EFFECT OF COOPERATIVE LEARNING ON COGNITIVE ACHIEVEMENT IN SCIENCE

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This study examines the effect of one of the methods of cooperative learning—STAD on achievement in science in an Indian context. The study used two intact classes of 9th grade students with 36 students. Both the classes were taught the same context for a duration of twenty five instructional days. Students in the experimental class worked in small heterogeneous groups to learn the content while the other class was taught by traditional lecture-discussion method. Students' outcomes were measured by an achievement test development for this purpose. Data analysed through analysis of covariance revealed that STAD was more effective than traditional method for knowledge level as defined by Bloom's taxonomy. However, both the methods were found to be equally effective for comprehension level.

INTRODUCTION

Cooperation is the basic characteristic of human beings. Most of our attitudes and values are formed by discussing, what we know or think of others. However it appears that present educational systems consist of classrooms with competitive goal structures. In a competitive structure, a student's success depends on the failure

of other students. Students have to compete with their fellow students right from the stage of admission to primary classes up to the highest level in secondary classes. Excessive competition in classrooms results in maladjustment of students. Students are always a step far from cooperation, while the survival of human kind apparently is based on cooperation.

A well established principle of social psychology is that people working together on a common goal can accomplish more than people working alone. Based on this principle, cooperative learning strategies for classroom use have been developed and used. Cooperative learning is an approach to instruction in which students work in small groups to help another learn (Johnson & Johnson, 1987; Slavin, 1983a). Unlike a competitive classroom, students work together to achieve common successes. In other words, students in a cooperative classroom sink or swim together. (Johnson & Johnson, 1987). While discussing with each other cognitive conflicts may arise which leads to the development of reasoning skills and higher quality of understanding of the subject. In this method students are encouraged to work in groups on academic tasks with a common goal. According to Slavin (1977) cooperative learning strategies vary in two principal aspects of the classroom organization: task structure and reward structure. In a cooperative task structure, students are required to or encouraged to work with one another. These cooperative tasks vary considerably to which they use the cooperative reward structure. The reward may be individualised or a group reward. Group rewards provide an incentive to encourage each other and help the group members in order to succeed. It ensures individual accountability and thus the participation of all group members in the task. Since a successful task is rewarded, it means that the rewards act as stimulus to the pupils to lead to learning. Our traditional classroom setting does not prepare students for work and social tasks that they will face as adults. Cooperative learning can help students interact with each

other, generate alternative ideas and make inferences through discussion. Thus, it provides the ingredients for higher thought processes to occur and sets them to work on realistic and adult-like tasks.

Many studies indicate that cooperative learning promotes a greater achievement than the traditional learning methods. Slavin (1983b) identified 46 field experiments on cooperative learning, conducted in elementary and secondary classes (Grade 2-9). The effect on cooperative learning on students' achievement was clearly positive. Besides this many more studies, Lyons (1982), Yager (1985), Miller (1992), Ahuja (1995), Towns and Grant (1997) reported the greater effectiveness of cooperative learning for science achievement over traditional method. Although majority of studies favour the superiority of cooperative learning, there are studies which found no significant differences in these two methods with regard to science achievement (Scott, 1982, Sherman, 1988; Chang & Lederman, 1994; Wolf 1995; Boxtel, van Carla, van der Jos, Kansellor (2000). The present study was undertaken to provide a "filler" for inconsistencies in findings related to the effectiveness of cooperative learning. Also the dearth of studies in the Indian context was another reason for carrying out present investigation. This study will try to answer whether cooperative learning (STAD) will enhance students' knowledge and comprehension in science.

METHODOLOGY

The present investigation was a quasi-experimental research which used the two group pre-test-post-test design. The sample of the study consisted of two intact classes of IX grade from the National High School, Bareilly. One section of 16 students was taught by the cooperative learning method and the other of 20 students by traditional method. The treatments were assigned randomly to the groups and both the groups were taught the same content for 25 instructional days. According to Johnson and Johnson (in Blosser,

1992) for any significant changes to be observed, as a result of cooperative learning, at least four to five weeks experience is needed.

