

EFFECT OF CONSTRUCTIVIST APPROACH BASED LEARNING ACTIVITIES ON ACHIEVEMENT IN PHYSICAL SCIENCES OF 9TH GRADE STUDENTS

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Abstract

Constructivism as a description of human cognition is often associated with pedagogic approaches that promote learning by doing. Constructivist approach transforms the students from a passive recipient of information to an active participant in the learning process. In a constructivist classroom, knowledge is seen as dynamic, ever-changing with one's experiences, students work primarily in groups. Therefore, the application of constructivist approach to science teaching results in the development of deeper understandings. Hence, the present investigation was meant to study the effect of constructivist approach based learning activities on achievement in physical sciences among 9th grade students. The data was collected from 100 students of 9th grade from two schools of Amritsar city (Punjab). Both the groups were equated on intelligence test scores and pre-test scores. For treatment in the experimental group, the constructivist approach based learning strategy was applied and the controlled group was taught the same topics by traditional method. After the treatment, both the groups were administered post-test. Relevant statistical techniques were employed to analyse the data. The findings of the study revealed that there was a significantly positive effect of constructivist approach based learning activities in improving the physical science achievement of 9th grade students.

Key Words: Constructivist Approach, Achievement In Physical Sciences

Constructivism is an epistemology, a learning or meaning making theory, which offers an explanation of the nature of knowledge and how human beings learn. Constructivism is "a theory of knowledge with roots in philosophy, psychology and cybernetics" (Glaserfeld, 1989). In the constructivist perspective, the individual through his interaction with the environment constructs knowledge by testing ideas and approaches based on their prior knowledge and experience, applying these to new situations and integrating the new knowledge gained with pre-existing intellectual constructs. Constructivist paradigm is based upon the contributions of Piaget, Vygotsky, Bruner, Howard, Gardner, Gagne, Ausubel, Thorndike, F. Tolman, Wertheimer and many others. Piaget, who is best known for his research on the development of cognitive functions in children, laid the foundation for constructivism. His central idea is that "knowledge proceeds neither solely from the experience of objects nor from an innate programming performed in the subject but from successive constructions." (Fosnot, 1996). Piaget (1985) proposed that the mechanism of learning is the process of equilibration, in which cognitive structure assimilates and accommodates to generate new possibilities when it is disturbed based on human's self-organizing tendency. To reach an understanding of basic phenomena, according to Piaget, children have to go through stages in

which they accept ideas they may later see as not fruitful. In autonomous activity, children must discover relationships and ideas in classroom situations that involve activities of interest to them. Understanding is built up step by step through active involvement. According to Vygotsky, social interaction is important for the construction of knowledge. The main aspect of Vygotsky's theory is that the potential for cognitive development is limited to a "zone of proximal development". This 'zone' is the area of exploration for which the student is cognitively prepared, but requires help and social interaction to fully develop. Bruner, an American psychologist whose theory says that learning is an active process in which learners construct new ideas or concepts based upon their current/past knowledge. The interconnection of the new experience with the prior knowledge results in the reorganization of the cognitive structure, which creates meaning and allows the individual to "go beyond the information given". Thus constructivism has evolved from cognitive psychology and is also a synthesis of many dominant perspectives on learning. Constructivism is a view of learning, based on the belief that knowledge isn't a thing that can be simply given by the teacher to the students. Rather Constructivist approach focuses on independent learning, creativity, critical thinking and problem solving. It is based on the fact that skills and knowledge acquisition are

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not by passive receiving of information and rote learning but involve active participation of the learners through knowledge construction, hands-on and minds-on activities (Akinbobola & Ado, 2007). Carpenter & Fennema (1992) purposed a Cognitively Guided Instruction Mathematics programme and found that extensive training in constructivist methods increase the higher level thinking skills as well as solid achievement in traditional computational skills. Tynjala (1998) compared learning outcomes of educational psychology students studied traditionally with examinations and studied constructivist learning tasks without examination. Results showed that students in the constructivist group acquired an ability to apply knowledge and developed their thinking and communication skills.

