EFFECT OF COOPERATIVE LEARNING STRATEGY ON ACHIEVEMENT IN SCIENCE IN RELATION TO ATTITUDE TOWARDS SCIENCE

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ABSTRACT

The present study investigates the effect of cooperative learning strategy on achievement in science in relation to attitude towards science. The study was conducted on a sample of 100 students of class IX science students from two private schools (affiliated to CBSE, New Delhi) of Panchkula city. Tools used to collect data were science achievement scale developed and standardized by investigators, and Test of Science-Related Attitudes (TOSRA) by Fraser (1981). For the purpose of investigation, experimental method with pre-test and post-test factorial design was employed. In order to analyze the data, Analysis of Variance (2×2) was used for two independent variables – instructional strategies (cooperative learning strategy v/s conventional teaching strategy) and attitude towards science (favourable attitude towards science v/s unfavourable attitude towards science). Further, descriptive statistics (like mean and standard deviation) and inferential statistics (like F-test and t-ratio) were used to find significance of difference between mean gain science achievement scores related to different groups and variables. Following conclusions were drawn: (i) Cooperative learning strategy was found to be more effective than conventional teaching strategy for increase in science achievement, (ii) The students having favourable attitude towards science showed higher science achievement than students having unfavourable attitude towards science, (iii) Instructional strategies and attitude towards science were not found to significantly interact with each other to exercise effect on science achievement.

Keywords: Cooperative Learning Strategy, Achievement in Science, Attitude Towards Science.

Introduction

Achievement is the end product of all educational endeavours (Balasubriamaniam, 1993). Importance of achievement is much more pronounced in competitive world of today. At each stage in the school, some measures of achievement are used as a determinant of the status of student in classroom and as a basis for decision about the further opportunities for learning that can be provided in further upcoming stages. Hence, needless to mention, higher achievement is strong predictor of success in further education, employment and self development (Pannu, 2010). The referred issue of registering high achievement of the students has acquired much significance, particularly in the field of science, because presently we live in a society that is characterized by scientific and technological revolution. It wouldn’t be an exaggeration if one claims that modern society has science as part and parcel of life. Given the pervasive and ramifying impact of science in every department of life, every man must be acquainted with science, both as a product as well as a process (Darchhingpuii, 1988). Given this background, demand of accomplishment of high achievement in science for all students lays well pronounced.

Resultantly, curriculum and pedagogical pundits continue to execute search operation on teaching methods, curriculum contents, instructional materials, and other assistant factors which they believe may influence the ability of the learners to want to learn more science, and thereby help deliver high science achievement. As far as teaching methods go, different teaching techniques have been suggested and hence adopted to enhance students’ performance in science, ranging from some teacher-centered techniques to other learner-centered methods (Oloyede, Adebowale, & Ojo, 2012). Debatable area in this domain is whether time-tested formula of teacher-centered instructional method will be successful in making students understand the so-called intricacies involved in a subject like science; or whether students need to be engaged in creative acquisition of knowledge through learner centered methods (may be in form of certain social interactional pattern like cooperation based activities) in order to better understand scientific concepts and principles.

Difference between the two referred strategies is that while one is learner-centered strategy, another is teacher-centered method of instruction. Cooperative learning strategy is learner-centered in the sense that students work in small groups to maximize own and each other’s learning. In such kind of strategy, positive interdependence and promotive interaction occur in a way that students perceive that they can attain their goal if and only if other students in their respective groups reach their goal (Johnson & Johnson, 2009). In comparison to cooperative learning strategy, conventional teaching strategy is teacher-
centered in the sense that it involves authoritarian approach adopted by teacher to disseminate information to entire class in one go. In such kind of strategy, students are considered as passive recipients of knowledge, without any need of active participation in learning process.

