] and Chitra Singh[2]
[1]Regional Institute of Education, Shyamla Hills, Bhopal, Madhya Pradesh.
[2]Regional Institute of Education, Shyamla Hills, Bhopal, Madhya Pradesh.

ABSTRACT :

The present study was aimed at investigating the effectiveness of constructivist approach on student's academic achievement in selected topics of science at the secondary level. This quasi experimental research was conducted in Demonstration Multipurpose School in Bhopal. The sample consisted of 47 students of grade IX. Two sections of Class IX were chosen and one was designated as experimental group and other as control group. A pre-test and post-test was executed on both the groups, which comprised of questions from selected topics of science. 5E model of constructivist learning was planned and executed on a selected group of students, which was the experimental group. The control group was taught by the traditional approach. The achievement level of both the groups was checked and the difference was found statistically significant. This shows that the constructivist approach is effective in improving student's academic performance in science.

KEYWORDS : *Constructivism, Academic Achievement.*

INTRODUCTION

Apart from the identification and sequence of the stages of cognitive development, Piaget underlined that activities conducted by children are major means of learning and meaningful learning does not take place through oral communication. Therefore, inclusion of activities that provide opportunity to operate upon concrete objects enhances quality of learning. Secondly, Social interaction among children also helps to understand others' point of views. Though approximate age of attaining different stages of cognitive development have been mentioned earlier. These are tentative and cognitive development could be accelerated by including various cognitive activities.

Piaget was the first major constructivist. He emphasized on involvement of children through activities to achieve cognitive development. On the basis of extensive researches he identified four stages of cognitive development.

1. Sensory Motor Stage: 0-2years
2. Pre-Operational Stage: 2-7years
3. Concrete Operational Stage: 7-11 Years
4. Formal Operational Stage: 11 Years onwards

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not take place through oral communication. Therefore, inclusion of activities that provide opportunity to operate upon concrete objects enhances quality of learning. Secondly, Social interaction among children also helps to understand others' point of views. Though approximate age of attaining different stages of cognitive development have been mentioned earlier. These are tentative and cognitive development could be accelerated by including various cognitive activities.

Vygotsky was another person who contributed to the understanding of cognitive development. He emphasized on socio-cultural perspective in learning. The traditional classroom teaching is based on 'blank-slate' model and positivist view of learning. The blank-slate model assumesthat,

- Students come to the class with blank mind-slate and anything can be inscribed onit.
- The knowledge is with the teacher, propagated by him/her and is received, interpreted and assimilated by the student in the same form without any distortions,and
- A good lecture therefore, coupled with-some demonstrations, etc. is a sure method to improve efficacy ofteaching.

The positivist view of learning assumes that it is possible to study an object or phenomenon objectively and arrive at the 'universal truth' unaffected by previous ideas or beliefs. Through logic, mathematical applications and objective experience one could discover the reality. As a counteract to this, constructivist view of learning assumes that knowledge is constructed through experience, is continually refined in view of new observations and does not exist independently of human experience. The brain is an active agent which continually draws interpretation on the basis of information received by it. The brain is assumed to be selective in receiving information while it ignores other information's which it considers as useless for its purpose. The mental constructs are mental models which are continually tested against the new experiences and modified, if need be. In this way the prior experiences, beliefs and emotions affect the individual's perception and interpretation of events. The important features of constructivist model of learning could thus be statedas,

- Knowledge acquisition is a constructive or generative process and each student's knowledge is personal oridiosyncratic.
- Misconceptions may originate as a result of students interaction/experience with the real world and/or because of his/her misinterpretation of ideas presented tohim/her.
- The process of concept formation is a continuous process of successive approximations andrefinement.
- Due to their different conceptual ecologies, different learners can interpret the same new experience/idea differently in their conceptual structures/frameworks.
- Development of alternative frameworks or misconceptions is from the same mechanism that leads to the development of conception. In addition, some modes and sequences of presenting information during teaching may result into development ofmisconception.
- Students hold intuitive ideas that are both stable and identifiable and have enough commonality to make it worth using in planning instructional strategies.

In the context of constructivist approach, student's errors are recognized as a part of developmental phenomenon and not due to misunderstanding of the concept. The constructivist philosophy regards high epistemological status to individual's personal conceptions. It considers 'error' as a natural developmental stage, rather than the cognitive deficiency, inadequate learning, carelessness on the part of student and poor teaching. In India teachers rarely follow this approach or rather they are not trained in using this approach in their classrooms.

Sridevi (2008) has studied the effect of constructivist approach on achievement of Class VIII students in science. In constructivist approach students actively participate in the construction and reconstruction of knowledge. It was suggested by Dogra (2010) compared one in which a traditional approach of science learning was followed and the other in which constructivism was followed. She found that when the constructivist approach was used students found the learning environment more enthusiastic and enjoyable. She has suggested several activities like concept mapping, graphs, brainstorming etc. which can be used in

the biology classroom to create a constructivist learning environment. Cakir (2008), Kumar and Gupta (2009), Nayak and Senapaty (2009) also found a positive impact of constructivist approach on pedagogy of science teaching.