The nature of Science subject also focuses on "way of knowing". To make the science teaching effective and interesting, learning environment in science classroom should be such that it engage learners in knowledge construction through collaborative activities Carey, et al. (1989) found in their study that prior to the constructivism based methods that included scientific inquiry, most students viewed science as a way of understanding facts about the world. After the constructivist methodology, most of them experienced scientific inquiry as a process guided by questions and ideas. Orhan (2006) reported in his study that the implementation of problem based active learning model had positively affected student's academic achievement in science courses. The study conducted by Bimbola (2010) revealed that constructivist based teaching strategies used by teacher had positive effect on academic performance of junior secondary school students in integrated science. Cooper and Marie (2002) found in their study that peer instruction as a viable pedagogical approach within a class, rather than traditional approach for learners' achievement. As much studies have been conducted on beliefs and perceptions of teachers and students on constructivist practices till now and few studies are conducted on the application of these practices in real classroom situations. Hence there is a need to explore the effect of constructivism based method on learning activities of school students in learning science. Moreover, the National Curriculum Framework (2005) envisages the importance of active learning in the construction of knowledge by students and emphasizes on active role of teachers in relation to the process of knowledge construction. So, the present study was undertaken by the experimenter to know the practical utility of constructivist approach in teaching learning process and to find out whether children taught through constructivist approach have any difference in their understanding and

achievement as compared to those taught through conventional method.

Objectives

1. To study the effect of constructivist approach based learning activities in improving physical science achievement of 9th grade students.
2. To study the influence of treatment, intelligence and their interaction on the achievement of 9th grade students in physical science.
3. To investigate if constructivist approach based learning activities cause any difference in physical science achievement of 9th grade students of different level of intelligence.
4. To investigate if constructivist approach based learning activities causes any differences in physical science achievement of boys and girls.

METHODOLOGY

Sample:

A sample consisting of 100 students of 9th grade from two schools of Amritsar city was selected. Out of 100 students, 50 boys and 50 girls belonging to a specific age group and educational level were selected for the purpose of the study. The sampling technique used was random and representative.

Measures

1. Intelligence test by M.C. Joshi (1996) was administered to equate the different groups of 9th grade students on the basis of intelligence.
2. Pre-test to find out their previous knowledge on five selected topics that were to be taught during the experiment.
3. 5 E's model based lesson plans on the selected topics of physical science to teach the experimental group of 9th grade students.
4. Post-test to find out their achievement gain on the selected topics of physical science.

Procedure

Since the present study falls under the domain of experimental research, therefore, only a single factor or variable was manipulated or changed, the experimental factor was varied for one group (experimental group) while the parallel group served as the controlled group for comparative purposes. Students were randomly assigned to the experimental and control group. Groups were also matched on the basis of intelligence. Achievement test in science was applied as post test to assess the Achievement in science.

Phase 1: Development and tryout of tools and lesson plans

Five topics of physical science were selected from prescribed syllabus of 9th grade students. These were (1) Is matter around us pure (2) Motion (3) work and energy (4) Force and laws of motion (5) Matter in our surroundings. At this stage, lesson plans for instruction tools like achievement tests (pre-test, post-test) in physical science were developed on these topics.

Development of instructional materials based on constructivist model Constructivist approach based 5 E's model i.e. Engage, Explore, Explain, Elaborate, and Evaluate was used to prepare the lesson plans on the five selected topics to teach the experimental group.

Phase 2: Equating the groups

For the present study, the intelligence test by M.C. Joshi (1996) and pre-test were administered on 9th grade students of each section of two schools. Intelligence test scores and pre-test were equated on means and S.D's. After equating the groups, technique of randomization was used to determine experimental and controlled group.

Phase 3: Experimentation/Treatment

The experimental group was taught the selected topics through constructivist approach based lesson plans developed by the experimenter. The controlled group was taught the same topics through conventional method. Experimenter taught both the groups herself daily excluding Sundays and other holidays for ten days

Phase 4: Administration

Post-test was administered to find out the achievement of experimental and controlled group after teaching with the help of constructivist approach and conventional method respectively. Post-test was of 40 minutes duration. It was administered after the completion of experiment.