Cooperative learning strategy, as a rival to conventional teaching strategy, assumes importance in light of fact that learners are cooperative beings and like to work together with other learners (Chauhan, 2012). However, practicing cooperative learning strategy does not mean placing people together and telling them that now they have to cooperate as a group (Johnson & Johnson, 1996). Osarenkhoe (2010) opined that successful cooperation is based on trust, commitment, and mutual agreement that can be spelled in a formal or an informal contract in order to achieve common goals (Armas & Sniras, 2013). Ample research demonstrates that cooperative learning produces positive effects with respect to learners of all grades and all subject areas, on astonishingly wide variety of tasks (Joyce, Showers, & Rolheiser-Bennett, 1987; Bossert, 1988; Johnson & Johnson, 1989; Slavin, 1990; Sharan & Sharan, 1992; Cohen, 1994; Hilk, 2013). However, if essential elements of cooperation (namely positive interdependence, individual accountability, promotive interaction, interpersonal and small group skills, and group processing) are not structured in cooperative learning strategy, then it can render the referred strategy as ineffective (Johnson & Johnson, 1996). Thus, given the fact that 'cooperative learning strategy comes along with a catch', one is left to wonder whether time-tested formula of teacher-centered instructional method in form of conventional teaching strategy is more apt in making students learn as well as understand science, and thus register higher science achievement.

Besides the emphasis on environmental control attempted by the teacher in form of adoption of particular learning strategy, adopting an integrated approach to learning by emphasizing the cognitive/affective state of learner, can go a long way in keeping all learners satisfied in process of attaining high science achievement. Students' attitude towards science is one of the significant cognitive/affective state of learner, that can affect the learning outcomes as the learner's mental mediator or moderator. As per Schibeci (1984), attitudes that are linked to science can be separated into two major categories of scientific attitude and attitude towards science. Attitude towards science refers to adoption of scientific attitude. Attitude towards science is becoming a hot topic of research amongst educational researchers. This increased focus is based on either or both of two assumptions: (a) that attitude towards science may be more important than a student's understanding of science since attitudes would direct how well that student will use his/her science knowledge, and/or (b) although a student has the ability to do science tasks, still his/her willingness to do such tasks would originate in the affective domain that comes under realm of attitude towards science (Okebukola, 1986; Chung-Schickler, 1998).

Katz (1960) defines attitude as a predisposition of an individual to evaluate some symbol or object or aspect in a favourable or unfavourable manner (Ahmed, 2007). As per Bagozzi and Burnkrant (1979), McGuire (1985), and Rajecki (1990), three main components are involved in description of attitude – cognition, affect and behavior. Reid (2006) provides a clear definition of these components as – knowledge about the object or the beliefs (idea component – cognitive), feeling about the object (like or dislike component – affective), and tendency towards action (objective component – behavioural). Reid's (2006) tripartite view of attitude, as cited above, can easily be extrapolated in describing concept of students' attitude towards science as students know about science as a subject and thus have a feeling or an opinion about it, that may cause them to take some actions (Kind, Jones, & Barmby, 2007; Khalil, 2015). Attitude towards science is obviously not an inborn trait. A student develops his/her own attitude towards science gradually. The way science is presented in classroom and perceived by the students as a subject, even when teachers believe that they are presenting it in most authentic and context-dependent style, tends to form students' attitude towards science and hence effect learning outcomes (Barton, 2000; Ahmed, 2007). As such, concept of students' attitude towards science can cross the path of any learning strategy adopted to enhance science achievement; so extent of aspired upgradation of science achievement is likely to be influenced by the interaction between the learner's referred mental mediator (attitude towards science) and the specific treatment presented (cooperative learning strategy v/s conventional teaching strategy).

Need and Significance

Educational research has always shown keen interest in exploration of relationship of various variables with academic achievement. However, in this relation, it is a recently observed phenomenon that it has shifted its focus from emphasis on specific pupil characteristics to the influence of broad situational factors on academic achievement (Rzoska & Ward, 1991). In this regard, despite an already extensive collection of research examining the effects of one of such situational factors - social interdependence (positive interdependence as manifested in cooperative learning structure) on various learning outcomes.