NATURE OF STUDENT'S IDEAS

From the large number of studies, some common features of student's ideas have been observed. These are:

- Ideas are stable and do not change easily despite teachers tutoring them to the contrary in the instructions in the school. Sometimes they seem to change, but students retrograde to the earlier ideas when they encounter new/difficult situation.
- The ideas are context specific and may not be applied in another scientifically similar situation. They lack generality and have limited application.
- Many ideas are developed prior to teaching. When children come to the classroom, and are provided with different scientific ideas, children either (i) modify the previous view-points (ii) possess two ideas, one for the classroom and the other for personal feelings and interpretate in a compartmentalized manner, or (iii) discard the original idea and adopt the scientificexplanation.
- Ideas are personal. Some experience may have different implications for different students due to their varied conceptual ecology. Thus what they internalize and remember is different. This does not mean that many children do not have common ideas. For example, some commonly held misconceptionsare:
  - If a body is not moving, there is no force acting on it.
  - Half lens would make halfimage
  - Sun inliving.
- Children's ideas do not have precise language. They may have similarity with-scientific theories rejected in thepast.

TEACHING IN VIEW OF CHILDREN'S IDEAS

In view of existing variety of concepts, which may not be in accordance with scientific ideas, it is necessary to adopt special strategies to bring out necessary conceptual change. For conceptual change the necessary conditionsare:

1. Learner must encounter such a situation which he is not able to understand using existing knowledge. Thereby producing dissatisfaction in thelearner.
2. Learner must come across some knowledge which is intelligible to him and seemsplausible.
3. The new knowledge helps learner to understand some new situations which were beyond his reachearlier.

Driver and Oldham (1986) has suggested constructivist teaching sequence consisting of five phases: 1) Orientation, 2) Elicitation of children's ideas, 3) restructuring of children's ideas through (i) clarification and exchange, (ii) exposure to conflict situation, (iii) constructions of new ideas and (iv) evaluation of new ideas, 4) Application of new idea and 5) Review of change in ideas and comparison with previously held ideas.

To reconstruct children's ideas various strategies could be used. These include demonstration, discussion, debate and experiment etc. In this context it is important to remember that,

- Conduction of activity in itself is not enough. It is the way it is done and meaning is made out of it isimportant.
- Analyzing student's response, it is important to see the reasoning given in aiming at theresponse.
- Scientific theories are not the unique result of scientific observations. Theories are constructs of human intellect.
- Learner's construct meaning themselves and do not nearly repeat what is told tothem.
- Learners do not learn in unconnected bits but are able to see relationship with otherideas.

- Teacher understands that meaningful learning cannot take place without consideringpreconceptions.

Characteristics of Constructivist Classroom Environment

- Atmosphere is democratic and student's ideas are paid adequate attention.
- Students feel free to ask questions and raisedoubts.
- Students have autonomy and they are encouraged to takeinitiative.
- For learning raw data, primary sources and interactive material are used.
- Cognitive activities such as reflective thinking, prediction, creating hypothesis are extensivelyused.
- Misconceptions are not considered as mistakes but as point of views which need to be examined and evaluated by the learner himself.
- Supports cooperativelearning.
- Activities are learner centered rather than teachercentered.

METHODOLOGY

The researcher used a quasi-experiment following a non equivalent control group design to verify the effectiveness of the constructivist approach in learning science at the secondary level. It involved the comparison of achievement of the students between those exposed to constructivist approach and those to traditional approach. The students who were exposed to constructivist approach- were designated as experimental group and those who were exposed to traditional approach were designated as control group. The students' achievement score in science before and after the experiments were gathered and measures were employed. The research was conducted at Demonstration Multipurpose School (DMS), Bhopal. The respondents of the study were the two sections of the Class 9th students wherein the research was carried out. In total of 47 students were selected for the study, out of which the control group comprised of 23 students and experimental group comprised of 27 students.

This research made use of the following data gathering instruments:

a) The Pre and Post Achievement Test
b) The Traditional Approach of learning
c) The Constructivist Approach of learning

Before the experimental study, the pre-achievement test was administered to the two groups to find out their achievement in selected topics of science. The pretest comprised of multiple choice in selected topics of science which included.

During the period of study, the experimental group was exposed to the constructivist approach of learning based on the 5E model.The 5E Instructional Model (Bybee & Landes, 1990) comprises of five stages which are Engage, Explore, Explain, Elaborate and Evaluate. Any science lesson can be planned following these 5Es. The lessons chosen for this study were force and newton's laws of motion, sound, tissues, structure of atom and natural resources. Each lesson was taught to the experimental group, involving various aspects of the different phases of the 5E model.