Results and discussion

Hypothesis 1: Significant differences exist between the mean achievements scores of experimental group (taught with constructivist approach) and controlled group (taught with traditional method) in teaching physical science.

To test the above hypothesis, t-test was used. The summary of the test result is shown in table 2.

Table 2: Showing 't' value of Mean Gain scores of Experimental and Controlled group of 9th grade in physical science.

Groups	N	Mean	S.D	r	SE _p	Mean Differenc(D)	df	t-ratio	Remarks
Experimental	50	7.80	3.21	0.012	0.59	3.66	98	6.20	Sig. at 0.01 level
Controlled	50	4.14	2.67						

The table 2 shows that Mean gain scores of the experimental and controlled groups are 7.80 and 4.14 respectively. The obtained 't' value (6.20) which in comparison to the table value is found to be significant at 0.01 level of significance which further shows that there exists significant differences in achievement of students in physical sciences of experimental and controlled groups.

Since the experimental group differentially gained more achievement scores, we can say that the constructivist approach has proved very much fruitful in enhancing the better performance of students in physical sciences. Hence the hypothesis-1 "significant differences exist between the

mean achievement scores of experimental group (taught with constructivist approach) and controlled group (taught with traditional method) in teaching physical science" stands accepted.

Hypothesis 2: "There is significant influence of treatment, Intelligence and their interaction on achievement scores of 9th grade students."

In order to test this hypothesis, ANOVA 2x3 factorial design was used by taking treatment and intelligence as independent variables and achievement (in physical science) as dependent variable. F values so obtained have been entered in table 3.

Table 3: Results of ANOVA 2×3 factorial design, showing effect of treatment, intelligence and their interaction on achievement in physical sciences.

Source of Variation	Sum of Squares	df	Means squares	F-Values	Remarks
Teaching Methods (A)	334.89	1	334.89	36.17	Significant at 0.01level
Intelligence levels (B)	105.13	2	52.57	5.67	Significant at 0.01level
Interaction (A×B)	214.23	2	107.12	11.57	Significant at 0.01level
Within cells	870.56	94	9.26		
Total	1524.81	99			

A careful scrutiny of results inserted in Table 3 reveals that the calculated 'F' value is (F=36.17) for treatment (as an independent variable) which in comparison to the table value is found to be significant at 0.01 level of significance and calculated 'F' value for intelligence is 5.67, which is comparison to the table value also found to be significant at 0.01 level of significance. The computed 'F' value for interaction of Intelligence and treatment is 11.56 which in comparison to the table value is found to be significant at 0.01level of significance. Hence, we can observe that treatment, Intelligence and interaction of treatment and Intelligence have significantly affected the achievement of students in physical science.

Thus, the second hypothesis "There is significant influence of treatment, Intelligence and their interaction on

achievement scores of 9th grade students" is accepted.

Hypothesis 3: "Significant differences exist in the physical science achievement of students taught through constructivist approach and traditional method in relation to their level of intelligence".

To analyse this hypothesis, the students belonging to high, average and low level of intelligence of experimental as well as controlled groups were identified by using the formula MSD. The mean gain scores and S.D of students belonging to high, average and low level of intelligence of both the groups were calculated. The significance of difference between the mean achievement scores of experimental and controlled groups in relation to their level of intelligence was calculated by applying t-test. The results of analysis are reported in table 4.

Table 4: Mean scores, S.D's and 't' values of high average and low intelligent students of experimental and controlled groups.

Intelligence level	Groups	N	Mean	SD	SE _D	Mean Diff (D)	t-ratio	df	Remarks
High	Experimental	9	7.44	2.30	7.43	2.71	0.36	18	Insignificant 0.01 level
	Controlled	11	4.73	2.26					
Average	Experimental	31	7.84	3.41	0.83	3.77	4.57	58	Significant at 0.01 level
	Controlled	29	4.07	2.98					
Low	Experimental	10	8.00	3.71	1.34	4.30	3.20	18	Significant at 0.01 level
	Controlled	10	3.70	2.05					

From table 4, it is clear that the 't' values for the students with average and low level of intelligence were found to be significant at 0.01 level of significance whereas for the students with high level of intelligence was found to be insignificant. It can be concluded from above results that the students with high Intelligence are equally benefitted by both the teaching method i.e. constructivist approach as well as conventional method. Whereas the students with average and low intelligence were benefitted by the constructivist

approach as their achievements in physical science has significantly increases. Hence, third hypothesis namely, "Significant differences exist in the physical science achievements of students taught through constructivist approach and traditional method in relation to their level of Intelligence" is accepted.