Out of several cooperative learning methods, Students Team-Achievement Division (STAD) was used for teaching experimental class which consisted of heterogeneous groups of four students of mixed ability in each group. The previous academic achievements and abilities of the students as rated by teachers, were the bases of forming the groups. Most class periods for the experimental class consisted of presentation of the content to understand the assigned material and master the worksheet. During this students discussed the material and helped each other to clarify and understand the material. Following team practice, students took test on each unit. During test, help was not allowed. After the unit test, team with the highest score was declared as winner. The control group was taught the usual lecture discussion method by one of the investigators. Topics taught to both groups were 'basic concepts of heat' and 'basic concepts of valency.'

Science achievement of the students was measured by a science achievement test developed by the investigators for this purpose. This test was used as the pre- and post tests. The test had 40 items, out of which 18 were meant for measuring the knowledge level and 22 for measuring the comprehension level as defined by Bloom's taxonomy. Analysis of covariance, with pretest scores as covariate was used to analyse the data.

RESULTS AND DISCUSSION

To study the effect of cooperative learning on science achievement (total), marks obtained by students on an achievement test taught by both methods were compared using ANCOVA. Results of the ANCOVA analyses are given in Table 1.

Table 1
Summary of Results of ANCOVA for Achievement in Science (total)

Source of variation	df	SSy.x	MSy.x	F
Among means	1	490.59	490.59	7.12*
With means	33	2275.44	68.95	
Total	34	2766.03		

* $p<0.05$

A significant difference was found between two groups ($F=7.12$, $p<0.05$) after holding the effect of previous achievement constant. Adjusted means for groups taught by cooperative learning and traditional method were found to be 24.08 and 16.27 respectively. This shows that cooperative learning significantly enhances the science achievement of students as compared to traditional method.

ANCOVA was also used to study the effect of cooperative learning and traditional method on knowledge and comprehension levels in science. Results of the ANCOVA analyses for knowledge in science are given in Table 2.

Table 2
Summary of Results of ANCOVA for Knowledge Level

Source of variation	df	SSy.x	MSy.x	F
Among means	1	126.46	126.46	5.74*
With in means	33	698.38	21.16	
Total	34	824.84		

* $p<0.05$

It is clear from Table 2 that a significant difference exists between two groups ($F=5.74$, $p<0.05$) after holding the effect of previous knowledge constant. Adjusted means for both groups, i.e., the experimental group and the control group were found to be 11.42 and 7.39 respectively. This shows that cooperative learning

significantly enhances the knowledge of science as compared to a traditional method of teaching.

Table 3 shows the results of the ANCOVA analysis for comprehension level in science.

Table 3
Summary of Results of ANCOVA for Comprehension Level

Source of variation	df	SSy.x	MSy.x	F
Among means	1	70.07	70.07	2.81*
With in means	33	822.11	24.91	
Total	34	892.18		

* $p>0.05$

Table 3 shows that no significance difference exists between the two groups ($F=2.81$, $p>0.05$) after holding the effect of previous comprehension level constant. This means both the methods are equally effective as far as comprehension in science is concerned.

The superiority of the cooperative learning method over the traditional method can be explained on the basis of several mechanisms. In traditional classrooms individual competition exists where failure of an individual plays an important role in the success of another. So, instead of helping others, students try to "pull the legs" of their peers, so as to enhance the chances of their success. Competition also exists in a set up cooperative learning of classrooms but unlike the traditional set up, there is inter-group competition. In cooperative learning an individual is not the winner. It is the group which loses or wins. The members of a particular group help each other to promote the success of their group members. In addition to this, cooperative learning emphasises group rewards. The rewards are given on the basis of the sum-total of the performances of individual members in the group. Thus individual accountability is ensured. Individual accountability

ensures that each member puts his/her maximum effort for the group rewards. For this members try to make sure that all have understood the assigned material. Cooperative regard structures create a situation in which the only way group members can get their personal goals is if the group is successful (Johnson & Johnson, 1992; Slavin, 1983a). Students in cooperative learning value the success of the group so they encourage and help one another to achieve, and this factor is absent in a traditional classroom. This might have been the reason for the significantly greater achievement for the knowledge level and the total achievement in science in the cooperative learning group.

However, no significant difference in the comprehension level of science was found in this study. This result is partially in tune with the findings of Perreault (1983) who found that cooperative learning resulted in significantly higher achievement in industrial arts students at the knowledge and comprehension levels of Bloom's taxonomy. The reason for the present result may be that students are accustomed of traditional lecture method. Perhaps they require a longer duration of exposure to cooperative learning to break their mind set. Then only any conclusion regarding higher level of cognitive achievement may be drawn.

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