The t-test was used to determine if there was difference between the experimental and control groups in their:

a. Pre-achievement scores in science
b. Post-achievement scores in science

RESULTS AND DISCUSSION

Hypothesis 1: There is no significant difference between the pre-achievement scores of experimental and control groups.

Table 1: Difference between the Pre-Achievement Scores of Experimental and Control Groups

Group	Mean	SD	Df	T	p
Control	26.67	3.284	45	1.607	.122
Experimental	24.31	3.987			

Table-1 shows that control group had a mean score of 26.67 with SD of 3.28 while that of experimental group had a mean score of 24.31 with SD of 3.987. The t-test was performed to find out whether there is significant difference between the two means. It has been assumed that distribution of the achievement scores of control and experimental group were sufficiently normal for the purpose of conducting a t-test. Assumption of homogeneity of variances was tested and satisfied via Levene's F test, F(35)=.021 , p=.885. The t-ratio of 1.607 has an associated probability of .122. The obtained t-value is less than table value at 0.05 level of significance. This means that the null hypothesis is accepted. Hence, there is no significant difference between the pre-test mean scores of the two groups of respondents. This only means that the two groups had the same cognitive level before the study was conducted.

Hypothesis 2: There is no significant difference between the post-achievement scores of experimental and control groups.

Table 2: Difference between the Post-Achievement Scores of Experimental and Control Groups

Group	Mean	SD	Df	T	p
Control	17.23	6.070	45	5.636	.000
Experimental	25.44	3.787			

As shown in the Table-2, the students exposed to constructivist approach-based learning had a post-test mean score of 25.44 with SD of 3.787 while the group exposed to traditional experiments had a mean score of 17.23 with SD of 6.070. The t-ratio of 5.636 has an associated probability of .000. The t-value obtained is greater than the table value at 0.01 level of significance hence the null hypothesis is rejected. Hence, there is significant difference between achievement scores of the two groups after the study. After the treatment, the two groups of study varied statistically in terms of their learning achievement. Hence we can say that constructivist approach was more effective in teaching selected topics of science as compared to the traditional approach.

Hypothesis 3: There is no significant difference in pre- and post-achievement scores of the experimental group.

Table 4: Difference between the Pre- and Post-Achievement Scores of the Experimental Group

Achievement	Mean	SD	Df	T	p
Pre	19.95	5.744	21	4.134	.000
Post	25.50	3.419			

Before the study was conducted, the mean score of the students was 19.95 with SD of 5.744 which was increased significantly to 25.50 with SD of 3.419 after the conduct of the study. Table-3 reveals that the t-ratio is 4.134 which has a probability of 0.000 which means that the null hypothesis is rejected. The obtained t-value is greater than the table value at 0.01 level of significance. Hence, there is significant difference between the pre- and post-achievement scores of the students exposed to constructivist learning situations and we reject the null hypothesis. It also suggests that constructivist learning situations in different subjects did enhance achievement. The students performed better in different areas of science as a result of the positive effect of the approach that was employed.

Further it is also observed that during the execution of the constructivist lesson plans students enjoyed learning, they played an active role in the teaching learning process with great enthusiasm.

Furthermore, it is also observed that during the conduct of the study, students showed willingness to undertake new tasks, initiative new ideas related to classroom activities, project and adapt easily to changes in procedures.

CONCLUSION

The study used constructivist approach based 5E model where students where in learning is the center where all other learning processes revolve around. We have correlated the constructivism learning situation with the traditional learning: the two being student-centered paradigm of learning. The model was applied to science classroom at the secondary level for effective learning of the students. It was highlighted that for effective science learning; teacher must always consider the students' prior knowledge. This prior knowledge determines everything the students learned and the also the pattern of teacher instruction. The teacher acts as a facilitator in the teaching learning process. Teachers need to be trained on using 5E model in their classrooms and how to create constructivist learning situations in the classrooms.

REFERENCES

1. Bybee, R., &Landes, N. M. (1990). Science for life and living: An elementary school science program from Biological Sciences Improvement Study (BSCS). The American Biology Teacher, 52(2), 92-98.
2. Cakir, M. (2008). Constructivist Approaches to Learning in Science and their Implication for Science Pedagogy: A Literature Review. International of Environmental & Science Education, 3(4), 193-206.
3. Nayak, R.K. & Senapaty, H.K. (2009). Effect Constructivist Approach in Fostering Creativity of Primary School Children. Journal of Indian Education, No. 2.
4. Sridevi, K. V. (2008). Constructivism in Science Education. New Delhi: Discovery Publishing House, Pvt. Ltd.
5. Kumar, Rajesh & Gupta, V.K. (2009). An introduction to cognitive Constructivism in Education. Journal of Indian Education, NCERT, New Delhi.
6. Dogra, Bharati. 2010. Constructivist Classroom Activities for Biology Learning. JIE, 36(1).
7. Rosalind Driver & Valerie Oldham. 1986. A Constructivist Approach to Curriculum Development in Science, Studies in Science Education, Volume 13, 1986 - Issue 1 Pages 105-122.