Research Paper

IJRAR- International Journal of Research and Analytical Reviews
(Hilk, 2013), a significant opportunity has been grabbed by the researcher to generate refined understanding of relative effects of cooperative learning strategy versus conventional teaching strategy on achievement of students in Indian context.

As far as rationale behind taking attitude towards science (as a classifying variable) goes, the present study intends to provide empirical evidence to settle disagreement about how students with differing attitude towards science respond to particular learning structure designed to promote learning in science in terms of elevated science achievement. As such, placing the students with favourable or unfavourable attitude towards science in cooperative v/s conventional learning situation, may reveal interesting aspects on learning outcomes. Further, the study holds significance in light of fact that it can draw really revealing outcomes with respect to relationship between students’ attitude towards science and achievement in science. This is needful as students’ cognitive achievement must also be related with affective factors (Schibeci, 1983; Chung-Schickler, 1998). ‘Swing away from science’ amongst students is not an uncommon phenomenon in our society (Dearing, 1996; Roberts, 2002; Narmadha & Chamundeswari, 2013). But given the importance of science in present era led by scientific and technological revolution, students’ attitude towards science needs to be assessed in relation to various concerned variables. This can help to shape suitable learning structure to enhance achievement in science.

Objectives
1. To compare the achievement in science of groups taught through cooperative learning strategy and conventional teaching strategy.
2. To compare the achievement in science of groups having favourable and unfavourable attitude towards science.
3. To examine the interaction effect of instructional strategies and attitude towards science on achievement in science.

Hypotheses
H1: There exists no significant difference between achievement in science of groups taught through cooperative learning strategy and conventional teaching strategy.
H2: There exists no significant difference between achievement in science of groups having favourable and unfavourable attitude towards science.
H3: There exists no significant interaction effect of instructional strategies and attitude towards science on achievement in science.

Sample
The random sampling was used to select two schools out of English medium private co-educational schools of Panchkula, affiliated to Central Board of Secondary Education, New Delhi. Names of two schools taken for the study are Hallmark Public School and Doon Public School. After selecting schools, two intact class IX sections (of strength 25 each) were selected randomly for allocation to experimental group and control group in each school. Thus, experimental group and control group comprised of 50 students each, making a total of 100 students whose scores were subjected to data analysis. The sample of students taken from each school, as selected for the study, has been presented in table 1.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of the School</th>
<th>Experimental Group</th>
<th>Control Group</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hallmark Public School, Sec-15, Panchkula</td>
<td>25</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>Doon Public School, Sec-21, Panchkula</td>
<td>25</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>50</td>
<td>50</td>
<td>N=100</td>
</tr>
</tbody>
</table>

Design
For the purpose of present investigation, experimental method with pre-test and post-test factorial design was employed. In order to analyze the data, statistical techniques like mean, standard deviation, analysis of variance (2×2) and t-ratio were used. The two independent variables were instructional strategy and attitude towards science. Two instructional strategies taken for the study are cooperative learning strategy and conventional teaching strategy. The variable of attitude towards science was studied at two levels, i.e. favourable attitude towards science and unfavourable attitude towards science. The dependent variable was achievement in science calculated as mean difference in post-test and pre-test science achievement scores.
Tools Used

The following tools were used for data collection:
1. A test to assess Achievement in Science was developed by investigators.
2. 5 lesson plans each based on cooperative learning strategy and conventional teaching strategy on topics such as matter, states of matter, cells, tissues, motion, etc. from the prescribed science syllabus of IX class were developed by investigators.
3. Test of Science-Related Attitudes (TOSRA) by Fraser (1981) was used.