Hypothesis 4: "Sex variations do not exist in the physical science achievement of students of experimental group."

To test the above hypothesis, t-test was used. The summary of test result is shown in table 5.

Table 5 : t-test result for comparison of boys and girls

Groups	N	Mean	SD	SED	Mean Diff	df	t-ratio	Remarks
Boys	25	6.20	3.03	0.88	0.24	48	0.27	Insignificant at 0.05 level
Girls	25	6.44	3.16					

A non-significant difference was observed in the Mean Achievement scores of boys and girls. The t-value 0.27 was found to be insignificant at 0.05 level. From the mean values it is clear that boys had almost same academic achievement scores as girls. Hence the hypothesis 4 was accepted.

Conclusions:

- The constructivist approach has a positive effect on the achievement of 9th grade students in physical sciences. It is evident from the analysis that the students taught by constructivist approach scored higher in physical sciences than those taught by conventional method.
- The treatment, Intelligence and interaction of treatment and Intelligence have significantly affected the achievement of students in physical science.
- The use of constructivist approach based teaching is significantly effective for average and low intelligent students as compared to high intelligent students of 9th grade.
- The constructivist approach is found equally beneficial for both boys and girls in improving their achievement in physical sciences.

Educational Implications: In the light of findings of the present study, it is found that constructivist approach is beneficial in improving the achievement of students in physical science so:

1. It should be adopted by the teachers to teach physical sciences in schools.
2. Constructivists approach based learning activities are more beneficial to average intelligent and low intelligent students So, it can be used for better understanding and achievement of these students.
3. Constructivist approach is not gender sensitive. Boys and girls are equally benefited by this approach. So it can be used to teach both boys and girls without any discrimination.
4. Constructivist approach based learning activities are example of an instructional arrangement that can be used to foster active student learning which is an important dimension of science learning. Students

can be given tasks to discuss, to solve problems, to compare the ideas and elaborate their understanding.

5. Teachers can use constructivist approach based learning activities to provide students with opportunities to practice newly introduced concepts, or to review skills and concepts.
6. This approach helps the students to make connections between the concrete and abstract level of instruction through peer interactions and carefully designed activities.
7. The provision of flexible timetable is essential for implementation of constructivism in the classroom.

References

- Afolabi, F. & Akinbobola, A.O. (2007). Constructivist problem based learning technique and the academic achievement of physics student with low ability level in Nigerian secondary schools. *Eurasian J. Physics & Chemistry Education*, 1, 45-51.
- Bimbola, O. (2010). Effect of constructivist based teaching strategy on academic performance of students in integrated science at junior secondary school level. *Educational Research and Reviews*. 5(7), 347-353.
- Carpenter, T. & Fennema, E. (1992). Cognitively guided instruction: Building on the knowledge of students and teachers. *International Journal of Educational Research*, 17,457-470.
- Carey, S., Evans, R., Honda, M., Jay E. and Unger, C. (1989). An experiment is when you try it and see if it works: A study of grade seven students' understanding of the construction of scientific knowledge. *International Journal of Science Education*, 11, 514-529.
- Cooper, S., & Marie (2002). Classroom Choices for Enabling Peer Learning. *Theory into practice*, 41(1),53-60.
- Glaserfeld, E. Von (1989). Cognition, Construction of Knowledge and Teaching. *Synthese*, 80(1),121-140.
- Orhan (2006). Effects of Constructivist Learning Activities on Trainee Teachers' Academic Achievement and Attitudes. *World Applied Sciences*. 4 (6), 837-848.
- Tynjala, P. (1998). Traditional studying for examination versus constructivist learning tasks: do learning outcomes differ? *Studies in Higher Education*, 23(2), 173-190.

Websites

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