Procedure

After selection of the sample and allocation of the students in the groups for instructional strategies, the experiment was conducted in four phases. Firstly, Test of Science-Related Attitudes was administered for the classification of students. Secondly, achievement test in science as pre-test was administered to the students of experimental and control groups. The answer sheets were scored to obtain the information with regard to preliminary level of achievement in science of students. Thirdly, treatment was given to the experimental group by teaching it through cooperative learning strategy and the control group was taught the same topics through conventional teaching strategy. The duration of instructional treatment was 5 sessions in each group and time for each session was 45 minutes. Fourthly, after the completion of the experiment, same achievement test in science was administered as post-test to the students of both the groups. The answer sheets were scored to obtain the information with regard to post-experimental level of achievement in science of students. The scores of experimental and control groups were compared according to their pre-test and post-test science achievement scores.

Analysis and Interpretation

The obtained data was analyzed through descriptive statistics like mean and standard deviation to see the nature of distribution of the scores. The data was also analyzed through inferential statistics, like two-way analysis of variance (2×2) was employed on mean difference in science achievement scores to test various hypotheses.

- Analysis of Descriptive Statistics

A summary of descriptive statistics of mean gain achievement scores of treatment and control groups with respect to attitude towards science has been presented in table-2.

Table-2: Means and SD of mean gain achievement scores for the different sub-groups

<table>
<thead>
<tr>
<th>Attitude Towards Science</th>
<th>Instructional Strategies</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cooperative Learning</td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Strategy</td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td></td>
</tr>
<tr>
<td>Favourable Attitude</td>
<td>14</td>
<td></td>
<td>9.72</td>
<td>1.67</td>
<td>14</td>
<td>7.00</td>
<td>1.44</td>
<td>28</td>
</tr>
<tr>
<td>Towards Science</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.36</td>
</tr>
<tr>
<td>Unfavourable Attitude</td>
<td>14</td>
<td></td>
<td>5.71</td>
<td>2.95</td>
<td>14</td>
<td>3.72</td>
<td>1.16</td>
<td>28</td>
</tr>
<tr>
<td>Towards Science</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.72</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>28</td>
<td>7.72</td>
<td>3.12</td>
<td>28</td>
<td>5.36</td>
<td>2.10</td>
<td>56</td>
</tr>
</tbody>
</table>

Source: Field Study, 2017

It is observed from table-2 that the mean gain achievement scores of students taught by cooperative learning strategy (M = 7.72) is higher than that of conventional teaching strategy (M = 5.36). This shows that cooperative learning strategy is more effective than the conventional teaching strategy for the increase in science achievement. It is also observed from above table that the mean gain achievement scores of students having favourable and unfavourable attitude towards science is 8.36, and 4.72 respectively. This indicates that students having favourable and unfavourable attitude towards science differ with respect to their respective science achievement.

- Analysis of Variance on Mean Gain Achievement Scores

The means of different sub-groups, sum of squares, degree of freedom, mean sum of squares and the f-ratio have been presented in table-3.
Table-3: Summary of analysis of variance (2×2) factorial design

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Sum of Squares</th>
<th>f-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructional Strategy (A)</td>
<td>77.79</td>
<td>1</td>
<td>77.79</td>
<td>19.35**</td>
</tr>
<tr>
<td>Attitude Towards Science (B)</td>
<td>185.79</td>
<td>1</td>
<td>185.79</td>
<td>46.22**</td>
</tr>
<tr>
<td>Interaction (A×B)</td>
<td>1.78</td>
<td>1</td>
<td>1.78</td>
<td>0.44</td>
</tr>
<tr>
<td>Error Term</td>
<td>208.57</td>
<td>52</td>
<td>4.02</td>
<td></td>
</tr>
</tbody>
</table>

**Significant at 0.01 level
(Critical Value 4.02 at 0.05 and 7.16 at 0.01 levels, df 1/52)

Main Effects

Cooperative learning Strategy (A)

Table-3 reveals that the F-ratio for difference in mean gain achievement scores of students taught by cooperative learning strategy and conventional teaching strategy is 19.35, which in comparison to the table value was found highly significant at 0.01 level of significance. It shows that the two groups were different beyond the contribution of any possibility of chance factor. Hence, the hypothesis H$_1$: There exists no significant difference between achievement in science of groups taught through cooperative learning strategy and conventional teaching strategy, was rejected. The result indicates that the achievement in science of group taught by cooperative learning strategy was more than that of the conventional teaching strategy group.

To probe deeper, F-ratio was followed by t-test. The value of t-ratio for experimental and control groups have been placed in table-4.

Table-4: t-ratio of mean gain achievement scores between experimental and control groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Experimental Group</th>
<th>Control Group</th>
<th>SE$_D$</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean</td>
<td>SD</td>
<td>N</td>
</tr>
<tr>
<td>Mean Gain Achievement Scores</td>
<td>28</td>
<td>7.72</td>
<td>3.12</td>
<td>28</td>
</tr>
</tbody>
</table>

**Significant at 0.01 level
(Critical Value 2.00 at 0.05 and 2.66 at 0.01 levels, df 54)

Table-4 reveals that mean gain achievement score of experimental group is 7.72, which is higher than the corresponding mean gain achievement score of 5.36 for the control group. Further, the t-value testing the significance of mean differences of cooperative learning strategy and conventional teaching strategy is 3.32, which in comparison to the table value was found significant at 0.01 level of significance. Thus, the result indicates that the students taught through cooperative learning strategy performed better than students taught through conventional teaching strategy in terms of science achievement.

Attitude Towards Science (B)

Table-3 shows that the F-ratio for difference in mean gain achievement scores of students having favourable and unfavourable attitude towards science is 46.22, which in comparison to the table value was found highly significant at 0.01 level of significance. It shows that the two groups were different beyond the contribution of any possibility of chance factor. Hence, the hypothesis H$_2$: There exists no significant difference between achievement in science of groups having favourable and unfavourable attitude towards science, was rejected. The result indicates that the achievement in science of group having favourable attitude towards science was more than that of group having unfavourable attitude towards science.

To probe deeper, F-ratio was followed by t-test. The value of t-ratio for groups having favourable and unfavourable attitude towards science have been placed in table-5.
The present study revealed that cooperative learning strategy was more effective than conventional teaching strategy for increase in science achievement. Hence, the hypothesis H1: There exists no significant difference between achievement in science of groups taught through cooperative learning strategy and conventional teaching strategy, was rejected. This result is consistent with the studies of the kind undertaken by Balfakih (2003) whose results revealed that cooperative learning method is more effective than traditional approach for teaching high school chemistry. Likewise, Chester (2009) too highlighted significant relationship between cooperative learning dyads and physics achievement of high school minority students. In a systematic review of published and unpublished citations associated with cooperative learning in secondary and early post-secondary science classrooms, Romero (2009) too indicated that cooperative learning improves students’ achievement in science. Ajaja and Eravwoke (2010); Bukunola and Idowu (2012); Ebrahim (2012); Mari and Gumel (2015,); and Joel, Kamji and Godiya (2016) also found significantly higher achievement test scores of science students in cooperative learning group than those in traditional classroom. However, the findings of present study are contradicted by studies like one of Shachar and Fischer (2004) who were particular in reporting 41.7% of their study sample who did not show supportive result in favour of cooperative learning approach. Further, Pisani (1994); Keban and Erol (2011); and Khan and Inamullah (2011) theorized that no significant difference exists between science achievement of treatment group exposed to cooperative instruction and control group resorting to conventional instruction.

Another major finding of the study was that the students having favourable attitude towards science performed better than students having unfavourable attitude towards science in terms of science achievement. Hence, the hypothesis H2: There exists no significant difference between achievement in science of groups having favourable and unfavourable attitude towards science, was rejected. This result is consistent with the studies of the kind undertaken by Hough and Piper (1982); Oliver and Simpson (1984); Freedman (1997); Chung-Schickler (1999); Eccles (2007); Ali and Awan (2013); Narmadha and Chamundeswari (2013); and Ali, Iqbal and Akhtar (2015) who indicated that attitude towards science had significantly positive relationship with the achievement of science students. However, the findings of present study are contradicted by studies like one of Matern and Schau (2002) whose research results showed no critical impact of attitude towards science on science achievement amongst females, and

Interaction Effect (AxB)

Table-3 reveals that the F-ratio for the interaction between instructional strategies and attitude towards science is 0.44, which in comparison to the table value was found not significant even at 0.05 level of significance. It indicates that the two variables do not interact with each other. Hence, the hypothesis H3: There exists no significant interaction effect of instructional strategies and attitude towards science on achievement in science, was accepted. The result indicates that there was no significant difference in mean gain science achievement scores due to interaction effect of instructional strategies and attitude towards science groups.

Discussion

There exists no significan
difference in mean gain science achievement scores between groups having favourable and unfavourable attitude towards science. The result indicates that the two variables do not interact with each other. Hence, the hypothesis H3 was rejected. This result is consistent with the studies of the kind undertaken by Balfakih (2003) whose results revealed that cooperative learning method is more effective than traditional approach for teaching high school chemistry. Likewise, Chester (2009) too highlighted significant relationship between cooperative learning dyads and physics achievement of high school minority students. In a systematic review of published and unpublished citations associated with cooperative learning in secondary and early post-secondary science classrooms, Romero (2009) too indicated that cooperative learning improves students’ achievement in science. Ajaja and Eravwoke (2010); Bukunola and Idowu (2012); Ebrahim (2012); Mari and Gumel (2015,); and Joel, Kamji and Godiya (2016) also found significantly higher achievement test scores of science students in cooperative learning group than those in traditional classroom. However, the findings of present study are contradicted by studies like one of Shachar and Fischer (2004) who were particular in reporting 41.7% of their study sample who did not show supportive result in favour of cooperative learning approach. Further, Pisani (1994); Keban and Erol (2011); and Khan and Inamullah (2011) theorized that no significant difference exists between science achievement of treatment group exposed to cooperative instruction and control group resorting to conventional instruction.

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outcomes were diverse as far as males were concerned. Papanastasiou and Zembylas (2002) also demonstrated the differential effects that science achievement and science attitudes can have on each other, depending on the characteristics of the educational system of the country.

The present study also found that the science achievement of various instructional strategy groups did not interact with each other at different levels of students’ attitude towards science. Hence, the hypothesis H3: There exists no significant interaction effect of instructional strategies and attitude towards science on achievement in science, was accepted.

Findings

1. The cooperative learning strategy was found to be more effective than conventional teaching strategy for increase in science achievement.
2. The students having favourable attitude towards science showed higher science achievement than students having unfavourable attitude towards science.
3. The instructional strategies and attitude towards science were not found to significantly interact with each other to exercise effect on science achievement.

Educational Implications

The present study has widespread educational implications. Higher achievement, being a stronger predictor of success in further education or employment, is much desired by one and all. This desire registers its strong presence in case of science achievement, particularly given the present era marked by scientific and technological revolution. As revealed by present study, the so-called intricacies involved in a subject science can be better addressed through learner-centered cooperative learning strategy than teacher-centered conventional teaching strategy. Since cooperative learning strategy involves working together of pupils in heterogeneous grouping, so cooperative learning can boast of producing positive effects with respect to science learners of varied abilities. Further, the study revealed that students having favourable attitude towards science showed higher science achievement than students having unfavourable attitude towards science. This indicates that students’ cognitive achievement is related with affective factors. As such, the issue of students’ ‘swing away from science’ in terms of unfavourable attitude towards science needs to be placed on top priority list for addressal by educationists. Moreover, the study underlines importance of favourable attitude towards science as positive predisposition of learners towards science that has potential to predict learning outcomes in science, given its positive relationship with science achievement. Since students’ attitude towards science is not an inborn trait, so positive influence on science-related attitudes of students can be targeted by organizing certain activities like science fairs, science exhibitions, talks by scientists/subject experts, debates and declamations on scientific topics, and so on.

References


